Instantaneous intake rates of 9 browse species by white-tailed deer

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Abstract

Instantaneous intake rate (IIR) and instantaneous nutrient intake rate (INIR) by tame white-tailed deer (*Odocoileus virginianus*) of 9 common browse species in south Texas were studied to determine if morphological properties of the plants were associated with intake rate, and if IIR and INIR correlated to preference ratings derived from percent time spent foraging a particular species and with total foliage consumed. Mean leaf mass showed a significant ($P < 0.05$) positive correlation to IIR ($r = 0.75$), INIR of neutral detergent fiber ($r = 0.73$), acid detergent fiber ($r = 0.73$), and acid detergent fiber nitrogen ($r = 0.68$). Mean leaf length showed a significant ($P < 0.05$) positive correlation to INIR of crude protein ($r = 0.67$). Thorn density showed no significant ($P > 0.05$) correlations to IIR or INIR. Leaf weight/stem weight ratio showed a significant ($P < 0.05$) positive correlation to IIR ($r = 0.65$) and INIR of acid detergent fiber nitrogen ($r = 0.81$). Rankings of IIR and INIR did not agree with preference indices based on weight of forage removed or amount of time spent browsing. Significant ($P < 0.05$) positive correlations for all trials between preference indices based on weight removal and time spent browsing ($r = 0.73$ for new leaf development, $r = 0.87$ for stem elongation, and $r = 0.70$ for full leaf development) indicated these 2 techniques closely agreed on species rank.

Key Words: instantaneous intake rate, instantaneous nutrient intake rate, white-tailed deer, *Odocoileus virginianus*, browse

Browse is a major component of white-tailed deer (*Odocoileus virginianus*) diets in subtropical thornscrub woodlands in south Texas and northern Mexico. Although diet selection can vary between herds and with season (Arnold and Drawe 1979), numerous species of browse plants have been found to consistently make up a large part of deer diets in this area and several have been termed as preferred food plants (Davis 1952, Davis and Winkler 1968, Chamrad and Box 1968, Drawe 1968, Everitt and Drawe 1974, Arnold and Drawe 1979). Preferential selection for a species is hypothesized as being correlated with palatability as well as with availability (Willms 1978). Palatability has been defined as a plant characteristic that stimulates a selective response by foraging animals (Heady 1964) and may determine the duration of foraging and ingestion rate. Profitability of browsing should be directly and positively related to the amount of nutrients an animal can consume in a given time.

Morphological attributes of plants, including growth form, biomass of leaves, and presence of thorns or other forms of spinescence, may interact to defend foliage loss to herbivory (Willms 1978, Cooper and Owen-Smith 1986). While most browse plants in south Texas are armed with spines or thorns, many are considered important foods for white-tailed deer. Free-ranging herbivores select diets from plants that differ in canopy shape and architecture as well as temporal and spatial variation (Provenza and Balph 1990). More controlled environments are needed to differentiate individual plant parameters affecting intake rate. Our objectives were to determine if morphological properties of browse plants

were associated with instantaneous intake rate (IIR) and instantaneous nutrient intake rate (INIR) by deer, and if IIR and INIR correlated to preference rankings by percent time spent foraging on a particular species and with amount of foliage consumed.

Study Area and Methods

The study was conducted on the Texas Agricultural Experiment Station's La Copita Research Area (27° 40' N, 98° 12' W) about 15 km southwest of Alice, Texas, in Jim Wells County. Vegetation of La Copita is characteristic of the northern Tamaulipan thornscrub woodland. The climate is subtropical with hot, humid summers and mild winters with an average growing season of >260 days. Long-term mean precipitation is 716 mm with maxima in May--June and September (Scifres and Koerth 1987).

Deer used in the trials were 3 male and 1 female yearlings (1 yr old at Trial 1). All deer were tame and readily accepted hand feeding. Deer were held in a 0.2-ha pen containing some native woody and herbaceous plants but primarily maintained on a commercially available pelleted feed. While in the holding pen, all deer were introduced to hand feeding of cut branches of the various plant species. The deer also were trained to feed from branches stapled to sawhorses used in our preference trials. Habituation was started as soon as the deer were completely weaned from bottle feeding as learning and experience early in life may influence preferences or aversions and enables young animals to acquire necessary skills to efficiently harvest different forages (Provenza and Balph 1988). McMahan (1964) felt that feeding behavior and plant selection by experienced tame white-tailed deer were similar to those of their wild counterparts.

