Food Availability Versus Preference of Wild Turkey Poults in Intensively-managed Pine Stands in Mississippi

Raymond B. Iglay, *Department of Wildlife and Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762*

Bruce D. Leopold, *Department of Wildlife and Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762*

Loren W. Burger, *Department of Wildlife and Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762*

Darren A. Miller, *Southern Timberlands Research and Development, Weyerhaeuser Company, P.O. Box 2288, Columbus, MS 39704*

Abstract: Importance of invertebrates to growth and development of eastern wild turkey (*Meleagris gallopavo silvestris*) poults has been well documented. However, few studies have investigated direct invertebrate use by poults, specifically in relation to alternative forest management regimes. Therefore, we measured invertebrate selection by turkey poults in thinned, mid-rotation loblolly pine (*Pinus taeda*) plantations, treated with factorial combinations of prescribed burning and a selective herbicide, in east-central Mississippi in 2000 and 2001. Using suction sampling and human-imprinted turkey poults, we quantified invertebrate use by poults relative to availability. Turkey poults exhibited heterogeneous use of invertebrate Orders among broods across all treatments and years of study ($P < 0.001$). Additionally, poults did not select invertebrates relative to availability across all treatments and years of study ($P < 0.001$). Consistent with previous research, poults exhibited selection of five Orders (Coleoptera, Diptera, Gastropoda, Homoptera, Hymenoptera) and avoided four Orders (Araneae, Hemiptera, Orthoptera, and 'other'). Future research better defining relationships between poults, vegetation structure, and food availability may assist managers in achieving quality brood habitat.

Key words: herbicides, intensively managed pine stands, invertebrates, *Meleagris gallopavo*, Mississippi, poults, prescribed burning, resource selection, wild turkey

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Eastern wild turkeys (*Meleagris gallopavo silvestris*) rely on a variety of food throughout their development (Hurst 1992). During the first four weeks post-hatch, turkey poults require ≥ 28% protein to meet nutritional demands of somatic growth, feather development, and development of endothermic regulatory processes (Marsden and Martin 1955). These protein needs are met by consuming arthropods and some seeds and fruit (Dickson 1992). In Mississippi, Hurst and Stringer (1975) observed that 79% of one-week-old turkey poult diets mostly consisted of insects. Food quantity, quality, and distribution can significantly influence growth, movement, and survival of turkey poults (Hurst 1992).

Although past research demonstrated importance of invertebrates to turkey poult development, little research has investigated direct relationships between invertebrate availability and poult use (Rumble and Anderson 1996). Such research may provide insight into management techniques that increase invertebrate abundance and thus turkey poults (Rumble and Anderson 1996). Hurst (1992) suggested multiple factors contribute to turkey poult food selection including vegetation type, structure, and poult age. Past studies have reported that diverse plant assemblages are important brood habitat given habitat use by hens with poults (Rumble and Anderson 1993). These studies, however, did not present data on proximate mechanisms for habitat selection (Seth et al. 1998). It has been suggested that forest clearings and pastures are ideal brood habitat for turkeys because early successional herbaceous vegetation supports high invertebrate populations and provides protection cover (Martin and McGuinnes 1975, Kennamer et al. 1980, Healy and Nenno 1983, Healy 1985, Sisson et al. 1991). Midstory management practices, such as prescribed fire and herbicidal hardwood control (Dickson and Wigley 2001), also can be used to maintain early seral vegetation (e.g. pine-grassland ecosystem) and may provide high quality poult foraging habitat by increasing availability and access to invertebrates.

We quantified invertebrate resource selection of turkey poults in thinned, mid-rotation, intensively managed loblolly pine (*Pinus taeda*) stands managed under one of four competition control methods (prescribed burning, selective herbicide, burning and herbicide, and a control). Our objective was to determine if poults exhibited selection among invertebrate Orders and if resource use and selection differed in relation to midstory management practices. This information may enhance understanding of the effects of pine management on turkey brood habitat. This study is part of a larger project investigating effects of prescribed burning and selective herbicides on biodiversity in intensively managed pine stands of east-central Mississippi (Hood et al. 2002, Thompson 2002, Carroll 2004, Woodall 2004).

