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ILLINOIS NATURAL HISTORY SURVEY

CONTRACT FOR COMPLETION OF ILLINOIS WATERFOWL STUDIES
FORMERLY FEDERAL AID PROJECT W-88-R

Section of Wildlife Research

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Completion of Illinois Waterfowl Studies
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Introduction

Current information about the food habits of Illinois' migratory waterfowl is necessary for effective long-term management of this resource. The last extensive food habits study was based on waterfowl gizzards collected during 1938-1940 (Anderson 1959). Since that time, pollution and sedimentation have materially reduced the quantity and quality of waterfowl habitat associated with Illinois' streams and rivers. A number of changes in agricultural practices have affected the availability of waste grain to migrating waterfowl. Although the number of acres in corn production has increased somewhat along with the yields of better hybrids, fall plowing has become a common practice. The construction of several flood-control reservoirs and power-plant cooling lakes has created new waterfowl habitat in areas where previously little existed.

The earliest waterfowl food habits study in Illinois was conducted by Uhler (1933) who analyzed the contents of 87 mallard (Anas platyrhynchos) stomachs from the Duck Island Club along the Illinois River in Fulton County. Bellrose (1938) examined 79 duck gizzards collected from the Starved Rock Pool near Ottawa and the Duck Island Club. Martin and Uhler (1939) listed the foods of 185 duck gizzards from 11 locations in Illinois.

Anderson's (1959) classic work was based on 4,977 duck gizzards of 17 species collected from 32 private duck clubs and commercial pickers along the Illinois and Mississippi rivers during 1938-1940. The foods of 88 lesser scaup (Aythya affinis) from Pool 19, Mississippi River were reported by Rogers and Korschgen (1966). Bell and Klimstra (1970) analyzed the contents of 561 "crops" of Canada geese (Branta canadensis) from Horseshoe Lake in southern Illinois. R. Root (unpubl. report 1970) summarized the foods of 119 mallards collected at Mallard Farms Duck Club along the upper Illinois River. The results from analyses of 409 gizzards of 5 species of diving ducks collected from Pool 19, Mississippi River were reported by Thompson (1973). Sweet (1976) studied the food habits of 220 mallards and wood ducks (Aix sponsa) collected at Oakwood Bottoms greentree reservoir in southern Illinois. Stinauer (1976) examined the contents of 581 mallard and 162 lesser scaup gizzards from Pools 18 and 19 of the Mississippi River. Paveglio and Steffeck (1978) reported on the food habits of 151 diving ducks from Pool 19, Mississippi River. With the exception of Anderson's (1959) work, all of the previous studies have been limited in the number of species examined, localized geographically, or have combined data from different species.

The objectives of this study were to: (1) determine the principal foods used by waterfowl in Illinois, with emphasis on the mallard; (2) assess changes in food habits since the last

major study (1938-1940); (3) examine differences in major foods among different geographic regions of the state; (4) determine the variation in food habits within and between years; (5) summarize the nutritive and energy contents of major food items; and (6) relate the effectiveness of various management techniques to the food habits observed.

Methods

The mallard was selected for intensive state-wide evaluation because it currently comprises approximately 80% and 45% of all duck-use days in the fall for the Illinois and Mississippi rivers, respectively, and makes up approximately 50% of the Illinois harvest. Management practices on the majority of the state's waterfowl management areas have been directed to the requirements of the mallard. The importance of Illinois' waterfowl habitat to migrating mallards is illustrated by the fact that during the 5-year period 1978-1982, peak fall censuses of mallards from the Illinois and Mississippi rivers alone averaged 44.7% of the winter inventory population for the Mississippi Flyway. A large sample size was deemed necessary to adequately address the various geographical and chronological aspects of the data set. A total of 9,300 mallard gizzards was collected from 45 locations state-wide during the hunting seasons of 1979-1982 (Figure 1-1).

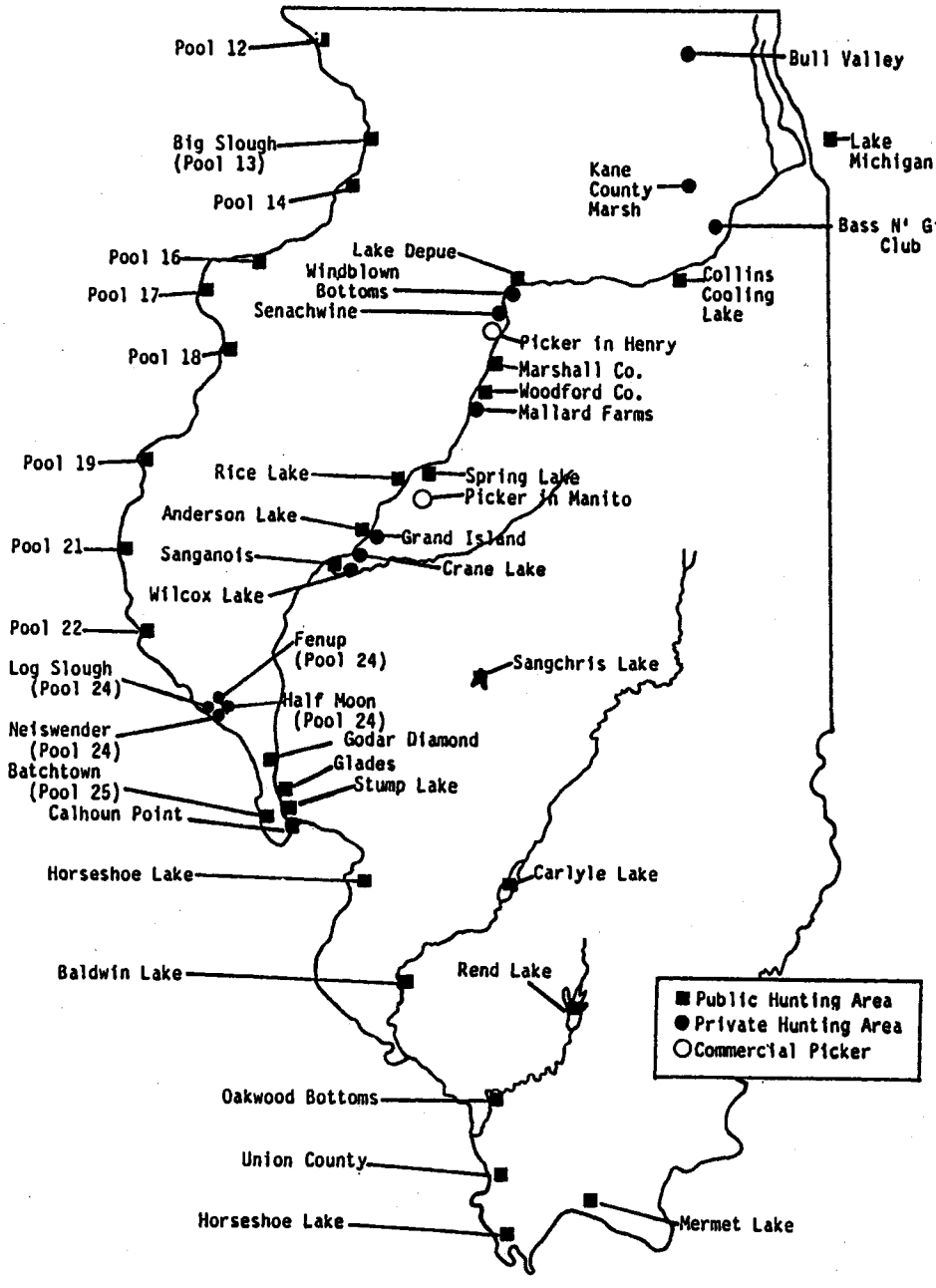

Figure 1-1. Gizzard collection sites for food habits analyses.

The Mississippi River, particularly Pool 19 (Keokuk Pool), is also an important fall concentration area for diving ducks. Trauger and Serie (1974:71) stated, "Keokuk Pool has been characterized as the most important inland area for migrating diving ducks in North America." Lesser scaup comprised an average 22.2% of the total duck use-days in the fall for the Mississippi River (1978-1982) and the 5-year average peak fall count of lesser scaup from that area alone comprised 62.6% of the Mississippi Flyway winter inventory population. A total of 378 lesser scaup gizzards was collected from Pool 19 during 1979-1982 to assess food resources on that critical area, and 238 lesser scaup gizzards were collected from 6 other locations for comparison (Figure 1-1). Smaller samples of other diving ducks were collected from the Mississippi River including redheads (Aythya americana) (39), ruddy ducks (Oxyura jamaicensis) (16), and ring-necked ducks (A. collaris) (15).

Although the majority of the Mississippi Valley Population (MVP) of Canada geese winters in southern Illinois, only one food habits study of this species has been conducted there (Bell and Klimstra 1970). During 1981 and 1982, 512 Canada goose gizzards were collected at Rend Lake, Union County, and Horseshoe Lake wildlife management areas (Figure 1-1) to determine the fall and winter food habits in that region.

The contents of 265 wood duck gizzards collected mainly from the Illinois River during 1978-1983 were analyzed. The wood duck

has greatly increased its abundance in Illinois during recent years. It is now second only to the mallard in the hunters' bag, averaging approximately 14-15% of the total harvest.

In addition to these species, gizzards were also analyzed from 218 green-winged teal (Anas crecca), 37 pintails (A. acuta), 31 wigeon (A. americana), 22 gadwalls (A. strepera), 6 black scoter (Melanitta nigra). A mixed sample of 164 blue-winged (A. discors) and green-winged teal was collected at Carlyle Lake during the 1981 September teal season to document the foods of teals during early migration.

Prior to the hunting season, most cooperators including private hunting clubs, public hunting areas, and commercial duck pickers were supplied with gallon jugs partially filled with 10% formalin or 95% ethanol solutions; some cooperators froze gizzard samples. Each jug was labeled according to week of the season and species of waterfowl gizzard to be collected. At the end of the hunting season, jugs were collected and delivered to the Illinois Department of Conservation for preliminary processing.

Each gizzard was opened and its contents were washed into a 24-cm diameter bowl. Washing was continued and the bowl moved in a "panning" motion to flush organic and other less dense materials over the lip and into a 30-cm diameter, 60-mesh (0.25-mm grid) sieve. The "food" sample was removed from the sieve and the "grit" sample from the bowl and placed on separate blotters.

These were transferred to a tray with retaining edges, labeled with sequentially numbered ticket stubs, and air dried for at least 24 hours. After drying, each food sample was sealed in a 6 x 7.5-cm plastic bag, fluoroscoped to determine the presence of any shot, and frozen for later analysis. Grit samples were examined manually and X-rayed for a separate study on shot ingestion, and then sealed in bags and stored.

