Diets of Greater Prairie Chickens on the Sheyenne National Grasslands[1,2]

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Abstract.-- Diets of greater prairie chickens on the Sheyenne National Grassland of North Dakota were examined. During the winter months agricultural crops (primarily corn) were the predominant food items. Green vegetation was consumed in greater quantities as spring progressed. Dandelion flowers and alfalfa/sweetclover were the major vegetative food items through the summer. Both juvenile and adults selected diets high in digestible protein obtained through consumption of arthropods and some plants.

INTRODUCTION

Initially, the development of agriculture on the prairies was credited with increasing the population and range of the greater prairie chicken (Tympanuchus cupido (Hamerstrom et al. 1957). Further development however, of agriculture, primarily "clean farming", contributed to their decline (Yeatter 1963, Westemier 1980). Prairie chicken populations are highest in areas where agriculture is interspersed with grasslands in approximately a 1:2 ratio (Evans 1968). The quality of the grassland habitats is also important, however (Christisen and Krohn 1980).

Greater prairie chickens are primarily herbivorous, as are other grouse except during the juvenile stage (Evans 1968). Prairie chicken broods generally select areas of high herbaceous cover with forbs where they forage for insects. Winter is a critical period, during which prairie chickens depend on agricultural crops. Corn is generally thought to be the staple food of prairie chickens (Trippensee 1948, Hamerstrom et al. 1957) but other agricultural crops may be selected (Evans 1968).

The Sheyenne National Grassland is an island of suitable prairie chicken habitat in eastern North Dakota. Because the population of prairie chickens on the Sheyenne National Grassland increased during the period 1974-1980 (Manske and Barker 1981), the possibility of an annual harvest arose. Yet, the reasons for this population increase were not clear. As a result, this study was initiated by the Rocky Mountain Forest and Range Experiment Station, in cooperation with Montana State University to determine food habits of greater prairie chickens on the Sheyenne National Grassland.

This food habits study was designed to be part of a larger effort to gain a better understanding of the ecology of prairie chickens. Habitat selection patterns are reported elsewhere in this symposium.

METHODS

This study was conducted on the Sheyenne National Grassland, Custer National Forest, in southeast North Dakota. This area represents an island of tall- and mixed-grass prairie surrounded by farmland. Vegetative descriptions of seral stages and habitat types are provided by Manske and Barker (1981), and Barker and Manske (this proceedings).

Prairie chicken fecal samples were collected from marked night and day roost locations of radio marked birds, booming grounds, and incidental flushes. Eighty-seven percent of all samples were obtained from radio marked birds. Samples were collected between April and August of 1983-1984 (spring-summer samples) and December to February 1984-1985 (winter samples). Winter samples were collected only during periods when at least 3 cm of snow was present. Samples were air-dried and analyzed separately (Sparks and Malachek 1968) by the Diet Composition Laboratory at Colorado State University. Diet composition (percent dry weight) was estimated from one slide

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(containing 20 fields). Estimates of summer diets were based on 321 samples; winter diet were based on 119 samples.

Data from both periods were separately subjected to a divisive cluster analysis program (Ball and Hall 1967) to search for natural grouping of samples. There were few trends toward natural biological groupings such as sex, age, or monthly differences. Within the summer period however, brood samples tended to be different from adult samples. Therefore, data from adult diets are presented as monthly averages for winter and spring-summer; data from brood diets are presented separately.

The food item categories listed often represent combinations of similar food items. For example, corn includes small amounts of the corn plant (less than .02%); sunflower includes plant material and seeds from other species of the composit family and soybean includes other legume seeds which could not be discerned from soybeans. The food category forb seeds represents seeds from unidentified forbs. Other forbs, shrubs, and grass refers primarily to plant material other than seeds.