Study Area

We conducted our research on land owned and managed by Weyerhaeuser Company in Kemper County, Mississippi. This area in east-central Mississippi was within the Interior Flatwoods Resource Area (Pettry 1977), west of Scooba, Mississippi, in the Upper Gulf Coastal Plain Region of Mississippi. We positioned study plots within a 9,700-ha area of primarily loblolly pine stands, intensively managed for pine sawtimber, on a short rotation (25–32 years). Our sites were intensively managed prior to selection for our study following typical Weyerhaeuser Company forest management protocol, which includes harvesting at approximately 27–32 years of age followed by site preparation for planting, vegetation management, one or two commercial thinnings, pruning, and fertilization.

Methods

Experimental Design

We used six stands (>60 ha) of 18- to 22-year-old loblolly pine plantations thinned four to seven years prior to research initiation in April 2000. We divided each stand into four treatment plots (10 ha each, 286 x 350 m) with plots separated ≥50 m and assigned randomly each one of four treatments with each treatment only occurring once per stand. This created a randomized complete block design with six replicates of four treatments with stands as blocking variables and treatment plots as replicates. However, the analysis for this study did not rely on a randomized complete block design (see below). Our four treatments were prescribed burning, herbicide application, herbicide application followed by prescribed burning, and no treatment application (control). We fertilized all stands twice, once immediately after thinning and again in winter 2001. Using contracted skidder operators, we applied herbicide in September 1999 at a rate of 150–187 L ha^{-1} with a tank mixture of 697–872 ml ha^{-1} of Arsenal (BASF 2000), with 0.5% of the total solution of Timbursurf90 (Timberland Enterprises, Inc. Monticello, Arkansas) as a surfactant and water for dilution. Imazapyr is the active ingredient in Arsenal which is primarily applied for control of hardwoods. We used drip torches to light strip fires for prescribed burning during January 2000 and 2003. A detailed description and comparison of treatment effects for each stand in 2000 and 2001 can be found in Thompson (2002).

Food Availability

We sampled selected invertebrate communities of understory vegetation using suction sampling. We conducted sampling once between 0900 and 1300 hours in May to June 2000 and again in 2001 using a gasoline-powered leaf vacuum with bags for gathering samples similar to an altered suction device described by Harper and Guynn (1998). In each treatment plot, we randomly located two 40-m transects and sampled a 1-m^2 area every 10 m, beginning at 0 m, resulting in 10 subsamples per treatment plot per month. We placed invertebrate sample bags in a kill bucket with ethyl acetate, then froze them at < 0 C for later processing of Order-specific abundance. To avoid biasing results, we did not collect invertebrates during high winds or rain (Hughes 1955). Because treatment plots were experimental units, we pooled invertebrate abundance across subsamples by Order for each plot and month.

Food Preference

Human-imprinted turkey poults forage similar to wild turkey poults (Healy et al. 1975). Therefore, we reared turkeys from eastern wild strain birds obtained through Pinewood Poultry Farm (Sam Rayburn, Texas). We incubated eggs for 26–28 days in May 2000 and 2001 in a Petersime (Zulte, Belgium) egg incubator until hatching. For ease of fieldwork and recapture, we imprinted poults to humans following recommendations by Kimmel and Healey (1987). We removed poults from incubators within four hours of hatching and immediately placed them in a blanket.

We then held and called individual poults (whistling or talking) to imprint them on their handlers. We devoted ≥15 hours of human contact within the first 24 hours post hatching. When poults gained walking coordination (ca. 24 hours of age), we moved poults to poultry battery brooders and walked them daily in nearby pastures. We were unable to forage poults within similar vegetation types to study areas. Poults were fed gamebird-turkey starter mash ad libitum and live crickets (Order Orthoptera) daily to imprint them on catching invertebrates. By day 4, we observed poults easily finding, chasing, and capturing most crickets placed close to them. We also observed poult behavior similar to behavior described by Healey et al. (1975).