After receiving the food samples at the Natural History Survey, they remained frozen until examination. Each bag was opened and the contents examined in a petri dish under a 7-30x zoom binocular dissecting microscope. Contents were identified, measured using the dry volumetric method, and recorded to the nearest 0.01 ml on separate note cards. Volumetric determinations were made using 1 ml, 5 ml, 10 ml, and 25 ml graduated cylinders depending on the volume to be measured. After placing the material in the cylinder, contents were compressed slightly with a small dowel rod to remove air spaces. Measurements of bulky items were made by adding a known volume of #9 steel shot, subtracting the known amount, and retrieving the steel shot with a magnet. Volumes of small numbers of seeds in gizzard samples were often estimated by multiplying the number of seeds times the calculated average volume for that species; unit volumes for seeds of uniform size were calculated by measuring a larger volume of seeds and counting the number of individuals in the sample. This procedure helped to streamline analyses and was

considered more accurate than attempting to measure very small volumes. Samples of all food items found in gizzards were placed in a reference collection for later use. Leroy J. Korschgen, Food Habits Specialist, Missouri Department of Conservation, supplied some reference samples and helped identify numerous unknown items throughout the study.

Primary references used for identification of food items were Martin and Barkley (1961), Delorit (1970), and Montgomery (1977) for seeds; Hitchcock (1935), Fassett (1940), Mason (1957), Britton and Brown (1970), and Mohlenbrock (1975) for vegetative parts and some seeds; Pennak (1978) for invertebrates in general; and Burch (1975a, 1975b, 1982) for Pelecypoda and Gastropoda. Scientific names follow the taxonomy of Mohlenbrock (1975) for plants, Burch (1975a, 1975b, 1982) for Mollusca, and Pennak (1978) for other invertebrates. Scientific names of animal and plant matter used as food items are listed in Appendix 1-1.

Both frequency and volume measurements are used to express results. Frequency is presented as a percent of the total number of samples in which a given item occurs. Volume is summarized using the aggregate volume method where all volumes recorded for a given item in a set of samples is summed and divided by the total volume of all food items in the set and expressed as a percent (Martin et al. 1946). Tabular lists of "important" food items for a set of samples are ranked in order of decreasing

percent volume. An item classified as "important," "major," or "principal" for a set of samples simply means the item comprised 1% or more of the total food volume. The actual importance of a food item is more accurately determined by comparing both frequency and volume measurements. An item with high ratings of both frequency and volume indicate a food of high quality, quantity, or preference. A high frequency and low volume rating for an item may indicate low quality or quantity, or suggest that the item is eaten infrequently but retained in the gizzard for a longer period of time. A high volume and low frequency rating for an item may indicate a food of very localized abundance, or one that is particularly efficient for an individual to forage upon when located.

Use of Gizzards for Food Habits

Much concern has been devoted to the bias resulting from differential digestion rates when using gizzard contents to determine foods consumed by waterfowl. Before presenting results of a large-scale study using gizzard contents, it seems appropriate to review information on this subject.

Swanson and Bartonek (1970), using both field and laboratory procedures, identified a significant bias associated with food analysis in gizzards of blue-winged teal. The laboratory phase of the study consisted of 13 feeding trials with 7-week-old blue-winged teal which were subsequently sacrificed and examined for force-fed food items in the digestive tract (esophagus,

proventriculus, proventriculus and gizzard, gizzard and intestine, and intestine and cloaca) over a series of time intervals from 2.5 minutes to 72 hours. They concluded that there was significant disagreement in composition between esophageal and gizzard contents related to different breakdown rates, and that magnitude of the bias increased in direct proportion to the time lapse between feeding and sampling. However, magnitude of the bias may also have been affected by the methods employed in the study. Comparisons of esophageal and gizzard contents were based on numbers of items counted instead of relative volumes, the standard method employed in food habits summaries (Korschgen 1969). All items were counted only if sufficiently intact to insure accurate enumeration. This probably resulted in significant portions of softer material being excluded from gizzard samples because they were broken up. If volume had been used as the measure, this bias would not have been a factor. Korschgen (1969:246) stated, "Numbers of items eaten often are of little more than academic interest because size (volume) of food items is not taken into account."

Most field studies demonstrating significant disagreements between gizzard and gullet (esophagus and proventriculus) contents, have dealt with spring, summer, and early fall waterfowl foods (Perret 1962, Bartonek and Hickey 1969, Dirschl 1969, Swanson and Bartonek 1970); general conclusions were that

importance of soft-bodied animals was reduced and hard-coated seeds inflated by using gizzard contents. Dillon (1957, 1959) and Wright (1959) also reported distortion of hard-coated seeds in gizzards of wintering waterfowl. There is considerable evidence, however, that these biases are not as critical in studies of late fall and winter food habits of waterfowl, especially mallards. Because the mallard was investigated most extensively in this study, much of the discussion will concern that species.

Numerous studies have shown that mallards eat plant parts (mainly seeds) almost exclusively during fall and winter (Table 1-1). Sugden and Driver (1980) reported that by mid-September, mallards in Saskatchewan obtained 95% or more of their food from grain fields, and thus had completed the transition to a plant diet characteristic of late fall and winter. Review of 19 fall and winter food habits studies where data were listed separately for mallards confirmed this; all but 1 showed plant foods to comprise over 95% of the diet (Table 1-1). The only exception was a study of foods utilized at a greentree reservoir in southern Illinois (Sweet 1976), where animal matter comprised 17.84% of the total food volume consumed by mallards. A comparison of available plant and animal foods in the reservoir by the author showed animal foods were consumed in proportion to their availability. The local abundance of this readily available food source probably accounted for its higher occurrence in the diet.

Table 1-1. Proportions of plant and animal food identified in the fall and winter diets of mallards using different analysis methods.

	LOCATION	DATES	PLANT	ANIMAL	NO.
		GIZZARDS ONLY			
Uhler 1933	Illinois	H.S.[a] 1933	95.8	4.2	87
Stoudt 1944	Minnesota	Autumn 1940	96.5	3.5	306
Korschgen 1955	Missouri	H.S. 1940, 1946-1952	98.3	1.7	1467
Anderson 1959	Illinois	H.S. 1938-1940	97.73	2.27	2825
Dillon 1959	Louisiana	Nov. 1954-Jan. 1958	96.5	NR[b]	125
Yocum and Keller 1961	California	H.S. 1953-1959	96.4	3.6	24
Drake 1970	Alabama, Georgia	Nov. 1967-Feb. 1968 Oct. 1968-Feb. 1969	99.6	0.4	69
Kerwin and Webb 1971	S. Carolina	H.S. 1965-1967	98.14	1.86	80
Stinauer 1976	Illinois	H.S. 1975	98.08	1.92	581
Perry and Uhler 1981	Virginia	Winter 1973-1974, 1975-1976	96.0[c]	1.0	38
Tabatabai et al. 1983	Tennessee	H.S. 1977-1978	95.0	4.2	615
		PROVENTRICULUS OR ESOPHAGUS OR BOTH			
Dillon 1959	Louisiana	Nov. 1954-Jan. 1958	96.8	NR[b]	106
Wright 1959	Arkansas	Nov.-Jan. 1957-1958, 1958-1959	99.4[c]	0.6	583
Glasgow and Junca, 1962	Louisiana	Fall 1961	>98	<2	225
Forsyth 1965	Arkansas	Dec. 1960, Dec. 1961	99.97	0.03	300
Drake 1970	Alabama, Georgia	Oct. 1968-Feb. 1969	98.8	1.2	27
Sweet 1976	Illinois	H.S. 1972-1973	82.16	17.84	118
		GIZZARD, ESOPHAGUS, AND PROVENTRICULUS COMBINED			
Wills 1972	Louisiana	H.S. 1968	99.7	0.3	57
Prevost et al. 1978	S. Carolina	H.S. 1976-1977	100.0	0	14
Allen 1980	Texas	Nov.-Jan. 1972-1973, 1973-1974, 1974-1975	98.6	1.4	85

[a] Hunting season.
[b] Not reported.
[c] Data summarized using average percent volume. All others used aggregate volume.

The proportion of animal matter identified by other investigators in fall and winter diets of mallards was similar whether gizzards or gullets or both were used in analyses (Table 1-1). Based on these factors, it appears that any reduction in the importance of animal matter by using gizzard contents in fall and winter food habits studies of mallards is probably insignificant.

Perry and Uhler (1982), investigating food habits of canvasbacks on Chesapeake Bay, also concluded that a close relationship existed between food in the gullet and in the gizzard. In that study, animal matter comprised 94% and 96% of the food volume in gullets and gizzards, respectively; important animal foods included both hard-shelled mollusks such as baltic clams (Macoma balthica) and soft-bodied invertebrates such as clam worms (Nereis sp.) and amphipods (Leptocheirus plumulosus).

Likewise for Canada geese in Wisconsin, Craven and Hunt (1984) found the frequency of occurrence of major food species to be similar in both proventriculus and gizzard samples. Out of 188 Canada goose digestive tracts, 4 additional species were added from proventriculus samples; 3 out of the 4 species occurred only in trace amounts, and the fourth occurred in only 1 sample (Craven and Hunt 1984).

Distortion of the importance of hard-coated seeds in gizzard samples due to their resistance to digestion has been reported by several authors. Dillon (1957) compared esophagus samples to proventriculus-gizzard samples of several duck species and found

about the same proportions of the top 4 seeds and some less important seeds in both samples, but 3 species of hard seeds occurred in higher amounts in "stomach" samples based on frequency of occurrence. However, this discrepancy would not have greatly affected conclusions about major foods consumed. In a similar comparison, Dillon (1959) reported considerable re-ordering of food item ranks between gullet and gizzard samples of mallards due to a few species of hard-coated seeds. Wright (1959:294) in another comparison of mallard gullets and gizzards stated, "Each gizzard contained approximately the same foods as did the gullet, except that several also contained indigestible seeds..." These studies demonstrated that similar results may be obtained using either method if the investigator takes into account the possible bias associated with very hard seeds. In the interpretation phase, these seeds should be considered lower in value than relative volumes suggest. Even when ingested in large quantities, hard-coated seeds may be voided intact (Swanson and Bartonek 1970) thereby contributing little food value. However, hard seeds may be used as supplemental grit (Dillon 1957) and the relative ash content of such seeds (Dillon 1959) suggests they may contribute to mineral requirements.

In addition to these factors, when analyses are restricted to birds actively feeding as suggested by Swanson and Bartonek (1970), more important biases may result. When a collection site

is selected, the investigator has predetermined that birds collected will contain only foods available at that specific place. To extrapolate results to any larger geographic area, one must make the often erroneous assumption that food resources are homogeneous throughout the area. Stieglitz (1966) reported this sampling bias in a food habits study of diving ducks on Apalachee Bay, Florida. Even though observations indicated widgeongrass (Ruppia maritima) was being heavily utilized by diving ducks, none was recorded in food samples because no divers were collected in areas vegetated by widgeongrass. In addition to this sampling bias, it is virtually impossible to collect a sufficient sample of birds actively feeding for studies encompassing large geographic areas. Samples of hunter-killed birds collected from several different locations usually contain birds that have fed in a wide variety of habitats. However, gullets of hunter-killed birds are often empty or contain little food (Drake 1970, Perry and Uhler 1982), making it necessary to rely on gizzard contents to obtain sufficient sample sizes.