Instantaneous Intake

To estimate IIR, 9 browse species known to be eaten by white-tailed deer in south Texas (Everitt and Drawe 1974, Arnold and Drawe 1979) were used and included guajillo (*Acacia berlandieri* Benth.), huisache (*A. farnesiana* (L.) Willd.), blackbrush (*A. rigidula* Benth.), Texas persimmon (*Diospyros texana* Scheele), spiny hackberry (*Celtis pallida* Torr.), brasil (*Condalia obovata* Hook.), coma (*Bumelia celastrina* H.B.K.), lime pricklyash (*Zanthoxylum fagara* (L.) Sarg.), and kidneywood (*Eysenhardtia texana* Scheele). For the instantaneous intake trials the deer were confined in an 8 × 5-m pen divided into 2 sections. Individual deer could be penned in 1 section for feeding. Five branches (terminal 50 cm) of each browse species were offered separately to each of 4 deer for 30 sec during each trial. Branches were held in a horizontal position about 0.5 m above the ground. Branches were selected from plants growing adjacent to the holding pen to minimize weight loss through desiccation. Branches were weighed to the nearest 0.01 g immediately before and after offering to determine intake. Branches were of sufficient size so that no more than a mean of about 25% of the available material of any species was consumed within the time period (range 7.0 to 23.9%) (Table 1). Trials were conducted during major morning or evening feeding periods during 3 times of the year representing major growth phases of the woody plants. To minimize selection bias by deer, the same species was offered to each deer and only 1 species/day was used. Trial 1 was in June 1988 during stem elongation of the browse. Trial 2 was in August 1988

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Table 1. Mean mass (g) and standard error (SE) of herbage on 20 branches/species of browse before and after offering to deer to determine instantaneous intake rate during 3 plant development stages on La Copita Research Area.

Species	New leaf development				Stem elongation				Full leaf development			
	Before	SE	After	SE	Before	SE	After	SE	Before	SE	After	SE
	(g)		(g)		(g)		(g)		(g)		(g)	
Spiny hackberry	27.4	2.3	23.5	2.2	38.7	2.9	32.9	2.7	34.7	2.1	29.4	1.9
Brasil	31.5	2.1	28.2	2.0	30.4	1.7	27.6	1.7	39.1	2.2	35.1	2.1
Guajillo	32.2	2.3	24.5	2.4	29.3	2.2	22.5	1.9	43.4	1.9	35.1	2.2
Texas persimmon	37.1	2.5	34.5	2.3	41.2	3.2	36.9	3.1	25.9	1.6	23.9	1.6
Lime pricklyash	30.2	1.9	25.5	1.7	29.8	1.9	23.7	1.9	35.9	1.9	29.3	1.8
Blackbrush	25.6	1.5	23.8	1.4	23.2	1.4	20.7	1.3	49.5	2.9	44.0	2.9
Coma	26.5	2.0	23.6	1.9	16.8	1.2	14.2	1.1	33.5	2.1	31.0	2.2
Huisache	27.6	1.3	24.2	1.3	9.5	0.6	7.7	0.6	20.9	1.5	15.1	1.3
Kidneywood	12.5	0.8	11.2	0.9	18.5	1.1	16.2	1.1	16.1	1.3	14.2	1.1

during full leaf development. Trial 3 was in May 1989 during new leaf development.

Plant Morphology

To evaluate how morphological characteristics correlated to IIR and INIR, 10 branches of each browse species were measured for thorn density (number/20-cm terminal segment), total weight of green leaves, and leaf weight/stem weight ratio. Mean leaf length was taken from Vines (1960).

Nutrient Concentration

Quality of woody plant foliage was estimated from hand-plucked samples of each species collected immediately after observing the feeding behavior of the deer during the intake trials. Care was taken to select only plant parts actually eaten by deer. Grab samples were dried for 48 hours at 50° C and then ground in a Wiley mill to pass a 1-mm screen. Diet quality analysis included percent crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent fiber nitrogen (ADFN) and was expressed on an organic matter (OM) basis. Crude protein was determined using standard micro-kjeldahl techniques (A.O.A.C. 1970). Neutral detergent fiber, ADF, and ADFN were determined by nonsequential procedures of Goering and Van Soest (1970). Estimates of INIR were derived by multiplying nutrient concentrations (g/100g OM) by the recorded intake rate (g/min).