RESULTS

Winter Diets

A total of 34 different food items were found in winter samples. These were condensed into 9 categories (Table 1). Waste from agriculture crops comprised over 60% of diets during all winter months. Corn alone made up about 50% of the diets during each month, but sunflowers and soybeans made up over 50% of some individual samples. The frequency of occurrence of corn in prairie chicken diets was 83% compared to 39% for sunflower and 24% for soybeans. Grass seeds comprised a large portion of the December diets but were somewhat less important during January and February. Consumption of a variety of unidentified forb seeds was not apparent until January. During the latter two months of the winter, forb seeds were relatively important food items. Fringed sage (Artemesia frigida) in the prairie chicken diets increased from zero in December to 11% by February. A number of forbs of various species comprised about 9% of the diets during December, then declined during January followed by a slight increase in February. Shrubs were an unimportant food category during this study; Russian olive (Elaeagnus angustifolia) was taken most frequently. Vegetative material from grasses were also relatively unimportant. Kentucky bluegrass (Poa pratensis) was the predominant food item in this category.

Spring-Summer Diets

A total of 59 food items or categories were identified in the diets of adult prairie chickens between April and August. Of these only four were consistently important over the spring-summer period (Table 2). These four food categories over two-thirds of the prairie chicken diets.

During the prenesting through incubation period (April-May), dandelion (Taraxacum officianle flowers, alfalfa/sweetclover and waste corn dominated the diets. Fringed sage continued to contribute a relatively constant portion of the diet from the winter months. During this period, corn declined while dandelion flowers and alfalfa/sweetclover increased . An unidentified composite comprised 13% of the diet in April but only about 2% in May.

Arthropods increased in importance as a food to adult prairie chickens in June and continued to increased throughout the summer. By August nearly 60% of the diet of adult prairie chickens was composed of arthropods. Consumption of dandelions declined in June and comprised about 10% of the diet throughout the summer. Alfalfa/sweetclover in prairie chickens diets increased throughout the spring to 42% in June, then declined to 15% by August.

Arthropods were the single most important food category of juvenile prairie chickens (Table 3),

Table 1. Percent composition of greater prairie chicken diets during winter (Dec. -Feb) on the Sheyenne National Grasslands, North Dakota

Species	December (N=7)	January (N=49)	February (N=63)
	x + se	x + se	x + se
Corn	49.3 ± 17.6	52.1 ± 5.9	50.8 ± 5.0
Sunflower	18.6 ± 12.6	3.0 ± 0.8	4.8 ± 1.3
Soybean	4.1 ± 2.7	6.3 ± 2.3	6.6 ± 2.7
Grass seeds	16.6 ± 9.2	7.7 ± 2.1	9.4 ± 2.1
Forb seeds	0	21.8 ± 4.4	8.5 ± 2.8
Artemesia frigida	0	4.0 ± 1.9	10.7 ± 2.7
Other forbs[1]	9.3 ± 3.5	2.9 ± 1.8	4.8 ± 1.4
Other shrubs[1]	0.2 ± 0.2	0.9 ± 0.3	2.7 ± 1.5
Other grasses[1]	1.8 + 1.3	1.1 + 0.5	1.6 + 0.3

[1]Includes both identified and unidentified species.

Table 2. Percent composition of greater prairie chicken brood diets on the Sheyenne National Grasslands, North Dakota.

Species	June (N-15)	July (N=30)	August (N=30)
	$\bar{x}$ + se	$\bar{x}$ ± se	$\bar{x}$ ± se
Arthropod parts	80.1 ± 6.9	87.3 ± 3.5	86.3 ± 3.5
Taraxacum officinale	0	3.5 ± 2.4	1.5 ± 0.7
Medicago/melilotus spp.	7.4 ± 6.5	2.9 ± 1.4	4.5 ± 1.3
Artemesia frigida	0.1 ± 0.1	0.2 ± 0.1	0.1 ± 0.1
Flower parts	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1
Unidentified composite	0	0.6 ± 0.4	1.8 ± 1.3
Poa pratensis	0.7 ± 0.4	0.6 ± 0.2	0.4 ± 0.2
Forb seeds	0	0.1 ± 0.1	0.2 ± 0.2
Carex spp.	5.6 ± 1.9	2.0 ± 0.5	0.3 ± 0.1
Grass seeds	0.3 ± 0.2	0.1 ± 0.1	0.1 ± 0.1
Equisetum spp.	0.6 ± 0.5	0.3 ± 0.1	0
Eleocharis spp.	3.3 ± 1.5	0.7 ± 0.5	0
Andropogon spp.	0	0.2 ± 0.1	0.1 ± 0.1
Ambrosia spp.	0	0.1 ± 0.1	0.2 ± 0.1
Agropyron spp.	0.1 ± 0.1	0.1 ± 0.1	0.2 ± 0.1
Other forbs[1]	0.1 ± 0.1	0.3 ± 0.1	0
Other grasses[1]	1.3 ± 0.6	0.9 ± 0.2	0.7 ± 0.2
Other shrubs[1]	0.1 ± 0.1	0.1 ± 0.1	0.2 ± 0.1