Surgical ligatures were applied to poults 9 to 12 days of age following Smith and Burger (2005). We withheld food for three hours prior to surgery. We anesthetized poults using a 5:1 mixture of ketamine to xylazine and then ligatured esophageal tracts of poults just proximal to the crop to restrict food matter from passing beyond the crop. After an overnight recovery, we foraged "groups" of three to four poults per treatment plot for a 40-minute period between 1000 and 1230 hours at random locations within each treatment plot, not associated with suction sampling locations. We waited five minutes for poults to acclimate from travel and let them forage for 40 minutes. We followed broods that initially moved in a direction on their own or made a wide circle in a random direction and called poults through undisturbed vegetation. Immediately following foraging trials, we euthanized poults and stored them in coolers until we removed and froze crops. When possible, we removed crops on the day of foraging or froze poults whole and removed them at a later date. Each treatment plot was sampled once in May and June 2000 and again in 2001. Because poults foraging within a single trial in a given plot were not independent, we pooled crop contents of individual poults within groups. We treated pooled crop contents of a single foraging event as a sample per treatment plot resulting in one sample per treatment plot per month or $N = 12$ per treatment for two months.

Statistical Analysis

We used resource availability analyses as described by Manley et al. (2002) to quantify heterogeneity of resource use and selectivity by poult groups. Our experimental design was consistent with Manley et al.'s (2002) design II in which individual animals were identified and resource use was measured for each but availability was quantified at the population level. We treated poult groups as our individual sample units and used suction sampling to quantify availability in each treatment. Our population level for poults was all the poult groups within each treatment. Our sampling protocol was consistent with sampling protocol A, as described by Manley et al. (2002), in which available resources were sampled randomly and a random sample of used resources was measured. We used likelihood ratio chi-square tests to determine if: 1) heterogeneity among groups in invertebrate use occurred irrespective of selection and 2) if invertebrate selection (use disproportionate to availability) occurred within treatments and Orders and across years of study. The difference of the two log-likelihood tests described above provided a measure of the extent to which poults were, on average, using invertebrates in proportion to availability, irrespective of whether they were exhibiting similar selection (Manley et al. 2002). Tests were conducted using $\alpha = 0.05$. We condensed Orders of invertebrates based on presumptive importance and preference as presented in past research regarding (1) feeding by turkey poults (Healy et al. 1975, Hurst and Stringer 1975, Hurst 1992) and (2) effects of silviculture on invertebrate communities (Holliday 1992, Beaudry et al.1997, New and Hannah 1998). We had 10 categories of invertebrates (Araneae, Hymenoptera, Orthoptera, Hemiptera, Gastropoda, Coleoptera, Homoptera, Diptera, immatures, and other). Our "immatures" category included all immature invertebrates of Class Insecta, and "other" included all occurrences of Mantodea, Isoptera, Lepidoptera, Neuroptera, Diplopoda, Chilopoda, and Blattaria. To avoid zeros and frequencies <5 in our data, we used pooled groups per treatments per year (12 samples per treatment per year) and followed a guideline frequency of ≥8 available invertebrates per category across all treatments and years to avoid invertebrate Orders used less than once per individual poult. We still encountered these conditions throughout the data set, but large significant statistics provided proper support for our analyses (Manley et al. 2002).

After our chi-square analyses, we calculated selection ratios ($\hat{w}_i$) for each Order and treatment at the population level. This was number of invertebrates in Order *i* used by all groups/treatment/year (u_{i+}) divided by total number of invertebrates used across all Orders/treatment/year (u_{++}) with the product divided by proportion of the population of available invertebrates in that specific Order (π_i; $w_i=(u_{i+}/u_{++})/(\pi_i)$,). Using 95% Bonferroni confidence intervals with standard errors and assuming no selection, we determined selection or avoidance of invertebrate Orders. Confidence intervals of $\hat{w}_i$ that included 1 reflected use proportional to availability, whereas $\hat{w}_i > 1$ indicated selection and those < 1 indicated avoidance (Manley et al. 2002). We calculated confidence intervals using $z_{(\alpha/2I)} = 2.81$ where 'I' represents number of categories of resource units (e.g., 10 invertebrate categories). We did not test for selection differences between or among (>3) Orders due to high variability of Orders encountered (e.g., Araneae versus Diptera), only 10 categories and or interpret absent invertebrate categories as avoided. For comparison of selection ratio results to sampling results, we calculated mean abundance of available and consumed invertebrates. We investigated how selection ratio analyses represented actual presence or absence of invertebrate Orders such that 'selection' results from increased invertebrate abundance and 'avoidance' results from decreased invertebrate abundance.