Preference Indices

Preference indices were determined concurrently using 2 techniques by offering all 9 browse species to all deer simultaneously for 15 min. Branches similar in size to those used in the intake trials were stapled to 2 sawhorses (approximately 2-m long and 0.5-m high) so that the branches extended outward from both sides. Branches were of sufficient size so that no more than a mean of about 50% of available material of any species was consumed within the time period (range 2.6 to 51.4%) (Table 2).

Four branches (1 for each deer) of each browse species were arranged randomly along the board. For the first technique, branches were weighed immediately before and after offering to determine the amount of material of each species consumed. Weights of material removed, calculated as a percentage of available material by species, were ranked and the species with the highest percentage of material removed was considered the most preferred. For the second technique, a preference index was determined using the amount of time spent browsing each species by recording which species each deer was eating at 15-sec intervals. Percent time was ranked on a frequency basis and the species with the highest frequency was considered the most preferred.

Statistical Analysis

Data for IIR were analyzed by analysis of variance using the GLM procedure in SAS (SAS 1985). Instantaneous intake rate of browse species constituted the dependant variable, individual deer were used as replications, and species $\times$ deer was used as the error term because species and deer did not interact ($F = 1.27, 24, 8 \text{ df}, P = 0.23$). Following a significant F test, the protected Least Significant Difference (LSD) procedure (Steel and Torrie 1960) was used to identify differences in means. Pearson rank correlation was used to determine relationships of IIR and INIR rankings to ranks of plant morphological attributes, and to the ranks of the 2 preference indices to examine the comparability of techniques. Because our plants showed little seasonal variation in leaf mass, leaf weight/stem weight ratio, and thorn density, correlations to IIR and INIR are presented only for 1 trial.

Results and Discussion

Instantaneous Intake/Plant Morphology

Of the plant morphological attributes considered, mean leaf mass and leaf weight/stem weight ratio showed significant ($P < 0.05$) positive correlations ($r = 0.75$ and 0.65 , respectively) with IIR

Table 2. Mean mass (g) and standard error (SE) of herbage on 4 branches/species of browse before and after offering to deer to determine preference by amount of material consumed during 3 plant development stages in La Copita Research Area.

Species	New leaf development				Stem elongation				Full leaf development			
	Before	SE	After	SE	Before	SE	After	SE	Before	SE	After	SE
	(g)		(g)		(g)		(g)		(g)		(g)	
Spiny hackberry	61.5	5.8	57.0	5.2	49.3	7.5	30.4	6.7	77.4	11.4	53.2	5.1
Brasil	36.2	0.3	32.0	0.7	80.6	7.1	57.8	3.7	59.9	10.8	41.3	9.2
Guajillo	36.2	5.5	28.5	6.8	45.5	5.6	31.4	4.6	35.9	7.2	17.6	0.6
Texas persimmon	47.9	1.1	41.3	2.6	120.7	15.5	108.8	11.7	49.6	7.6	43.6	5.8
Lime pricklyash	47.6	3.6	45.0	3.8	46.6	8.8	32.2	7.5	43.4	4.2	21.1	2.4
Blackbrush	34.2	2.6	33.3	2.5	59.2	9.4	52.3	8.6	41.8	3.8	37.7	3.4
Coma	54.9	3.8	49.9	3.4	60.0	5.5	47.8	6.0	33.0	2.8	24.4	1.7
Huisache	26.9	2.1	25.1	1.7	32.0	5.0	27.1	4.2	29.5	6.4	23.6	5.6
Kidneywood	46.7	3.4	43.9	3.0	33.6	4.6	29.9	4.4	21.1	2.1	15.1	0.8

Table 3. Plant morphological attributes correlated with instantaneous intake rate (IIR) (g/min) of dry matter and instantaneous nutrient rate (INIR) (g nutrient/min) of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent fiber nitrogen (ADFN) by white-tailed deer during Trial 1 on La Copita Research Area.