[1]Includes both identified and unidentified species.

Table 3. Percent composition of greater prairie chicken diets during spring-summer (April-August) on the Sheyenne National Grasslands, North Dakota.

Species	Month				
	April (N=45)	May (N=88)	June (N=39)	July (N=44)	August (N=27)
	x + se	x + se	x + se	x + se	x ± se
Arthropod parts	8.0 ± 2.1	6.4 ± 1.2	26.3 ± 4.2	39.0 ± 5.3	59.8 ± 6.3
Taraxacum officinale flower	14.6 ± 4.6	26.5 ± 3.8	9.0 ± 3.5	10.7 ± 4.1	8.1 ± 3.8
Medicago/Melilotus spp.	20.6 ± 4.5	30.7 ± 3.8	42.7 ± 5.6	30.7 ± 5.4	14.8 ± 4.2
Corn kernel	22.5 ± 3.8	13.8 ± 2.1	1.9 ± 1.2	1.9 ± 1.9	2.8 ± 1.4
Artemesia frigida	7.9 ± 2.4	8.7 ± 2.2	0.9 ± 0.4	0.3 ± 0.3	0.3 ± 0.1
Flower parts	1.4 ± 1.1	1.6 ± 0.8	7.5 ± 2.7	3.5 ± 2.4	1.2 ± 0.1
Unidentified composite	13.4 ± 4.2	1.6 ± 0.8	2.3 ± 1.5	1.2 ± 0.5	5.9 ± 3.7
Antennaria/Cirsium spp.	1.3 ± 0.6	2.8 ± 1.5	0.2 ± 0.1	0.1 ± 0.1	0
Poa pratensis	1.1 ± 0.3	0.6 ± 0.2	0.2 ± 0.1	0.2 ± 0.1	0.4 ± 0.2
Forb seeds	2.1 ± 1.9	0.2 ± 0.1	1.9 ± 0.6	1.2 ± 0.5	0.2 ± 0.2
Carex spp.	0.3 ± 0.1	0.7 ± 0.3	0.7 ± 0.6	1.2 ± 0.4	2.8 ± 2.2
Rosa spp.	0.1 ± 0.1	0.4 ± 0.2	2.1 ± 2.1	0.3 ± 0.2	**0.1 ± 0.1**
Grass seeds	1.3 ± 0.7	0.2 ± 0.1	0.1 ± 0.1	0.2 ± 0.2	0.6 ± 0.4
Equisetum spp.	0.4 ± 0.3	0.3 ± **0.1**	0	0.2 ± **0.1**	0
Eleocharis spp.	0.3 ± 0.2	0.2 ± 0.1	0.3 ± 0.2	**0.1 ± 0.1**	**0.1 ± 0.1**
Andropogon spp.	0	0.1 ± 0.1	**0.1 ± 0.1**	**0.1 ± 0.1**	0.4 ± 0.4
Ambrosia spp.	0.6 ± 0.4	0.5 ± 0.2	0.8 ± 0.7	2.5 ± 1.3	1.3 ± 0.9
Agropyron spp.	0	0.2 ± 0.1	**0.1 ± 0.1**	0	0
Other Forbs[1]	1.0 ± 0.4	0.9 ± 0.3	**1.6 ± 0.7**	1.4 ± 0.6	0.5 ± 0.3
Other Grasses[1]	0.6 ± 0.2	0.5 ± 0.2	0.2 ± 0.1	0.5 ± 0.2	0.7 ± 0.3
Other Shrubs[1]	0.1 ± 0.1	0.9 ± 0.9	0	0.1 ± 0.1	**0.1 ± 0.1**

[1]Includes identified and unidentified species.

comprising over 80% of the diet between June and August. Alfalfa/sweetclover was the only other food item consumed by juveniles in notable quantities throughout the summer. Prairie chicken chicks consumed some dandelion flowers later in the summer, and some shoots of sedges (Carex spp.) and rushes (Eleocharis spp.) during June. Other food categories recorded comprised less than 1% of the diets.