Results

We assessed poult invertebrate selection using 12 groups equaling approximately 40 poults per treatment across May and June 2000 and 2001. From log-likelihood tests quantifying heterogeneity in invertebrate use among groups despite selection or no selection, we observed similar invertebrate selection across groups in burn and herbicide treated, herbicide treated, and control plots ($P > 0.05$) during the first year post-treatment (2000) whereas groups in burned plots exhibited heterogeneous selection ($P < 0.001$; Table 1). During the second year post treatment (2001), we observed

Table 1. Log-likelihood chi-square test results regarding whether heterogeneity among turkey poult groups in resource use of invertebrates occurred irrespective of selection or no selection in intensively managed mid-rotation loblolly pine stands treated with prescribed burning, selective herbicide, burn and herbicide, or nothing (control) in Kemper County, Mississippi, during May and June 2000 and 2001.

Year	Treatment	d.f.[a]	Chi-square	*P*
2000	Burn	99	193.89	<0.001
	Herbicide	99	107.97	0.253
	Burn and herbicide	99	109.64	0.218
	Control	99	54.20	0.999
2001	Burn	99	205.22	<0.001
	Herbicide	99	256.67	<0.001
	Burn and herbicide	99	208.85	<0.001
	Control	99	167.39	<0.001

a. d.f. = (I–1)*(*N*–1), where I = 10 invertebrate Orders and *N* = 12 is the number of samples per year.

Table 2. Log-likelihood chi-square test results testing if resource selection of invertebrates (use disproportionate to availability) occurred by human-imprinted turkey poult groups in intensively managed mid-rotation loblolly pine stands treated with prescribed burning, selective herbicide, burn and herbicide, or nothing (control) in Kemper County, Mississippi, during May and June 2000 and 2001.

Year	Treatment	d.f.[a]	Chi-square	*P*
2000	Burn	108	293.28	<0.001
	Herbicide	108	119.60	<0.001
	Burn and herbicide	108	315.37	<0.001
	Control	108	219.81	<0.001
2001	Burn	108	298.19	<0.001
	Herbicide	108	222.74	<0.001
	Burn and herbicide	108	315.37	<0.001
	Control	108	365.08	<0.001

a. d.f. = *N**(I-1), where I = 10 invertebrate Orders and *N* = 12 samples per year.

heterogeneous invertebrate selection among groups in all treatments ($P < 0.05$; Table 1). Log-likelihood tests of resource selection based on expected values defined by availability indicated non-random or selective use among groups of one or more Orders in all treatments in both years ($P < 0.05$; Table 2). Our final log-likelihood test of the difference between the two prior tests resulted in disproportionate, or selective, resource use in treatments, one and two years post-treatment ($P < 0.05$; Table 3).

Table 3. The difference of two log-likelihood Chi-square tests resulting in a measure of how turkey poult groups were, on average, using invertebrates in proportion to availability irrespective of whether they were exhibiting similar selection in intensively managed mid-rotation loblolly pine stands treated with prescribed burning, selective herbicide, burn and herbicide, or nothing (control) in Kemper County, Mississippi, during May and June 2000 and 2001.

Year	Treatment	d.f.[a]	Chi-square	*P*
2000	Burn	9	99.39	<0.001
	Herbicide	9	207.39	<0.001
	Burn and herbicide	9	110.17	<0.001
	Control	9	65.39	<0.001
2001	Burn	9	92.97	<0.001
	Herbicide	9	58.70	<0.001
	Burn and herbicide	9	156.22	<0.001
	Control	9	55.35	<0.001

a. d.f. = I-1, where I = 10 invertebrate Orders.