Species	Plant attributes			
	Leaf ¹ mass	Leaf ² length	Thorn ¹ density	Leaf/stem ratio
	(g)	(cm)	(No/20 cm)	
Spiny hackberry	6.3	3.5	11.9	1.8
Brasil	6.0	2.3	16.5	1.0
Guajillo	4.8	12.7	0	2.1
Texas persimmon	4.6	4.0	0	0.4
Lime pricklyash	2.8	8.9	8.3	1.4
Blackbrush	2.7	1.7	36.4	0.7
Coma	2.3	2.5	7.3	0.5
Huisache	1.4	6.4	23.1	1.0
Kidneywood	1.1	4.5	0	0.3
Correlation coef. (r)				
for IIR	0.75*	0.37	-0.39	0.65*
for INIR-CP	0.50	0.67*	-0.47	0.56
for INIR-NDF	0.73*	0.32	-0.27	0.59
for INIR-ADF	0.73*	0.22	-0.37	0.48
for INIR-ADFN	0.68*	0.53	-0.30	0.81*

¹Mean from terminal 20 cm of 10 randomly selected branches/species.

²Mean leaf length from Vines (1960).

*Correlation coefficient significantly ($P<0.05$) different from zero.

(Table 3). Mean leaf length and thorn density were uncorrelated. Species with growth forms that provided larger quantities of lush leaves at stem ends and with few or small stems were readily consumed. In free ranging goats, Hanley (1982) found the amount and accessibility of palatable forage influenced the degree of selectivity. Apparently the relatively small mouth size of deer and goats (Hanley 1982) is counter adapted to many plant defenses and allows for harvest of palatable plant parts despite presence of spines or thorns. This agrees in part with Hervey (1989), who found mean leaf size and leaf crown volume weight (g/m³) were highly correlated with IIR of deer and goats while spinescence and amount of volatile oils were poorly correlated. Likewise, Cooper and Owen-Smith (1986) observed that plant prickles, unless coupled with small leaf size, were ineffective in deterring browsing ungulates in Africa. Wickstrom et al. (1984) also found that dry matter intake by mule deer (*O. hemionus hemionus*) was relatively insensitive to standing crop biomass.

Leaf mass also showed significant ($P<0.05$) positive correlations with INIR of NDF ($r=0.73$), ADF ($r=0.73$), and ADFN ($r=0.68$) (Table 3). Leaf length showed a significant ($P<0.05$) correlation ($r=0.67$) with INIR of CP. While not significant ($P>0.05$), thorn density tended to be negatively correlated to IIR and INIR.

Guajillo consistently ranked highest in IIR during all trials (Fig. 1). Although leaf length was poorly correlated to IIR (Table 3), guajillo's relatively long leaves, high leaf weight/stem weight ratio, and growth form where leaves and small twigs tend to be clustered on the terminal end of single large stems, likely presented the animals with large, leafy bites free from obstructions. Hervey (1989) found deer harvested guajillo almost 3.5 times greater than any other browse species tested. Lime pricklyash and spiny hackberry also were consistently prominent in IIR (Fig. 1). Although armed, both of these species exhibited a relatively high leaf weight/stem weight ratio (Table 3) allowing for a high intake rate. Texas persimmon ranked high during the stem elongation phase but dropped to a low level for the other 2 periods (Fig. 1). Hervey (1989) also found Texas persimmon to have a high IIR during June. Although persimmon had a high leaf mass, relatively large leaves, and no spinescence, the low leaf weight/stem weight ratio (Table 3) indicated animals would have to contend with numerous

stems while browsing. Vines (1960) described the growth form of Texas persimmon as intricately branched. Possibly during the stem elongation phase, terminal branches were pliable and did not hinder browsing as extensively. Brasil and blackbrush had a high IIR only during the full leaf development stage (Fig. 1). Both of these species are highly armed and have relatively small leaves (Table 3). Full mature leaves may be necessary to allow efficient harvest. To illustrate this, mean intake rate of all 9 species was estimated at 7.0 g/min during new leaf development, 7.8 g/min

Fig. 1. Instantaneous intake rate (IIR) by white-tailed deer of 9 browse species during 3 plant development stages (mean and standard error). Different letters above bars indicate significant differences ($P<0.05$) within a growth stage according to protected Least Significant Difference. GU = guajillo, LP = lime pricklyash, SH = spiny hackberry, TP = Texas persimmon, BR = brasil, CO = coma, BB = blackbrush, KW = kidneywood, and HU = huisache.

during stem elongation, and 9.2 g/min when all species had attained mature status. Huisache, another prominently armed species with a low leaf weight/stem weight ratio, showed a high IIR during the full leaf stage but also was ingested relatively efficiently during new leaf development (Fig. 1). Instantaneous intake rate for coma and kidneywood was low for all trials.