Results and Discussion

Mallard

Due to the wide variation of major foods used by mallards in different areas of Illinois, data were divided into regions to best illustrate these trends. Regional divisions were based on geographic relationships and similarity of food habits among collection sites. Analyses revealed 6 regions with characteristic

food habits patterns and 2 sites were considered separately. Regions identified were: Upper Illinois River, Illinois/ Mississippi River Confluence, Upper Mississippi River, Northeastern Illinois, Kaskaskia River, and Big Muddy River (Figure 1-2). Sangchris Lake and Mermet Lake (Figure 1-2) were considered separately due to the uniqueness of food habits at both sites. A complete listing of all mallard foods consumed by region can be found in Appendix 1-1. A listing of the energy and nutritional characteristics of seeds, vegetative parts of plants, and animal foods found in waterfowl gizzards is presented in Appendices 1-2, 1-3, and 1-4, respectively.

The Upper Illinois River (UIR) region included 15 collection sites between Spring Valley and Meredosia (Figure 1-2). A total of 4,308 mallard gizzards was collected from this region during the hunting seasons of 1979-1981. Over 90% of the 2,825 mallard gizzards collected during the 1938-1940 seasons and analyzed by Anderson (1959) also came from this region and are considered to accurately reflect mallard food habits in the UIR region at that time. Comparisons of the major foods found in the 2 studies showed that corn, the most important food item based on percent volume, was utilized in virtually equal proportions during both time periods (Table 1-2). Rice cutgrass was the second most important food in both studies but comprised a larger proportion of the diet (12.83%) in 1938-1940 than during the current study

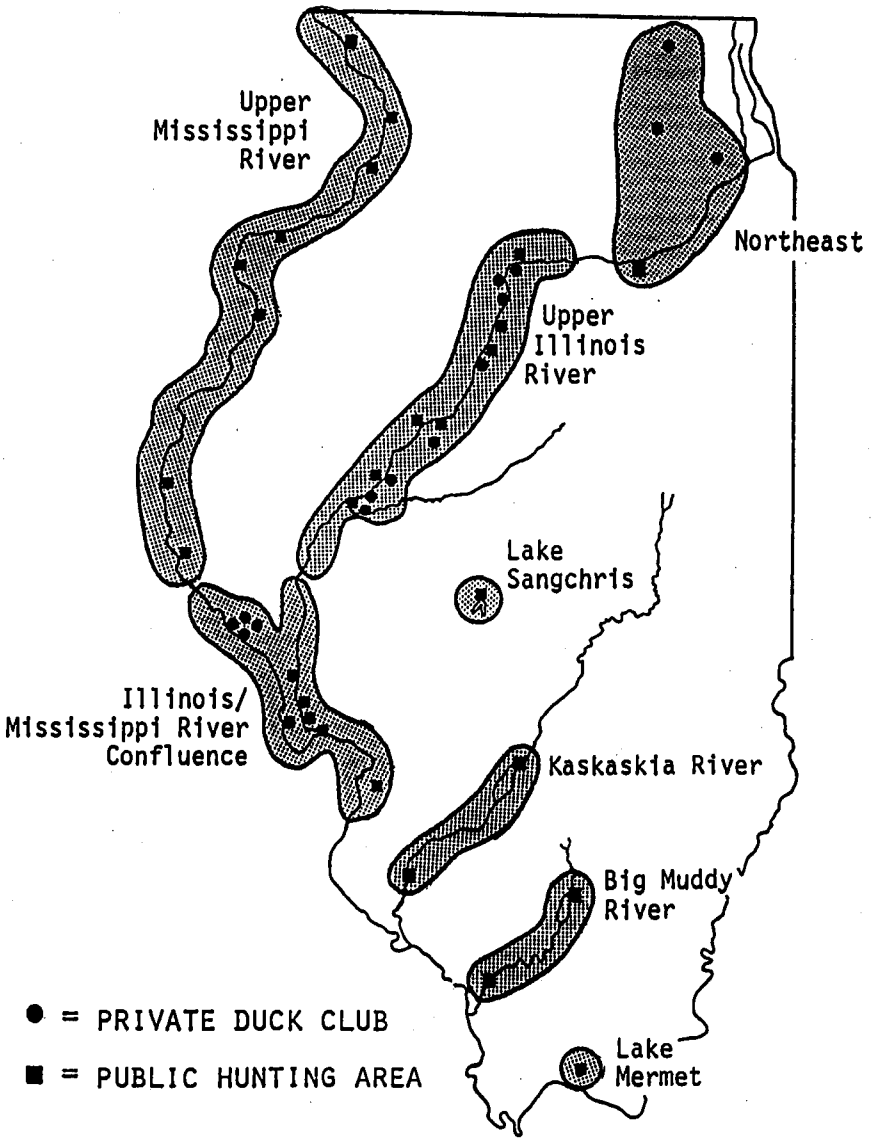

Figure 1-2. Geographic regions of gizzard collection sites used for analyses of mallard food habits.

Table 1-2. Major fall food (≥ 1% of total volume) of mallards from the Upper Illinois River region, 1979-1981, and from the Illinois and Mississippi rivers, 1938-1940 (Anderson 1959).

Food Item	1979-1981 N = 4,308		1938-1940 N = 2,825	
	% Freq.	% Vol.	% Freq.	% Vol.
Corn (Zea mays)	51.05	47.97	44.46	47.37
Rice cutgrass (Leersia oryzoides)	16.11	5.46	20.35	12.83
Japanese millet (Echinochloa frumentacea)	5.48	4.93	0[a]	0[a]
Buckwheat (Fagopyrum esculentum)	4.55	3.91	0	0
Chufa tubers (Cyperus esculentus)[b]	7.92	3.45	6.73	1.32
Largeseed smartweed (Polygonum pensylvanicum)	26.97	3.25	14.83	1.23
Walter's millet (Echinochloa walteri)	6.50	3.09	3.33	0.91
Wild millet (Echinochloa crusgalli)	8.06	2.30	13.84	4.87
Fall panicum (Panicum dichotomiflorum)	10.42	1.88	0	0
Coarse nutgrass (Cyperus ferruginescens)	8.61	1.78	0	0
Milo (Sorghum bicolor)	2.76	1.74	0	0
Giant ragweed (Ambrosia trifida)	7.99	1.41	0	0
Chufa seeds (Cyperus esculentus)[b]	6.83	1.19	6.73	1.32
Nodding smartweed (Polygonum lapathifolium)	23.38	1.18	20.78	0.89
Buttonbush (Cephalanthus occidentalis)	9.84	1.14	13.52	1.05
Coontail (Ceratophyllum demersum)	0.98	0.10	14.37	7.73
Marsh smartweed (Polygonum coccineum)	7.73	0.38	46.55	4.15
Water hemp (Amaranthus tamariscinus)	4.97	0.48	10.55	2.55
Longleaf pondweed (Potamogeton nodosus)	2.65	0.31	29.13	1.37
Duck potato (Sagittaria latifolia)[b]	2.09	0.52	3.15	1.26
Wheat (Triticum aestivum)	1.16	0.47	1.35	1.10
Red-rooted nutgrass (Cyperus erythrorhizos)	1.74	0.38	3.40	1.09
Total plant		99.44%		97.73%
Total animal		0.56%		2.27%
$\bar{X}$ food vol./gizzard		2.33ml		4.97ml
$\bar{X}$ grit vol./gizzard		2.2ml		2.95ml

[a] Not listed but may have occurred in trace amounts.
[b] Includes both tubers and seeds.

(5.46%). One major difference was that in this study Japanese millet, buckwheat, and milo, food plants intensively managed for waterfowl, were major food items, and the aquatic plants of coontail, longleaf pondweed, and duck potato no longer made up significant portions of the diet. Other important foods during 1979-1981 included the tubers and seeds of chufa, largeseed and nodding smartweeds, Walter's and wild millets, fall panicum, coarse nutgrass, giant ragweed, and buttonbush. Several of these items were also important during 1938-1940. The average volume of food per gizzard during 1979-1981 (2.33 ml) was less than half that reported by Anderson (1959) (4.97 ml).

Similar to Anderson's (1959) findings, comparisons of principal mallard foods by weekly collection periods revealed that the proportion of corn in the diet increased as the season progressed (Figure 1-3). The apparent decline in corn use during the last week (4-11 December) was caused by only two years of data being available for that week due to a change in hunting season dates. However, corn increased consistently as the season progressed during all 3 years, reaching levels as high as 81.45% of the diet by the final week of the season. Use of Japanese millet, buckwheat, and milo declined significantly after the first 3 weeks. Natural moist-soil food plants maintained a more consistent proportion of the diet, although all foods other than corn declined toward the end of the season. Other food items that were important during one or more weekly periods but