Using Bonferroni confidence intervals, we observed selection of invertebrates in proportion to availability for most categories across all treatments and years (Table 4). We observed avoidance of Araneae, Hemiptera, Orthoptera, and 'other' in control plots one year post-treatment. We observed selection of Coleoptera in control plots two years post-treatment; Diptera in control plots one year post-treatment; Gastropoda in burn and herbicide treated plots one year post-treatment and control plots two years post-treatment; Hymenoptera in burned plots, burn and herbicide treated plots, and control plots one year post-treatment; and Homoptera in burned treated plots two years post-treatment.

We found avoided Orders to not necessarily be less abundant. One year post-treatment, Araneae was more available in control plots than all other treatments yet was consumed more in herbicide plots (Tables 5, 6). Remaining avoided Orders of Hemiptera, Orthoptera, and 'other' had similar scenarios to Araneae as did selected Orders. We observed Coleopterans two years post-treatment as less abundant in control plots than burned and herbicide treated plots but consumed more in control plots than all other treatments. Dipterans, Gastropods, Hymenopterans, and Homopterans all exhibited variation between selection ratio results and field situations (Tables 5, 6).

Discussion

We used human-imprinted wild-turkey poults as a biological assay (Smith and Burger 2005) to evaluate poult invertebrate selection in intensively-managed, mid-rotation loblolly pine stands under differing midstory management practices. Groups

Table 4. Selection ratios (w_i) with Bonferronni Confidence Intervals of invertebrate categories selected by human-imprinted turkey poult groups in intensively managed mid-rotation loblolly pine stands treated with prescribed burning, selective herbicide, burn and herbicide, or nothing (control) in Kemper County, Mississippi during May and June 2000 and 2001.

		Treatment											
		Burn			Herbicide			Burn and herbicide			Control		
Year	Invertebrate category	w_i[a]	LCL	UCL	w_i[a]	LCL	UCL	w_i[a]	LCL	UCL	w_i[a]	LCL	UCL
2000	Araneae	0.32	–0.627	1.264	1.14	0.639	1.645	0.28	–0.675	1.243	0.57	–0.006	–0.413
	Coleoptera	0.49	–4.777	5.767	1.73	–6.565	10.019	0.28	–3.439	3.996	0.88	–2.242	2.117
	Diptera	0.33	–21.617	22.277	0.00	0.000	0.000	0.00	0.000	0.000	31.51	12.086	50.941
	Gastropoda	1.90	–0.148	3.953	0.86	–22.758	24.485	2.55	1.031	4.071	2.52	–11.159	7.545
	Hemiptera	1.62	–1.023	4.261	7.77	–4.068	19.610	0.77	–12.264	13.795	1.16	–4.065	–2.846
	Homoptera	0.23	–5.690	6.147	0.00	0.000	0.000	0.11	–9.449	9.668	0.28	–5.591	0.266
	Hymenoptera	1.94	1.459	2.418	2.39	0.845	3.938	6.89	5.473	8.301	2.19	1.494	2.885
	Immatures[b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
	Orthoptera	0.80	–1.109	2.711	0.24	–1.519	2.005	0.15	–3.426	3.732	0.39	–1.591	–0.699
	Other[c]	0.42	–7.780	8.628	0.00	0.000	0.000	1.79	–3.868	7.439	1.11	–4.868	–4.789
2001	Araneae	0.23	–0.737	1.189	0.25	–0.561	1.057	0.28	–1.303	1.871	0.26	–0.413	0.931
	Coleoptera	1.82	–0.721	4.364	2.31	0.399	4.216	1.22	–0.270	2.718	4.36	2.117	6.606
	Diptera	0.87	–3.364	5.108	1.25	–4.643	7.135	4.09	0.448	7.726	0.95	–4.034	5.938
	Gastropoda	0.82	–13.073	14.713	1.96	–12.949	16.865	6.37	–2.032	14.772	14.02	7.545	20.501
	Hemiptera	1.25	–0.458	2.961	1.49	–0.705	3.679	0.32	–1.573	2.222	1.18	–2.846	5.203
	Homoptera	2.67	1.744	3.606	1.85	0.499	3.198	1.43	0.315	2.543	1.56	0.266	2.845
	Hymenoptera	1.87	0.172	3.564	1.97	0.319	3.614	2.18	0.648	3.717	0.90	–0.460	2.268
	Immatures[b]	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
	Orthoptera	0.51	–0.430	1.443	0.37	–0.708	1.450	0.25	–1.358	1.854	0.70	–0.699	2.107
	Other[c]	0.33	–2.485	3.149	0.80	–2.919	4.513	0.36	–7.497	8.216	0.41	–4.789	5.613