DISCUSSION

Waste corn was the most important single food item consumed during the winter months. Corn averaged of 90% of the diet in about 50% of the samples. However, for some individual birds, other food items were equally important. Both soybeans and sunflowers made up over 50% of some individual samples. Forb seeds were probably the next most important food category. High composition of forb seeds (over 30%) was found almost exclusively in samples from prairie chickens observed feeding in soybean fields the previous day. Soybean fields tend to contain many weeds due to the susceptibility of soybeans to herbicides. Forb seeds comprised over 50% (and up to 98%) of some individual samples. Prairie chickens on occasion were noted flying past corn fields on occasion to feed in soybean fields. Thus, most feeding during the winter by prairie chickens in this study was related to agriculture. Various agronomic crops were noted in prairie chicken diets in other regions (Korschgen 1962, Toney 1980, Horak 1985). However, selection of agronomic crops may reflect a preference rather than requirement at southern latitudes (Horak 1985).

Prairie chickens were first recorded in North Dalota in the 1880s following the spread of agriculture (Evans 1968). Whether prairie chickens were native to this region or not may be debated (eg. Kirsch and Kruse 1973), but prairie chicken numbers increased dramatically with the agricultural invasion on the prairie (Hamerstrom et al. 1957). It is our opinion that agriculture is now a necessary habitat component for prairie chickens in this area.

Prairie chickens often fed in fields during the mornings then moved to the edges of fields for day loafing. During December, grass seeds were probably consumed during day loafing while some grass seeds were still attached to stalks.

Of notable significance was the lack of "budding" by prairie chickens during the winter in this study. Prairie chickens used tree habitats on 5.5% of the observations but were observed budding only 1.1% of the time. The lack of shrub or tree buds in the diet may have been due to the lack of snow accumulation during a relatively mild winter. Thus, prairie chickens in this study were not forced to select shrubs as major food items.

Fringed sage appeared in the diets during January and increased in February. Fringed sage tends to retain green leaves during mild winters and may provide a source of green material as the birds get closer to the breeding season. Vitamin A, from green plant materials, was found to stimulate breeding in Gambel's quail (Callipepta gambelii) (Hungerford 1965). Fringed sage continued to make up about 10% of the diets through the prenesting and incubation periods.

During the prenesting and incubating periods, prairie chickens appeared to be selecting food items that were high in digestible energy and protein. Waste corn is obviously a high-energy food. The other dominant food items during this period were arthropods, which are high in protein, and dandelion flowers, alfalfa/sweetclover, and fringed sage. Forbs generally tend to be higher in digestible protein than grasses (Cook 1972). Increased protein intake during egg laying can result in less weight loss to laying hens (Beckerton and Middleton 1983). Hens loose 15-20% of their body weight during incubation and a hen's ability to successfully raise a brood may depend on her condition after incubation.

Dandelions were also the most important forb in gray partridge diets when available (Weigand 1980), and were highly selected for by sage grouse (Peterson 1970). Individual fecal samples contained up to 96% dandelion flowers during the spring (April-May), indicating that prairie chickens also appear to prefer dandelion flowers when available.

Waste corn was still being selected by the prairie chickens during early spring but consumption of corn declined as the breeding season progressed. Reduced consumption of corn corresponded to decreased use of agricultural habitats and increased use of grasslands, and coincided with spring greenup and field preparations for spring planting of new crops. Consumption of agricultural crops by prairie chickens in this study showed similar patterns to those in Missouri (Korschgen 1962, Toney 1980). During early spring, birds would typically visit display grounds during the morning and evening and feed in the fields during the day.