Instantaneous Intake/Nutrient Concentration

Crude protein of the browse plants declined as the plants matured (Table 4). Verme and Ullrey (1974) estimated that dietary CP levels of 13–20% are sufficient for growth and reproduction in white-tailed deer. All browse species maintained or exceeded required CP during the 3 growth stages, similar to findings of Everitt and Gonzalez (1981) and Meyer and Brown (1985).

Table 4. Crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent fiber nitrogen (ADFN) of 9 browse species used to determine instantaneous intake rate (IIR) (g/min) of white-tailed deer during 3 plant development stages (% organic matter basis).

Species	New leaf development				Stem elongation				Full leaf development			
	CP	NDF	ADF	ADFN	CP	NDF	ADF	ADFN	CP	NDF	ADF	ADFN
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Spiny hackberry	32.3	37.4	21.1	6.8	27.7	42.7	25.2	4.0	24.1	35.2	20.6	3.6
Brasil	20.1	44.5	27.4	3.3	16.3	43.2	23.9	3.8	13.8	38.2	24.1	4.2
Guajillo	21.2	62.0	37.9	2.9	18.7	52.4	29.5	4.2	15.6	49.3	26.9	3.4
Texas persimmon	15.4	53.8	39.3	1.1	12.8	47.7	35.2	1.6	13.8	43.4	33.6	1.9
Lime pricklyash	24.8	31.9	19.5	5.0	18.9	27.2	19.9	3.3	18.5	33.5	23.4	2.4
Blackbrush	17.0	64.2	57.6	2.7	13.3	56.6	43.1	2.5	15.8	55.6	43.4	3.1
Coma	14.6	35.1	26.0	3.2	13.4	30.4	23.7	2.8	12.3	30.9	25.8	2.6
Huisache	27.8	54.6	28.9	6.3	26.2	55.9	31.3	3.6	20.7	46.8	25.5	5.0
Kidneywood	24.1	43.1	24.7	3.6	22.1	45.4	26.3	3.2	15.5	52.5	31.7	2.6
Correlation coef. for IIR	0.48	-0.15	0.30	0.38	-0.05	-0.40	-0.33	0.42	0.56	-0.05	-0.30	0.33

Trends in NDF and ADF during the various growth stages were not distinct (Table 4). Several species unexpectedly exhibited a higher fiber content during new leaf development than during the more mature stages. This may be partially explained by far below normal precipitation (approximately 97% below long term monthly median) and above normal temperature during May 1989 (Table 5). Low moisture and high temperature may interact to increase

Table 5. Thirty year temperature (°C) means and median precipitation (mm) from Alice, Texas and means for study period on La Copita Research Area.

	Thirty-year mean			May 1989	June 1988	Aug 1988
	May	June	Aug			
High temperature (°C)	31.5	34.3	36.1	35.3	34.4	36.6
Low temperature (°C)	19.9	22.4	23.0	22.6	21.7	23.5
Precipitation (mm)	73.4	71.6	34.0	2.5	53.8	28.7

cell wall components through increased lignification and more rapid conversion of photosynthetic products to structural components despite plant age (Van Soest 1982). June and August 1988 had precipitation 25% and 16% below long-term monthly median, respectively, with average temperatures (Table 5). Meyer and Brown (1985) found lower NDF concentrations in some winter forages compared to autumn samples following rains that broke a summer-long drought. Nutrient and fiber concentrations in our study were not significantly ($P > 0.05$) correlated to IIR during any plant development stage (Table 4).

Acacia species (guajillo, huisache, and blackbrush) and Texas persimmon tended to possess the highest fiber concentrations throughout the growing season (Table 4). Even though deer ingested guajillo faster than the other browse species, the high fiber content would likely require more microbial cellulose digestion and longer retention time in the rumen. Schoonveld et al. (1974) felt the small rumen-reticula, omasa, and abomasa size of mule deer would prevent fibrous material from remaining in the rumen long enough for adequate digestion of lignified fiber. Fiber concentrations in lime pricklyash and spiny hackberry tended to be the lowest of all species tested indicating a relatively high availability of cell solubles. Low fiber, high IIR, and high CP content may make lime pricklyash and spiny hackberry the most profitable plants of the species studied for nutrient intake by deer. Meyer et al. (1984) also found spiny hackberry and lime pricklyash were high quality summer forages for deer.