a. $w^i=(u^{i+}/u^{++})/(\pi i)$, where ui+ is the number of invertebrates from Order i used by all animals. u^{++} is the total number of invertebrates used by all animals. π^i is the proportion of invertebrates available from Order i.: Bonferronni Confidence intervals outlined selection ($w^i > 1$) or avoidance ($w^i < 1$).

b. All immature invertebrates of Class Insecta.

c. Combined abundance of Mantodea, Isoptera, Lepidoptera, Neuroptera, Diplopoda, Chilopoda, and Blattaria.

Table 5. Mean number of invertebrates per category with standard deviation (SD) across treatments consumed by human-imprinted turkey poults in intensively managed mid-rotation loblolly pine stands treated with prescribed burning, selective herbicide, burn and herbicide, or nothing (control) in Kemper County, Mississippi, during May and June 2000 and 2001.

		Treatment											
		Burn			Herbicide			Burn and Herbicide			Control		
Year	Invertebrate category	*N*[a]	$\bar{x}$	SD	*N*[a]	$\bar{x}$	SD	*N*[a]	$\bar{x}$	SD	*N*[a]	$\bar{x}$	SD
2000	Araneae	39	0.5	0.8	39	1.1	2.6	37	0.4	0.7	39	0.9	1.1
	Coleoptera		0.1	0.3		0.1	0.5		0.1	0.3		0.3	0.6
	Diptera		0.0	0.2		0.0	0.0		0.0	0.2		0.3	0.5
	Gastropoda		0.6	0.1		0.0	0.2		0.8	1.5		0.1	0.3
	Hemiptera		0.5	1.2		0.2	0.6		0.1	0.2		0.2	0.6
	Homoptera		0.1	0.3		0.0	0.3		0.0	0.2		0.1	0.3
	Hymenoptera		2.5	6.1		0.6	1.1		1.5	3.2		1.7	2.9
	Immatures[b]		0.0	0.2		0.0	0.2		0.0	0.0		0.0	0.2
	Orthoptera		0.4	2.2		0.2	0.5		0.1	0.3		0.3	0.5
	Other[c]		0.1	0.3		0.0	0.0		0.2	0.6		0.2	0.4
	All		4.8	—		2.1	—		3.1	—		3.9	—
2001	Araneae	43	0.4	–0.9	42	0.5	0.8	41	0.3	0.6	42	0.6	1.0
	Coleoptera		0.6	–0.9		0.8	1.3		0.7	1.1		0.9	1.2
	Diptera		0.2	–0.6		0.2	0.6		0.5	2.1		0.2	0.5
	Gastropoda		0.1	–0.3		0.1	0.3		0.3	0.7		0.6	1.6
	Hemiptera		0.7	–1.3		0.5	0.9		0.3	0.6		0.3	0.5
	Homoptera		1.8	–2.4		1.0	1.2		1.0	2.0		0.9	1.4
	Hymenoptera		0.8	–1.5		0.8	1.1		0.9	3.7		0.6	1.2
	Immatures[b]		0.8	–1.1		0.9	1.3		0.7	1.9		0.5	0.8
	Orthoptera		0.7	–1.4		0.5	1.2		0.3	0.5		0.5	0.8
	Other[c]		0.2	–0.5		0.2	0.9		0.1	0.3		0.1	0.3
	All		6.3	—		5.5	—		5.0	—		5.2	—

a. Number of turkey poults per treatment per year.
b. All immature invertebrates of Class Insecta.
c. Combined abundance of Mantodea, Isoptera, Lepidoptera, Neuroptera, Diplopoda, Chilopoda, and Blattaria.

exhibited selectivity in invertebrate use per Order in all treatments in both years but foraged on invertebrates disproportionate to availability in burn only plots during the first growing season post-treatment and in all treatments during the second growing season post-treatment. Thompson (2002) reported a significant understory vegetation decrease in prescribed burn plots one year post treatment with a recovery in plant height by two years post-treatment. However, we assumed similarity in invertebrate communities at suction sampling and foraging sites to avoid sampling the same area with inadequate temporal spacing.