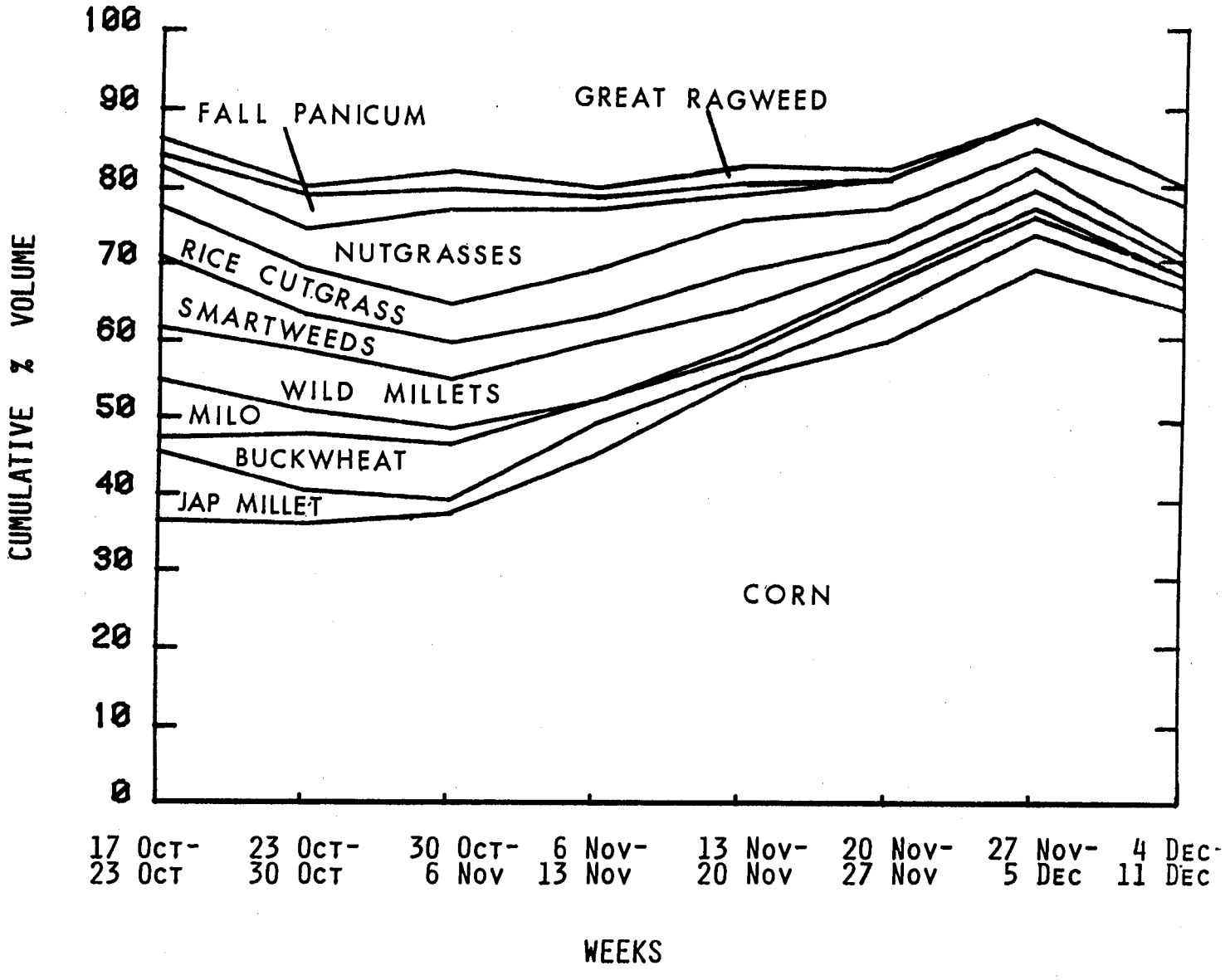

Figure 1-3. Average percent volume of principal food items of mallards (N = 4,308) by week of the hunting season in the Upper Illinois River region, 1979-1981.

comprised less than 1% of the overall food volume for the season included red-rooted nutgrass, leafy pondweed, marsh smartweed, giant bur-reed, duckweed, rough pigweed, and duck potato.

Sufficient samples of mallard gizzards were collected during all 3 years from 3 areas in the UIR region to assess annual variation in major food items (Table 1-3). Food use by mallards on Rice Lake, Anderson Lake, and Sanganois conservation areas, generally reflected food habits trends in the entire UIR region. The use of corn varied dramatically during the 3-year period from a low of 13.42% of the total food volume in 1980 to a high of 70.01% in 1981 (Table 1-3). The increase of corn in the diet in 1981 was coupled with a significant decrease in the diversity of major food items from 15 and 17 in 1979 and 1980, respectively, to 9 in 1981. During 1980, Japanese millet replaced corn as the top food item and other managed foods, milo and buckwheat, were major items.

These three conservation areas are dependent on water levels in the Illinois River to achieve drawdown, but have dams capable of preventing low-level fluctuations from reflooding moist-soil beds during the growing season. Therefore, moist-soil production is often higher on these areas than in the UIR region as a whole during years when drawdowns are achieved and no major floods occur during the growing season. During 1979 and 1980 the proportion of moist-soil foods was higher and the proportion of corn lower in samples from these 3 areas than in the UIR region,

Table 1-3. Major fall foods (> 1% of total volume) of mallards from from Rice Lake, Anderson Lake, and Sanganois Conservation Area in the UIR region during annual collection periods, 1979-1981.

Food Item	1979 N = 127		1980 N = 191		1981 N = 234	
	% Freq.	% Vol.	% Freq.	% Vol.	% Freq.	% Vol.
Corn (Zea mays)	21.26	17.63	21.99	13.42	67.95	70.01
Walter's millet (Echinochloa walteri)	25.20	12.33	10.47	2.96	0	0
Rice cutgrass (Leersia oryzoides)	24.41	8.61	18.85	4.57	5.98	3.27
Japanese millet (Echinochloa frumentacea)	14.17	8.60	23.04	25.45	3.85	3.08
Wild millet (Echinochloa crusgalli)	22.05	8.40	17.80	6.49	4.70	1.30
Coarse nutgrass (Cyperus ferruginescens)	28.35	7.86	22.51	6.97	0.43	0.12
Red-rooted nutgrass (Cyperus erythrorhizos)	9.45	6.00	2.09	0.22	0	0
Wheat (Triticum aestivum)	7.87	4.21	4.71	1.50	0.43	0.04
Chufa tubers (Cyperus esculentus)	10.24	3.47	18.85	5.01	0.85	0.04
Chufa seeds (Cyperus esculentus)	14.17	3.25	18.85	3.38	0.43	0
Marsh smartweed (Polygonum coccineum)	16.54	1.64	16.75	0.77	13.68	0.30
Buttonbush (Cephalanthus occidentalis)	18.11	1.34	22.51	2.62	14.53	2.13
Giant ragweed (Ambrosia trifida)	1.57	1.09	5.24	0.92	4.70	0.21
Nodding smartweed (Polygonum lapathifolium)	29.92	1.04	9.47	0.17	13.25	0.93
Largeseed smartweed (Polygonum pensylvanicum)	12.60	1.04	15.18	0.67	20.94	1.76
Buckwheat (Fagopyrum esculentum)	0	0	2.62	1.58	0	0
River bulrush (Scirpus fluviatilis)	6.30	0.51	7.33	1.07	5.56	0.45
Unclassified millets (Echinochloa sp.)	2.36	0.65	5.76	2.78	0.85	0.01
Salt meadow grass (Leptochloa fascicularis)	0	0	3.66	2.12	0	0
Duck weed (Lemna sp.)	0.79	0.19	2.09	1.21	1.71	0.88
Milo (Sorghum bicolor)	3.15	0.45	5.76	3.28	1.28	0.16
Soybean (Glycine max)	0	0	1.05	1.14	0	0
Least naiad (Najas minor)	0	0	0	0	1.71	1.31
Algae	0	0	0.52	0.08	5.56	2.93
Creeping water primrose (Jussiaea repens)	2.36	0.02	1.57	0.03	5.56	1.96
Total plant		98.96%		98.97%		99.10%
Total animal		1.04%		1.03%		0.90%
$\bar{X}$ food vol./gizzard		1.82ml		3.09ml		2.98ml

reflecting the greater degree of water control. Corn comprised 17.63% and 13.42% of the total food volume, respectively, in 1979 and 1980 on the 3 conservation areas, compared to 47.89% (1979) and 44.38% (1980) for the UIR region. No data were available for the entire UIR region in 1981.

Illinois River water levels at Havana, near the vicinity of Rice Lake, Anderson Lake, and Sanganois conservation areas, during the growing seasons 1979-1981 illustrate why moist-soil plants were more abundant in 1979 and 1980 than in 1981 (Figure 1-4). The river fell to 432.4 ft. MSL by the week of 3-9 July in both 1979 and 1980 and stayed near that level for 6 weeks. Low-level fluctuations later in the growing season did not overtop dams on the 3 areas except for a brief period at Rice Lake in 1979, after which the river fell again quickly (Figure 1-4). However, these late-season fluctuations did affect moist-soil plant beds on unprotected mudflats throughout the UIR region. In 1981, river levels were below 434.9 ft. MSL (where 15% of the potential mudflats are exposed) for only 1 week prior to the week of 18-24 September. By that date, it was too late in the growing season for moist-soil plants to mature and provide food (Bellrose et al. 1979). This explains the dramatic increase of corn in the mallard diet during 1981.

The Illinois/Mississippi River Confluence (IMRC) region included 12 collection sites along the lower Illinois River from Kampsville to Grafton, and the Mississippi River between Lock and

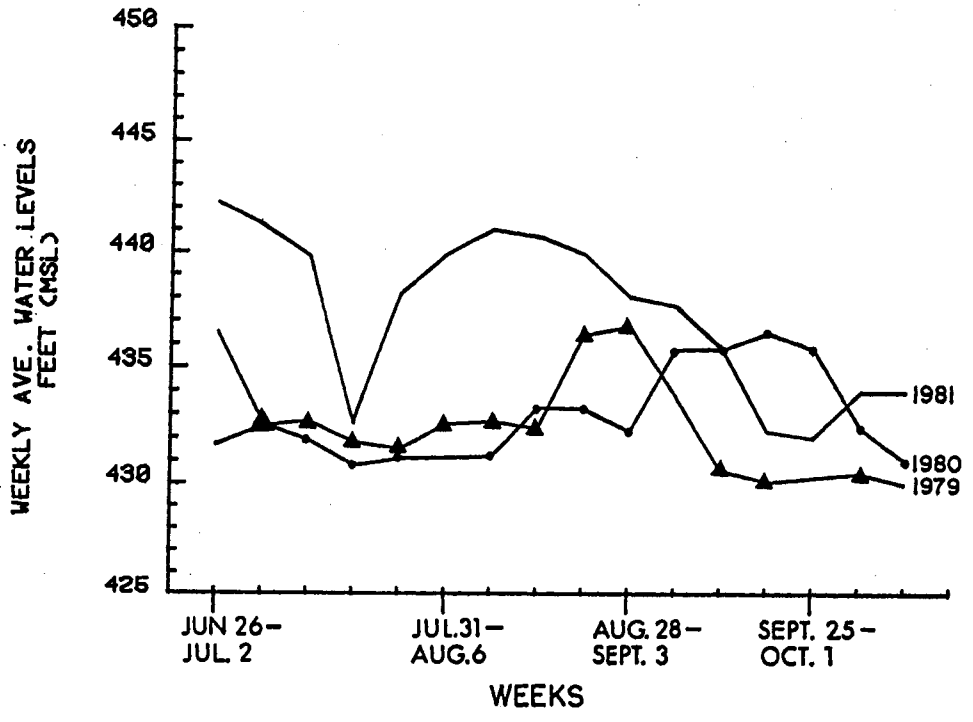

Figure 1-4. Weekly average of the level of the Illinois River at Havana during the growing season for moist-soil plants, 1979-1981.

Dam 22 and St. Louis, Missouri (Figure 1-2). A total of 1,967 mallard gizzards was collected from this region during the hunting seasons 1979-1981. Rice cutgrass made up the highest percent of the total food volume (14.44%) of any single item (Table 1-4). However, the occurrence of 4 species of smartweeds (largeseed, nodding, swamp, and marsh pepper) as major food items made this group the most important, collectively comprising 28.73% of the total food volume. Both largeseed and nodding smartweeds occurred more frequently than rice cutgrass in the samples. Corn was the fourth most important food item comprising 11.14% of the food volume. Other major food items included Japanese millet, creeping water primrose, wild millet, giant ragweed, buttonbush, fall panicum, chufa tubers, wheat, softstem bulrush, and duckweed.