Instantaneous Intake/Preference Indices

Instantaneous intake rate and INIR were poorly correlated with

preference indices based on weight of forage removed and amount of time spent browsing (Table 6). A significant ($P < 0.05$) positive

Table 6. Pearson correlations of instantaneous intake rate (IIR) (g/min) and instantaneous nutrient intake rate (INIR) (g nutrient/min) during 3 plant development stages and preference indices based on weight (WT) of forage removed and time (TIM) spent browsing by white-tailed deer. Nutrients investigated included crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent fiber nitrogen (ADFN).

Comparison	New leaf development	Stem elongation	Full leaf development
IIR with WT	0.48	0.71*	0.20
IIR with TIME	0.48	0.39	0.23
INIR-CP with WT	0.47	0.35	0.45
INIR-CP with TIME	0.48	-0.05	0.47
INIR-NDF with WT	0.38	0.53	-0.05
INIR-NDF with TIME	0.32	0.22	0.15
INIR-ADF with WT	0.38	0.60	0.07
INIR-ADF with TIME	0.32	0.33	0.15
INIR-ADFN with WT	0.50	0.70*	0.22
INIR-ADFN with TIME	0.52	0.36	0.33
WT with TIME	0.73*	0.87*	0.70*

*Correlation coefficient significantly ($P < 0.05$) different from zero.

correlation ($r = 0.71$) was found between IIR and weight of forage removed only during the stem elongation stage. Positive correlations between weight removed and time spent browsing, however, were significant ($P < 0.05$) during all 3 plant growth stages ($r = 0.73$ for new leaf development $r = 0.87$ for stem elongation, and $r = 0.70$ for full leaf development), indicating the 2 techniques closely agreed in species rankings.

A number of factors may affect preference and all relative preference indices have shortcomings (Krueger 1972, Cock 1978, Johnson 1980, Loehle and Rittenhouse 1982, Owen-Smith and Cooper 1987). A fundamental shortcoming of comparing usage and availability data to determine preference is the often arbitrary decision about the array of components actually available to an animal (Johnson 1980). Inclusion or exclusion of availability components can affect results. In determining preference indices in our study, availability components were set equal to each other within all trials. Our primary purpose was to rank the various species from most to least preferred under a specified condition. Use of rank data avoids absolute statements about preference or avoidance (Johnson 1980).

When presented with all browse species simultaneously, deer did not appear to select forages based solely on leaf size, spinescence, or possible rate of intake. Guajillo, for example, ranked first in IIR for all trials but ranked second to fourth in weight of forage

removed and fourth to seventh in time spent browsing (rank data not shown). Brasil, coma, spiny hackberry, and lime pricklypear consistently ranked first or second in weight removed or time spent browsing. Although brasil and coma had relatively low IIR, deer appeared to select for these species based on palatability factors not measured. Cooper and Owen-Smith (1986) found that intake rate was unrelated to acceptability of browse species for goats and impalas (*Aepyceros melampus*). For larger animals such as kudu (*Tragelaphus strepsiceros*), an intake rate of <2 g/min negatively influenced acceptance. Instantaneous intake rates among species in our study ranged from an estimated 2.6 to 16.6 g/min (Fig. 1). Therefore, we assume the deer in our study were selecting forages based on factors other than potential intake rate.

Given a limited number of choices (9 species in our case) with little spatial variation, a purely generalist foraging strategy (Nudds 1980) would suggest the deer should respond by feeding randomly among the species offered. However, when deer were exposed to all browse species at once, feeding was not sequential from branch to branch. Rather, each animal appeared to avoid some species while accepting others. This is supported by our preference ranks showing some species were consumed more and maintained longer feeding durations than others. However, the deer did consume parts of all species presented. While not designed to examine foraging theory in detail, our results appear to support the concept that white-tailed deer are selective feeders and attempt to obtain a nutrient-optimizing diet within a fixed bulk of food (Nudds 1980).

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