Selection of specific taxonomic Orders varied within treatments as determined by resource selection (Manley et al. 2001), potentially in relation to taxon-specific responses to treatment effects on invertebrates, vegetation, or turkey poult feeding habits (Stringer 1977). Control plots had the greatest influence on invertebrate selection by poults followed by burn only, burn and herbicide, and herbicide-only treatment plots. Many carabids (ground-dwelling beetles; Coleoptera:Carabidae) tend to

Table 6. Mean number of invertebrates per 10 m^2 per category with standard deviation (SD) across treatments available to human-imprinted turkey broods in intensively managed mid-rotation loblolly pine stands treated with prescribed burning, selective herbicide, burn and herbicide, or nothing (control) in Kemper County, Mississippi, during May and June 2000 and 2001.

		Treatment							
		Burn		Herbicide		Burn and Herbicide		Control	
Year	Invertebrate category	$\bar{x}$[a]	SD	$\bar{x}$[a]	SD	$\bar{x}$[a]	SD	$\bar{x}$[a]	SD
2000	Araneae	4.9	3.1	7.8	4.8	2.9	3.2	16.0	7.7
	Coleoptera	0.8	0.4	0.5	0.4	0.9	0.8	0.9	1.8
	Diptera	0.3	0.4	0.0	0.1	0.0	0.0	0.0	0.1
	Gastropoda	0.9	0.7	0.3	0.3	0.8	3.2	0.4	0.4
	Hemiptera	0.9	0.7	0.2	0.2	0.2	0.2	1.6	0.8
	Homoptera	1.3	0.8	0.6	0.6	0.6	0.8	2.8	1.4
	Hymenoptera	3.8	2.6	2.2	1.8	0.5	0.7	7.9	4.1
	Immatures[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Orthoptera	2.0	1.3	5.3	4.1	1.3	1.4	6.7	3.4
	Other[c]	0.5	0.4	0.8	0.6	0.3	0.3	1.4	0.7
	All	15.5	—	17.6	—	7.3	—	39.9	—
2001	Araneae	28.8	9.8	24.2	9.6	13.1	4.5	49.7	17.4
	Coleoptera	4.5	1.5	4.1	1.4	7.1	3.4	4.7	1.7
	Diptera	3.9	1.9	1.8	0.7	1.7	0.9	4.5	1.9
	Gastropoda	1.3	0.6	0.6	0.3	0.6	0.4	0.9	0.6
	Hemiptera	7.9	2.8	4.4	1.7	10.5	4.1	5.0	1.8
	Homoptera	9.8	3.5	6.3	2.8	8.7	3.4	13.1	5.1
	Hymenoptera	6.6	2.3	5.1	1.9	5.3	2.81	16.0	11.7
	Immatures[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Orthoptera	20.9	7.4	16.2	6.2	13.8	4.8	17.5	6.0
	Other[c]	9.3	3.2	3.6	1.0	2.6	0.8	6.5	3.2
	All	92.9	—	66.3	—	63.2	—	117.8	—

a. Means derived from 12 10-m^2 samples: one sample per treatment plot per month.
b. All immature invertebrates of Class Insecta.
c. Combined abundance of Mantodea, Isoptera, Lepidoptera, Neuroptera, Diplopoda, Chilopoda, and Blattaria.

be larger, abundant, and more active invertebrates in leaf litter making them more noticeable to foraging poults possibly influencing selection of Coleopterans in control plots. Mosquitoes (Diptera: Culicidae) may have been more available in control plots through increased humidity, standing water, or water proximal to sampling areas (Laird 1988) caused by a dense midstory, but possibly consumed less because of their size in relation to other prey such as Gastropods that were less available but consumed more (Hurst 1992). Burning also influenced poult invertebrate selection. Increased availability of Gastropods in burn and herbicide plots may have been due to greater plant abundance (Sternberg 2000). Burning reduces woody plants and increases herbaceous species (Stransky and Harlow 1981, Thompson 2002), which also may have increased consumption of Homopterans. High localized use of Hymenoptera across burn only, burn and herbicide, and control plots could have occurred due to forage trials crossing ant hills harboring dozens to thousands of individuals (Borror et al. 1989).