In contrast to the situation in the UIR region, analysis of major foods by weekly collection periods in the IMRC region did not reveal an increasing proportion of corn in the diet as the season progressed (Figure 1-5). In fact, only relatively minor fluctuations of principal food items occurred during the collection period. There were 18 food items found to comprise 1% or more of the total food volume during a weekly period that were not major food items for the season, including American bulrush, water milfoil, sago pondweed, barnyard grass, longleaf pondweed, chufa seeds, red-rooted nutgrass, water hemp, pin oak, prickly sida, common crabgrass, coarse nutgrass, giant duckweed,

Table 1-4. Major fall foods (≥ 1% of total volume) of 1,967 mallards from the Illinois/Mississippi River Confluence region, 1979-1981.

Food Item	% Frequency	% Volume
Rice cutgrass (*Leersia oryzoides*)	31.62	14.44
Largeseed smartweed (*Polygonum pensylvanicum*)	51.86	12.32
Nodding smartweed (*Polygonum lapathifolium*)	45.81	12.15
Corn (*Zea mays*)	12.81	11.14
Japanese millet (*Echinochloa frumentacea*)	11.85	5.87
Creeping water primrose (*Jussiaea repens*)	12.41	3.41
Swamp smartweed (*Polygonum hydropiperoides*)	16.52	3.13
Wild millet (*Echinochloa crusgalli*)	11.85	3.07
Giant ragweed (*Ambrosia trifida*)	5.64	2.74
Buttonbush (*Cephalanthus occidentalis*)	16.88	1.75
Fall panicum (*Panicum dichotomiflorum*)	5.54	1.36
Chufa tubers (*Cyperus esculentus*)	5.19	1.36
Wheat (*Triticum aestivum*)	4.78	1.34
Softstem bulrush (*Scirpus validus*)	7.52	1.27
Marsh pepper smartweed (*Polygonum hydropiper*)	5.85	1.13
Duckweed (*Lemna* sp.)	2.54	1.08
Total plant		99.56%
Total animal		0.44%
$\bar{X}$ food vol./gizzard		2.61ml
$\bar{X}$ grit vol./gizzard		2.2ml

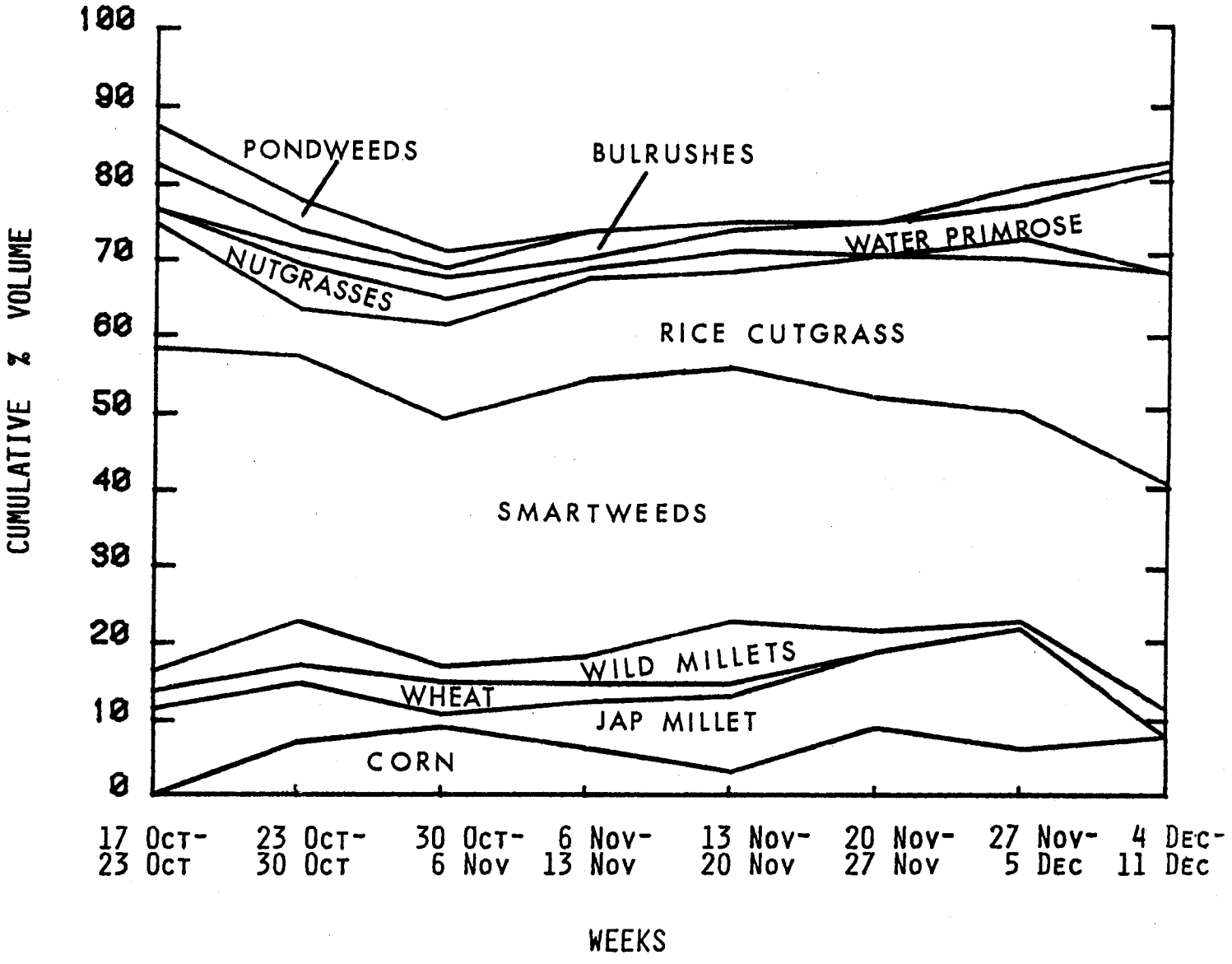

Figure 1-5. Average percent volume of principal food items of mallards (N = 1,967) by week of the hunting season in the Illinois/Mississippi River Confluence region, 1979-1981.

algae, common ragweed, blunt spike rush, gray dogwood, and southern naiad.

Principal mallard foods during the 3 years in the IMRC region were similar, with rice cutgrass, largeseed smartweed, and nodding smartweed, consistently ranking in the top 4 food items based on percent volume (Table 1-5). The proportion of corn in the diet ranged from 5.84% in 1979 to 15.20% during 1980 when it was the top food item. The smartweeds as a group were most important each year, comprising 29.46%, 22.16%, and 49.86% of the total food volume, respectively.

Eight collection sites located along Pools 12-22 of the Mississippi River represent the Upper Mississippi River (UMR) region (Figure 1-2). A total of 872 mallard gizzards were collected from this region during the hunting seasons 1979-1981. Corn was the most important food item, comprising 48.95% of the total food volume (Table 1-6). The second most important food item by volume was rice cutgrass (9.12%), and all other food items made up less than 4% of the total volume each. Other important food items included largeseed smartweed, duckweed, giant foxtail, wild millet, nodding smartweed, giant ragweed, longleaf pondweed, marsh pepper smartweed, least naiad, wheat, softstem bulrush, river bulrush, duck potato, and coontail. The average food volume per gizzard in the UMR region was 2.58 ml.

Analysis of principal mallard foods in the UMR region by weekly collection periods showed that although some fluctuation

Table 1-5. Major fall foods (> 1% of total volume) of mallards from the Illinois/Mississippi River Confluence region during annual collection periods, 1979-1981.

Food Item	1979 N = 544		1980 N = 1,082		1981 N = 344	
	% Freq.	% Vol.	% Freq.	% Vol.	% Freq.	% Vol.
Rice cutgrass (Leersia oryzoides)	40.63	17.33	27.54	12.16	30.21	17.17
Nodding smartweed (Polygonum lapathifolium)	53.49	15.35	40.30	7.75	51.03	20.69
Japanese millet (Echinochloa frumentacea)	20.77	12.67	9.61	4.35	4.69	1.18
Largeseed smartweed (Polygonum pensylvanicum)	51.84	11.93	48.43	9.10	62.76	22.20
Corn (Zea mays)	7.90	5.84	16.45	15.20	9.09	6.39
Wild millet (Echinochloa crusgalli)	14.89	2.58	11.28	3.98	8.80	1.09
Wheat (Triticum aestivum)	7.17	2.35	4.07	1.16	3.23	0.51
Pin oak (Quercus palustris)	4.23	2.30	0.28	0.11	1.17	1.15
Creeping water primrose (Jussiaea repens)	13.05	2.04	10.81	3.80	16.42	4.10
Swamp smartweed (Polygonum hydropiperoides)	13.97	1.81	16.91	3.34	19.35	4.27
Chufa tubers (Cyperus esculentus)	5.52	1.74	5.82	1.55	2.64	0.32
Buttonbush (Cephalanthus occidentalis)	14.89	1.44	17.47	2.10	18.18	1.14
American bulrush (Scirpus americanus)	9.56	1.38	4.62	0.40	0.88	0.04
Softstem bulrush (Scirpus validus)	6.62	1.27	8.87	1.21	4.69	1.43
Barnyard grass (Echinochloa muricata)	3.68	1.22	0.28	0.14	0.59	0.03
Giant duckweed (Spirodela polyrhiza)	3.68	1.17	3.42	1.13	0	0
Sago pondweed (Potamogeton pectinatus)	5.33	1.07	2.96	0.30	4.40	0.27
Giant ragweed (Ambrosia trifida)	1.47	0.09	8.87	4.89	2.05	0.04
Duckweed (Lemna sp.)	1.29	0.18	3.60	1.75	1.17	0.33
Red-rooted nutgrass (Cyperus erythrorhizos)	1.29	0.39	2.68	1.48	0.59	0.04
Unclassified millets (Echinochloa sp.)	0.18	0.01	3.88	1.19	1.47	0.10
Algae	0.37	0.12	1.20	0.59	4.11	1.94
Marsh smartweed (Polygonum coccineum)	4.23	0.14	3.05	0.47	13.49	1.47
Marsh pepper smartweed (Polygonum hydropiper)	2.57	0.23	8.13	1.50	3.81	1.23
Total plant		99.50%		99.47%		99.80%
Total animal		0.50%		0.53%		0.20%
$\bar{X}$ food vol./gizzard		2.41ml		2.63ml		2.87ml

Table 1-6. Major fall foods (≥ 1% of total volume) of 872 mallards from the Upper Mississippi River region, 1979-1981.