During the summer months adult prairie chickens continued to select for high-protein and high-energy food items. The level of protein in prairie chicken diets through consumption of arthropods increased from June through August, and probably reflected the increased availability of arthropods. Trends in the diets indicated that alfalfa/sweetclover were being traded for arthropods through the summer, which would indicate a trade off of plant protein for possibly more preferred animal protein. Insects were the dominant food item of lesser prairie chickens (T. pallidicintus) in Texas except during periods of low availability, during which acorns (Quercus arvardii) were selected (Doerr and Guthey 1983).

Prairie chicken hens attending broods occasionally selected diets similar in content to the juveniles. Some samples from hens attending broods contained over 80% arthropods. However, high quantities of arthropods were not being selected consistently by hens with broods. The reasons for the occasional selection of high quantities of arthropods by hens are unclear, the data did not result from misidentified brood samples, however. Brood samples were easily identified from adult samples on the basis of size.

The high composition of arthropods in the diets of juveniles was expected. The diets of most young gallinaceous birds are dominated by arthropods during their first 8-12 weeks (Kobridger 1965, Petersen 1970, Doerr and Guthery 1983, Whitmore et al. 1986). The importance of arthropods in the diets of young birds has been related to protein demands of the growing young (Cross 1966, Potts 1980, Hurst and Poe 1985). Experiments with sage grouse (Centrocercus urophasianus) chicks fed diets of varying amounts of insects showed that developmental deficiencies were apparent for birds whose diets contained restricted amounts of insects (Johnson 1987). Despite the importance of insects in diets, habitat selection patterns in sharp-tailed grouse in Nebrasks were not determined by the abundance of insects, however (Kobridger 1965).

Juvenile prairie chickens consumed small amounts of some vegetation throughout the summer. Sedges and rushes were found in the diets in notable quantities only when these plants were producing new shoots. Whether the sedges and rushes selected were from mesic or xeric species was not known; broods used habitats where both occurred (Newell 1987). Sedges and rushes declined in the diets following periods of initial rapid growth. Alfalfa/sweet clover was consumed by juvenile prairie chickens throughout the summer in low quantities. We suspect that these amounts of may have been related to availability of arthropods and succulence of the vegetation. Alfalfa produces new growth throughout the summer following cutting of fields for hay, and appeared in the diets throughout the summer. Alfalfa/sweetclover also tend to be higher than other forbs and grasses in digestible protein and energy (Church 1972, White and Wright 1984). Clover (Trifolium spp.), also a leguminous forb, was the most important plant food item for immature sharp-tailed grouse in Nebraska (Kobridger 1965). All of these plant foods items decreased in the diets as arthropods increased through the summer.

Low amounts of the several other species of vegetation which appeared in the diets of both adults and juveniles may have been from incidental intake from the guts of herbivorous arthropods (Hansen 1975).

CONCLUSIONS AND IMPLICATIONS

Agricultural crops interspersed with grassland habitats provide an important source of winter food for prairie chickens in this area. The importance of these high energy foods to sustaining prairie chicken populations may increase in regions with cold temperatures and snow accumulations. Although prairie chickens fed in both soybean and sunflower fields, corn appeared to be the most important single food item during the winter. Establishment of corn food plots could be a viable management objective if winter food were determined to be limiting this population of prairie chickens.

Agricultural crops declined in importance with a corresponding increase in consumption of green vegetative materials and arthropods during the spring. This diet shift coincided with breeding activities and spring field preparation. Forbs and arthropods were the dominant food items through the summer. These food items indicated that adult prairie chickens were selecting for food high in digestibility and protein. Prajrie chicken chicks consumed diets high in animal protein as expected, but included some plants through August.

Whereas there are few management alternatives for enhancing food availability on the grasslands during the spring-summer, other management actions could be detrimental. Pest management that impacts nontarget insects could have detrimental impacts on brood survival and growth due to the dependence of the juvenile prairie chickens on arthropods. Direct manipulation of vegetation to enhance native clover or dandelions is not recommended. However, inclusion of leguminous forbs in rangeland seeding mixes is recommended.

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