Rumble and Anderson (1996) similarly reported selective use of invertebrates based on a study of turkey poult fecal droppings where beetles, grasshoppers, and large bodied insects were most frequently consumed. Healy (1985) reported selective use of invertebrate taxon specific to particular habitats, but acknowledged that direct observations of poult feeding rates may overestimate importance of specific insects if feeding rates are not adjusted for insect size. We did not adjust for size, but were able to use crop contents for this investigation versus visual observations of poults feeding.

Avoidance of Orders only occurred in control plots and may have been caused by suction sampling causing unusually high abundance of these Orders. Suction sampling was most effective when areas could be easily accessed. With a denser hardwood midstory causing less understory growth (Thompson 2002), sampling points within control plots could be accessed with minimal disturbance prior to sampling that would normally cause active invertebrates such as Araneae, Hemiptera, Orthopterans, and Blattaria to flee from the sampling area. However, greater availability of invertebrates in control plots with less consumption negatively affected resource selection results causing Orders to appear avoided and consumed similar to other treatment plots. No selection or avoidance of Orders in herbicide plots may have also been a result of restrictive sampling techniques. Contrast to control plots, many herbicide plots had a thick cover of blackberry bushes (*Rubus argutus*) (Thompson 2002) making it difficult to access random sampling points with minimal prior disturbance.

Other sampling techniques such as pitfall traps, intercept traps, or sweep netting could have avoided some possible bias caused by suction sampling. Suction sampling damaged our invertebrate samples with flying debris, reducing identification to Order rather then Family. Past work with suction sampling has been able to identify invertebrates to Family and even to species (Harper and Guynn 1998). However, Harper and Guynn (1988) dried samples before sorting whereas we sorted thawed samples. Identifying invertebrate samples to Family may have enhanced our knowledge of resource selection by turkey poults if specialist Families, associated with specific understory characteristics, were present. Most studies using suction sampling have been in open or easy access areas such as grassy forest openings and fields (e.g., Martin and McGuinnes 1975, Harper and Guynn 1998). As mentioned, our control plot suction samples may have been the most accurate of all treatments due to easy access for sampling. Future studies should be aware that invertebrate sampling is difficult due to factors such as high species diversity, complex interactions, and species identifications (Halaj et al. 2000). Researchers may benefit by using "key assemblages" that are potentially critical to food-web dynamics providing suitable focus species for multi-species system investigations (Polis and Strong 1996).

Management Implications

Invertebrate Orders used by turkey poults in this study coincided with those described by Healy et al. (1975), Hurst and Stringer (1975), and Hurst (1992) prior to manipulation, but did not present any new evidence as to which Orders are "preferred" by poults. Finer taxonomic classification of invertebrates may reveal turkey poult food preferences based on behavior of invertebrate Families or species (i.e., where they reside in the understory, activity, size, social behavior). We agree with Lafon et al. (2001) that future studies investigating importance of invertebrates to poults be as direct as possible in measuring fluctuations in invertebrate abundance relative to changes in poult feeding habits. One suggestion is pair-wise comparisons of invertebrate consumption and availability in poult feeding areas to random points within the same habitat or treatment.

Even though high invertebrate abundance is a goal of many management plans for turkeys (Stoddard 1963, Healy 1985), the extent to which greater invertebrate numbers enhance brood habitat is still unknown and may not be as important as poult access to food. Through our research, we were unable to determine how to enhance wild turkey habitat for poults with herbicides, burning, burning and herbicide, or neither. However, our research demonstrates the difficulty in studying invertebrate communities and provides information regarding alternative techniques, both sampling and analysis, for determining ideal turkey brood habitat. If well-defined relationships between poults, vegetation structure, and food availability can be achieved, researchers will be able to better assess efficiency of management tools for Southeastern managers to achieve quality brood habitat.

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