Food Item	% Frequency	% Volume
Corn (Zea mays)	43.58	48.95
Rice cutgrass (Leersia oryzoides)	16.63	9.12
Largeseed smartweed (Polygonum pensylvanicum)	25.00	3.25
Duckweed (Lemna sp.)	8.37	2.41
Giant foxtail (Setaria faberi)	7.11	1.97
Wild millet (Echinochloa crusgalli)	8.49	1.89
Nodding smartweed (Polygonum lapathifolium)	23.28	1.63
Giant ragweed (Ambrosia trifida)	4.47	1.62
Longleaf pondweed (Potamogeton nodosus)	10.89	1.50
Marsh pepper smartweed (Polygonum hydropiper)	9.17	1.49
Least naiad (Najas minor)	3.78	1.44
Wheat (Triticum aestivum)	4.59	1.34
Softstem bulrush (Scirpus validus)	16.63	1.26
River bulrush (Scirpus fluviatilis)	12.96	1.25
Duck potato (Sagittaria latifolia)	7.11	1.12
Coontail (Ceratophyllum demersum)	7.00	1.05
Total plant		99.17%
Total animal		0.83%
$\bar{X}$ food vol./gizzard		2.58ml
$\bar{X}$ grit vol./gizzard		2.7ml

occurred, the proportion of corn in the diet increased as the season progressed, reaching a high of 82.00% of the total volume during the last week, 27 November-5 December (Figure 1-6). Rice cutgrass made up a fairly constant proportion of the diet, but other major food items fluctuated throughout the season. Only 4 foods other than corn were found to be major items during 5 or more of the weekly periods. The number of major food items during weekly collection periods ranged from 19 during week 2 when corn occurred at its lowest level (30.3%), to only 6 items during the last week when corn comprised 82.00% of the diet. Foods that composed 1% or more of the total volume during a weekly period that were not principal food items for the season included sago pondweed, water milfoil, giant duckweed, fall panicum, algae, swamp smartweed, gray dogwood, southern naiad, yellow-fruited sedge, giant bur-reed, dotted smartweed, amphipods, water boatmen, common hackberry, yellow foxtail, American lotus, unclassified acorns, and Virginia wild rye.

Annual variation of mallard food habits in the UMR region was investigated during 1980 and 1981 (Table 1-7). The 1979 data were not included because the sample was inadequate (N = 44) and included only 1 collection site. Corn was the top food based on percent volume during both years, but increased from 24.65% in 1980 to 56.21% in 1981. Rice cutgrass ranked second during both years, but ranks of other principal foods varied, with only 6 other items comprising 1% or more during both seasons (Table 1-7).

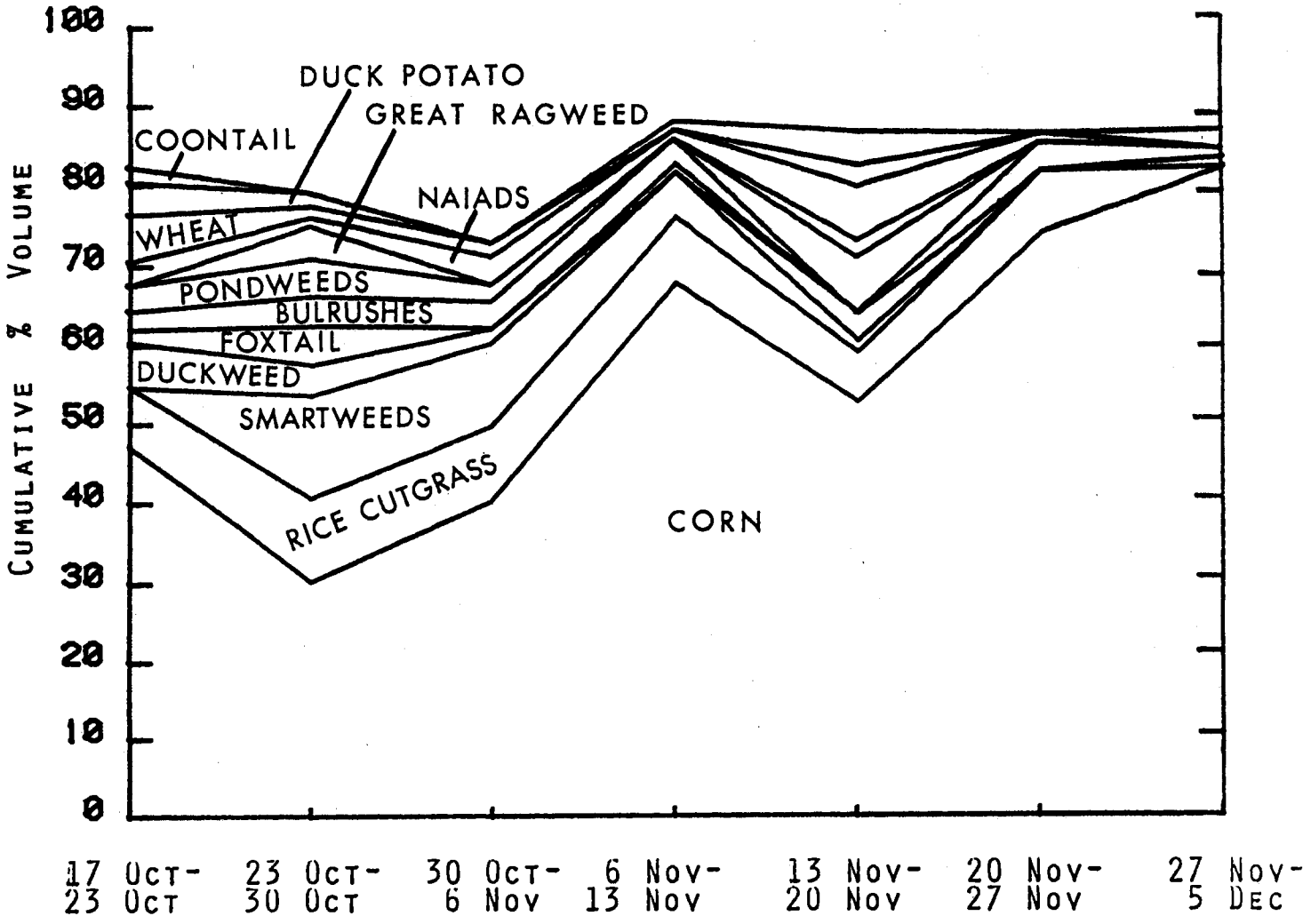

Figure 1-6. Average percent volume of principal food items of mallards (N = 673) by week of the hunting season in the Upper Mississippi region, 1979-1981.

Table 1-7. Major fall foods (≥ 1% of total volume) of mallards from the Upper Mississippi River region during annual collection periods, 1980-1981.

Food Item	1980 N = 215		1981 N = 613	
	% Freq.	% Vol.	% Freq.	% Vol.
Corn (Zea mays)	21.86	24.65	50.73	56.21
Rice cutgrass (Leersia oryzoides)	24.19	11.67	14.36	8.61
Wild millet (Echinochloa crusgalli)	11.16	4.52	7.83	1.16
Wheat (Triticum aestivum)	11.16	4.34	2.45	0.48
Largeseed smartweed (Polygonum pensylvanicum)	28.84	3.74	24.96	3.28
Creeping water primrose (Jussiaea repens)	5.17	3.64	0	0
Nodding smartweed (Polygonum lapathifolium)	25.58	3.33	23.00	1.18
Giant ragweed (Ambrosia trifida)	7.91	2.89	3.43	1.32
Duckweed (Lemna sp.)	3.26	2.53	10.28	2.41
Duck potato tubers (Sagittaria latifolia)	2.79	2.21	0	0
Giant duckweed (Spirodela polyrhiza)	5.58	2.03	0.49	0.13
Blunt broom sedge (Carex tribuloides)	4.19	1.82	0.49	0.01
Japanese millet (Echinochloa frumentacea)	2.79	1.69	1.31	0.40
River bulrush (Scirpus fluviatilis)	10.70	1.65	14.19	1.20
Unclassified acorns (Quercus spp.)	2.79	1.58	0.65	0.19
Red-rooted nutgrass (Cyperus erythrorhizos)	3.26	1.39	0	0
Sago pondweed (Potamogeton pectinatus)	6.98	1.34	5.71	0.54
Pin oak (Quercus palustris)	1.40	1.17	0	0
Giant foxtail (Setaria faberi)	3.72	0.47	8.81	2.56
Least naiad (Najas minor)	0	0	5.38	1.98
Marsh pepper smartweed (Polygonum hydropiper)	5.58	0.59	10.93	1.87
Longleaf pondweed (Potamogeton nodosus)	1.86	0.04	13.70	1.81
Coontail (Ceratophyllum demersum)	5.12	0.13	8.16	1.41
Softstem bulrush (Scirpus validus)	9.77	0.92	18.92	1.29
Fall panicum (Panicum dichotomiflorum)	0	0	3.10	1.15
Duck potato seeds (Sagittaria latifolia)	1.40	0.28	7.83	1.11
Total plant		99.93%		98.92%
Total animal		0.07%		1.08%
$\bar{X}$ food vol./gizzard		2.40ml		2.67ml

Ten foods were principal items during one of the years but comprised less than 1% of the combined total volume (Tables 1-6 and 1-7).

The Northeastern Illinois (NEI) region included 4 collection sites in McHenry, Kane, Will, and Grundy counties (Figure 1-2). A total of 256 gizzards was collected from the NEI region during 1980 and 1981. Corn was by far the most important food item, occurring in 59.77% of the gizzards and accounting for 69.78% of the total food volume (Table 1-8). Only 8 other food items comprised 1% or more of the mallard diet in the NEI region, including rice cutgrass, nodding smartweed, river bulrush, buckwheat, water milfoil, giant bur-reed, largeseed smartweed, and softstem bulrush. No comparison of food habits between the 2 years was made because only 50 gizzards were collected from the NEI region in 1980. Weekly sample sizes were also too small to permit accurate comparisons.

The Kaskaskia River (KR) region was represented by collection sites at Carlyle and Baldwin lakes along the Kaskaskia River (Figure 1-2). A total of 588 gizzards was collected from the KR region during 1979-1981. Corn was the most important food item, occurring in 27.89% of the gizzards and comprising 26.29% of the total food volume (Table 1-9). Nodding and largeseed smartweeds ranked second and third and made up to 10.46% and 8.02% of the total food volume respectively, but both occurred in a higher proportion of gizzards than did corn (46.94% and

Table 1-8. Major fall foods (≥ 1% of total volume) of 256 mallards from the Northeastern Illinois region, 1980-1981.

Food Item	% Frequency	% Volume
Corn (*Zea mays*)	59.77	69.78
Rice cutgrass (*Leersia oryzoides*)	17.19	5.04
Nodding smartweed (*Polygonum lapathifolium*)	26.56	2.01
River bulrush (*Scirpus fluviatilis*)	30.08	1.94
Buckwheat (*Fagopyrum esculentum*)	2.73	1.68
Water milfoil (*Myriophyllum* sp.)	9.38	1.30
Giant bur-reed (*Sparganium eurycarpum*)	21.09	1.24
Largeseed smartweed (*Polygonum pensylvanicum*)	25.78	1.13
Softstem bulrush (*Scirpus validus*)	23.44	1.05
Total plant		99.58%
Total animal		0.42%
$\bar{X}$ food vol./gizzard		3.33ml
$\bar{X}$ grit vol./gizzard		2.3ml

Table 1-9. Major fall foods (≥ 1% of total volume) of 588 mallards from the Kaskaskia River region, 1979-1981.

Food Item	% Frequency	% Volume
Corn (Zea mays)	27.89	26.29
Nodding smartweed (Polygonum lapathifolium)	46.94	10.46
Largeseed smartweed (Polygonum pensylvanicum)	48.64	8.02
Japanese millet (Echinochloa frumentacea)	10.54	7.66
Rice cutgrass (Leersia oryzoides)	15.64	7.53
Wild millet (Echinochloa crusgalli)	14.80	4.95
Fall panicum (Panicum dichotomiflorum)	11.39	3.63
Milo (Sorghum bicolor)	3.57	2.70
Marsh pepper smartweed (Polygonum hydropiper)	5.78	2.49
Buttonbush (Cephalanthus occidentalis)	10.20	2.02
Algae	4.42	1.58
Duckweed (Lemna sp.)	2.55	1.37
Junglerice (Echinochloa colonum)	2.72	1.27
Muskgrass (Chara sp.)	2.21	1.15
Giant duckweed (Spirodela polyrhiza)	4.25	1.10
Chufa tubers (Cyperus esculentus)	2.72	1.01
Total plant		98.68%
Total animal		1.32%
$\bar{X}$ food vol./gizzard		2.16ml
$\bar{X}$ grit vol./gizzard		1.8ml

48.64%). Other important foods were Japanese millet, rice cutgrass, wild millet, fall panicum, milo, marsh pepper smartweed, buttonbush, algae, duckweed, junglerice, muskgrass, giant duckweed, and chufa tubers. Due to an uneven distribution of samples, no comparisons were made between years or weeks of the season in the KR region. Other food items recorded as important during one of the collection years but comprising less than 1% of the total food volume for the region were longleaf pondweed, wheat, caddisfly larvae, water milfoil, unclassified acorns, dotted smartweed, leafy pondweed, pin oak acorns, softstem bulrush, sago pondweed, coontail, giant bur-reed, southern naiad, and giant foxtail.

The Big Muddy River (BMR) region included 2 collection sites, Rend Lake and Oakwood Bottoms (Figure 1-2). A total of 401 gizzards was collected from the BMR region during 1979-1981. Pin oak was the most important food item by volume (36.33%) and occurred in more gizzards than any other food item (34.16%, Table 1-10). In addition, fragments of acorns unable to be classified accounted for 4.12% of the total volume; many of those were probably also pin oak. Corn ranked second, comprising 8.36% of the food volume. Other food items which made up 1% or more of the diet were buttonbush, milo, largeseed smartweed, unclassified beggar-ticks, common beggar-ticks, duckweed, rice cutgrass, wild millet, giant duckweed, Japanese millet, fall panicum, buckwheat, devil's beggar-ticks, marsh pepper smartweed, coontail, and

Table 1-10. Major fall foods (≥ 1% of total volume) of 401 mallards from the Big Muddy River region, 1979-1981.

Food Item	% Frequency	% Volume
Pin oak (Quercus palustris)	34.16	36.33
Corn (Zea mays)	10.72	8.36
Buttonbush (Cephalanthus occidentalis)	33.17	7.21
Milo (Sorghum bicolor)	8.73	4.63
Unclassified oak (Quercus sp.)	12.97	4.12
Largeseed smartweed (Polygonum pensylvanicum)	27.43	3.12
Unclassified beggar-ticks (Bidens sp.)	9.48	2.66
Common beggar-ticks (Bidens comosa)	4.74	2.17
Duckweed (Lemna sp.)	7.48	1.85
Rice cutgrass (Leersia oryzoides)	8.73	1.81
Wild millet (Echinochloa crusgalli)	6.73	1.66
Giant duckweed (Spirodela polyrhiza)	4.24	1.56
Japanese millet (Echinochloa frumentacea)	1.75	1.47
Fall panicum (Panicum dichotomiflorum)	7.48	1.46
Buckwheat (Fagopyrum esculentum)	2.00	1.41
Devil's beggar-ticks (Bidens frondosa)	5.49	1.40
Marsh pepper smartweed (Polygonum hydropiper)	6.23	1.27
Coontail (Ceratophyllum demersum)	6.73	1.12
Nodding smartweed (Polygonum lapathifolium)	12.97	1.04
Total plant		99.0%
Total animal		1.00%
$\bar{X}$ food vol./gizzard		2.77ml
$\bar{X}$ grit vol./gizzard		1.3ml

nodding smartweed. Uneven sample size distribution precluded any seasonal or annual comparisons of food habits in the BMR region. Other foods which made up 1% or more of the diet during a given year but not for the combined total were creeping water primrose, algae, common crabgrass, chufa tubers, giant bur-reed, giant ragweed, giant foxtail, barnyardgrass, lady's thumb, common bur-reed, unclassified insects, swamp beggar-ticks, sallow sedge, tall swamp marigold, catchfly grass, and water willow.

Sangchris Lake in central Illinois was one of the 2 sites not included in a region (Figure 1-2). A total of 446 gizzards was collected at this power plant cooling lake during 1979-1981. One of the most striking characteristics of food habits recorded from the site was that only 4 items comprised 1% or more of the total volume for the 3-year period (Table 1-11). Corn was the most important food item, occurring in 67.71% of the samples, and accounting for 58.25% of the total food volume. The aquatic plants of least naiad and longleaf pondweed ranked second and third comprising 21.03% and 9.51% of the diet, respectively. Unclassified naiad accounted for 1.20% of the food volume and was made up of fragments of least and southern naiads which were indistinguishable.

Annual comparison of food habits data from Sangchris Lake revealed that corn far surpassed all other food items each year in both frequency of occurrence, and percent of the diet (Table 1-12). Least naiad ranked second during 1979 and 1980 and a close

Table 1-11. Major fall foods (≥ 1% of total volume) of 446 mallards from Sangchris Lake, 1979-1981.

Food Item	% Frequency	% Volume
Corn (*Zea mays*)	67.71	58.25
Least naiad (*Najas minor*)	36.32	21.03
Longleaf pondweed (*Potamogeton nodosus*)	55.83	9.51
Unclassified naiad (*Najas* sp.)	0.90	1.20
Total plant		99.36%
Total animal		0.64%
$\bar{X}$ food vol./gizzard		1.97ml
$\bar{X}$ grit vol./gizzard		2.8ml

Table 1-12. Major fall foods (> 1% of total volume) of mallards from Sangchris Lake during annual collection periods, 1979-1981.

Food Item	1979 N = 230		1980 N = 122		1981 N = 94	
	% Freq.	% Vol.	% Freq.	% Vol.	% Freq.	% Vol.
Corn (Zea mays)	71.74	56.76	64.75	62.35	60.64	54.79
Least naiad (Najas minor)	39.57	22.85	45.90	25.75	15.96	10.96
Longleaf pondweed (Potamogeton nodosus)	54.78	12.61	50.00	3.58	65.96	11.13
American lotus (Nelumbo lutea)	1.30	1.15	0	0	1.06	0.40
Nodding smartweed (Polygonum lapathifolium)	6.96	0.08	4.92	1.24	15.96	0.35
Unclassified naiad (Najas sp.)	0	0	0.82	1.09	4.26	5.27
Horned pondweed (Zannichellia palustris)	0	0	0	0	6.38	3.74
Largeseed smartweed (Polygonum pensylvanicum)	6.09	0.22	2.46	0.07	14.89	1.47
Softstem bulrush (Scirpus validus)	8.70	0.15	6.56	0.12	43.62	1.42
Giant bur-reed (Sparganium eurycarpum)	0	0	0.82	0.67	2.13	1.07
Total plant		98.86%		99.68%		99.95%
Total animal		1.14%		0.32%		0.05%
$\bar{X}$ food vol./gizzard		1.78ml		2.21ml		2.13ml

third in 1981. Longleaf pondweed was third in 1979 and 1980 and second in 1981. Other food items were variable, with the greatest diversity of major items occurring in 1981 when corn was at its lowest level.

Mermet Lake, a waterfowl management area in Massac County (Figure 1-2) was also considered separately due to the uniqueness of food habits recorded from the site. Southern naiad, a submergent aquatic plant, was the most important food item, occurring in 53.21% of the gizzards and accounting for 44.78% of the total food volume (Table 1-13). The managed foods of Japanese millet, milo, and buckwheat, ranked second, third, and eighth, respectively, comprising 9.34%, 6.92%, and 2.42% of the diet. Other principal food items included corn, wild millet, buttonbush, common beggar-ticks, Indian heliotrope, unclassified millet, largeseed smartweed, long-leaved ammannia, and nodding smartweed.

Southern naiad was the most important food item at Mermet during 1979 and 1980, comprising over 43% of the total food volume both years, but other principal foods were inconsistent (Table 1-14). Japanese millet was the second most important food in 1979 but comprised less than 1% of the food volume in 1980. Conversely, milo was unimportant in 1979 but ranked second in 1980. The shift in use of these managed food items reflects annual changes in the cropping plans for the impoundments that are drawn down and reflooded for waterfowl management.

Table 1-13. Major fall foods (≥ 1% of total volume) of 280 mallards from Mermet Lake, 1979-1980.

Food Item	% Frequency	% Volume
Southern naiad (Najas guadalupensis)	53.21	44.78
Japanese millet (Echinochloa frumentacea)	16.43	9.34
Milo (Sorghum bicolor)	10.36	6.92
Corn (Zea mays)	7.86	6.33
Wild millet (Echinochloa crusgalli)	10.00	4.83
Buttonbush (Cephalanthus occidentalis)	39.29	4.55
Common beggar-ticks (Bidens comosa)	19.29	3.67
Buckwheat (Fagopyrum esculentum)	4.64	2.42
Indian heliotrope (Heliotropium indicum)	38.93	2.20
Unclassified millet (Echinochloa sp.)	4.29	1.44
Largeseed smartweed (Polygonum pensylvanicum)	20.36	1.38
Long-leaved ammannia (Ammannia coccinea)	5.00	1.29
Nodding smartweed (Polygonum lapathifolium)	15.36	1.25
Total plant		98.17%
Total animal		1.83%
$\bar{X}$ food vol./gizzard		2.47ml
$\bar{X}$ grit vol./gizzard		2.2ml

Table 1-14. Major fall foods (≥ 1% of total volume) of mallards from Mermet Lake during annual collection periods, 1979-1980.

Food Item	1979 N = 162		1980 N = 118	
	% Freq.	% Vol.	% Freq.	% Vol.
Southern naiad (Najas guadalupensis)	51.23	45.94	55.93	43.16
Japanese millet (Echinochloa frumentacea)	27.16	15.65	1.69	0.51
Wild millet (Echinochloa crusgalli)	12.35	7.01	6.78	1.78
Common beggar-ticks (Bidens comosa)	29.01	4.98	5.93	1.84
Indian heliotrope (Heliotropium indicum)	49.38	3.62	24.58	0.22
Buckwheat (Fagopyrum esculentum)	7.41	3.54	0.85	0.84
Buttonbush (Cephalanthus occidentalis)	37.65	3.21	41.53	6.42
Corn (Zea mays)	4.32	3.09	12.71	10.86
Long-leaved ammannia (Ammannia coccinea)	8.64	2.21	0	0
Caddisfly larvae (Orthotrichia sp.)	19.14	1.22	19.49	0.15
Largeseed smartweed (Polygonum pensylvanicum)	20.99	1.06	19.49	2.83
Milo (Sorghum bicolor)	0.62	0.04	23.73	16.54
Unclassified millet (Echinochloa sp.)	0	0	10.17	3.45
Nodding smartweed (Polygonum lapathifolium)	9.26	0.72	23.73	1.99
Unclassified beggar-ticks (Bidens sp.)	0.62	0.01	5.93	1.38
Total plant		97.64%		98.90%
Total animal		2.36%		1.10%
$\bar{X}$ food vol./gizzard		2.49ml		2.44ml

Mallards are highly adaptable in their feeding habits and make use of a wide variety of natural and cultivated food plants available in different localities (Bellrose 1980). This characteristic is well illustrated by comparing major food items among the sampling regions in Illinois. To simplify the comparison, food plants were divided into classes based on life-form of the vegetation and whether the plant was "natural" or cultivated; corn was considered separately (Figure 1-7). The classes are defined as follows: other agricultural - all cultivated plants except corn, including milo, buckwheat, Japanese millet, and wheat; natural moist-soil plants - mostly pioneering annual plants which become established on exposed mud flats, in very shallow water, and in low wet areas; submergent and floating-leaved aquatic plants - both rooted and non-rooted aquatic plants with leaves and stems growing entirely on or below the water's surface; emergent aquatic plants - erect, rooted, herbaceous aquatic plants (usually perennial); woody plants - seeds and fruits of trees and shrubs. Among the 6 regions and 2 separate locations, corn was the most important class 4 times based on percent volume, followed by natural moist-soil plants (2), submergent and floating-leaved aquatics (1), and woody plants (1) (Figure 1-7). These results illustrate the importance of regional or site-specific analysis of food habits when studying a large geographic area. A statewide summary of mallard food

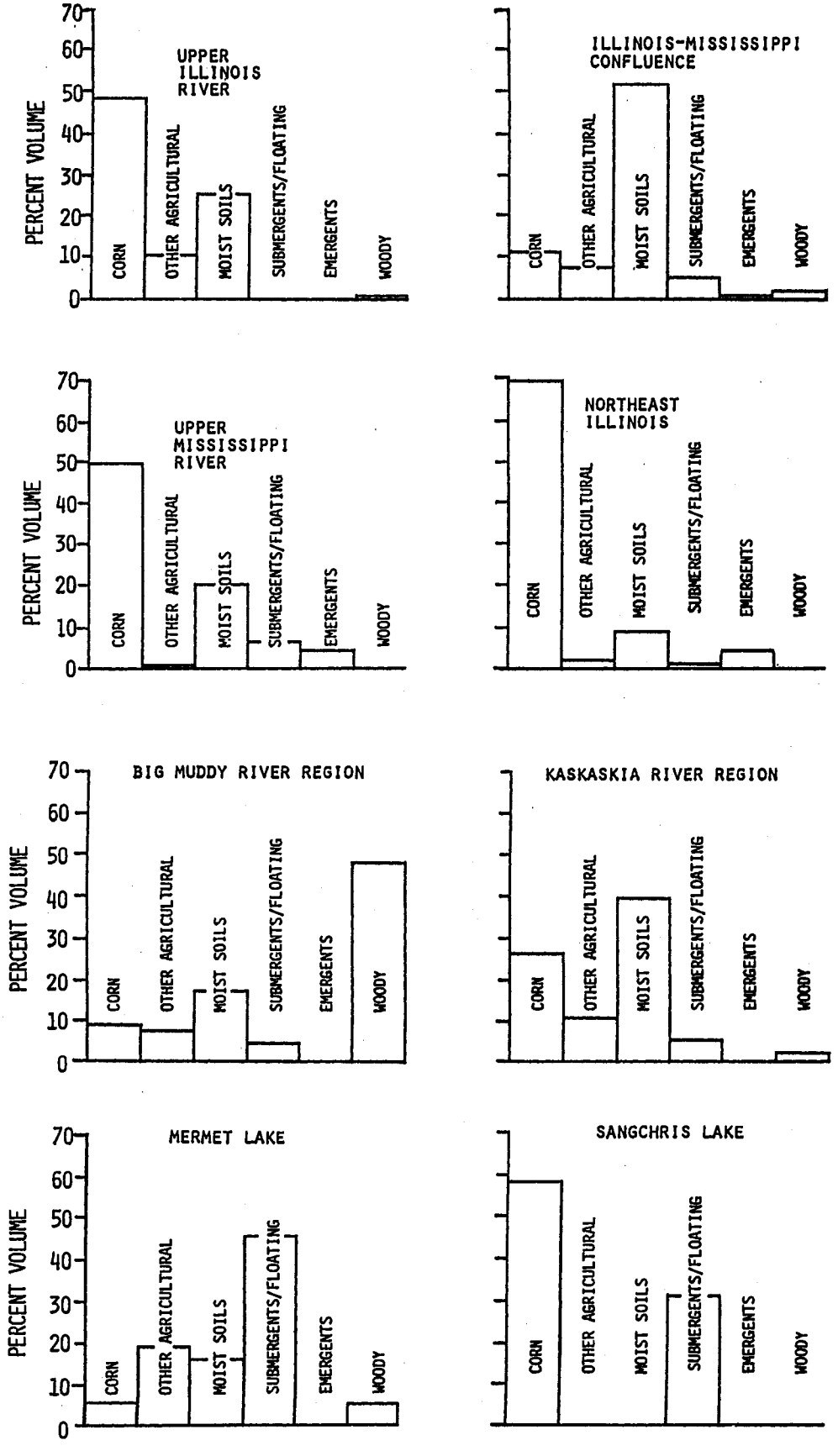

Figure 1-7. Average percent volume of mallard foods by classes for 6 regions and 2 locations in Illinois, 1979-1982.

habits would convey little information about the actual mallard diet in any given areas of the state.

Regional analyses of major food classes reflect availability of the various foods within that region. Use of corn was highest in the NEI region (69.78%) (Figure 1-7). Waterfowl habitat in the NEI region largely consists of remnant glacial lakes and potholes, many of which have experienced severe degradation from pollution. Most of the submergent and floating-leaved aquatic plants have disappeared, and management for moist-soil and cultivated waterfowl food plants is not widespread. Emergent plants, such as bulrushes, often dominate the shallow-water zones, and made up a higher percentage of the diet in NEI than any other region. The lack of other food resources apparently necessitates a high dependence on the availability of waste corn.

Corn comprised about half of the diet in both the UIR and UMR regions (Figure 1-7). Submergent, floating-leaved, and emergent aquatic plant foods were more prevalent in mallard gizzards from the UMR region. Many species of aquatic plants have all but disappeared from the UIR region as a result of sedimentation and other types of pollution (Bellrose et al. 1979). Use of natural moist-soil plant foods was slightly higher and other agricultural foods much higher in the UIR region. This is due to a greater number of public and private waterfowl areas which manage for moist-soil plants and flood agricultural crops in the UIR region.

In contrast to the UIR and UMR regions, corn comprised only 11.14% of the diet in the IMRC region, and moist-soil foods made up over half of the diet (Figure 1-7). The mallard diet in the IMRC region (Figure 1-5) also did not show an increasing use of corn as the season progressed as experienced in the UIR (Figure 1-3) and UMR (Figure 1-6) regions. This difference is probably more closely related to the abundance of natural foods in the IMRC region rather than the availability of corn. Although crop fields are more widespread in the UIR and UMR regions, all 3 regions are intensively farmed (Illinois Cooperative Crop Reporting Service 1982). These data suggest that natural foods, when available in sufficient quantity, may be preferred to corn. Likewise, increased use of corn later in the season in the UIR and UMR regions is probably due to a depletion of natural foods rather than a preference for an energetically more favorable food. If mallards consume a higher proportion of corn late in the season due to energy demands, the same trend should have been evident in the IMRC region as well. Drake (1970:113) studying mallard food habits on Eufola National Wildlife Refuge, Alabama, stated, "Mallards generally utilized the food item available in the largest quantity; however, they utilized preferred natural foods, when available during mild weather, even though corn was available in larger quantities."

Moist-soil foods also comprised the highest proportion of the mallard diet (39.36%) in the KR region (Figure 1-7). The

relatively high proportion of other agricultural foods (10.36%) was due primarily to plantings in sub-impoundments at Carlyle Lake.

In the BMR region, foods from woody plants, mainly pin oak acorns, received the highest use (47.66%) (Figure 1-7). Use of pin oak was high at both collection sites, Oakwood Bottoms green-tree reservoir and Rend Lake where pin oak flats are flooded in sub-impoundments along with natural moist-soil and agricultural food plants.

Sangchris Lake and Mermet Lake both exhibited high use of submergent and floating-leaved aquatic plants (Figure 1-7). Corn comprised the largest proportion of the diet at Sangchris Lake, and was the only other class of plant foods taken in appreciable amounts. Mermet Lake was the only site where submergent and floating-leaved aquatic plants were the most important class. The proportion of other agricultural foods at Mermet Lake (18.68%) was the highest recorded for any region. Plantings of milo, Japanese millet, and buckwheat on sub-impoundments at Mermet accounted for the high use. Both Sangchris and Mermet Lakes are relatively isolated from other areas of significant waterfowl habitat and this factor probably accounted for mallards being limited to food resources on or very near the lakes. The area surrounding Sangchris Lake is intensively row-cropped, whereas the vicinity around Mermet Lake is one of the lowest

corn-producing areas of the state (Illinois Cooperative Crop Reporting Service 1982).

Lesser Scaup

Of the 616 lesser scaup gizzards collected, 378 were from Pool 19 (Keokuk Pool) of the Mississippi River, 98 from Horseshoe Lake in Madison County, 75 from Collins Cooling Lake, 37 from Lake Michigan, 19 from Pool 16 and 5 from Pool 13 of the Mississippi River, and 4 from Calumet Lake (Figure 1-1).

Major foods of lesser scaup from Pool 19 (Table 1-15) were similar to those reported in previous studies for the Illinois and Mississippi rivers during 1938-1940 (Anderson 1959) and for Pool 19 during 1948 (Rogers and Korschgen 1966). Although lesser scaup are usually considered omnivorous feeders during the fall, this study and the 2 earlier investigations found animal matter to comprise about 90% of the diet. In this study, fingernail clams (Musculium sp., Sphaerium sp.) were the most important food items, collectively composing 42.77% of the total food volume, whereas snails made up 30.57%. Both previous studies reported snails to be the most important groups based on percent total volume. The proportion of these 2 groups of animals in the diet varied significantly on an annual basis. During the 4-year collection period, fingernail clams ranged from 15.63% in 1980 to 56.44% in 1981, while snails ranged from 24.32% in 1981 to 58.48% in 1980; each group was the major constituent of the diet during 2 of the 4 years (Table 1-16). The burrowing mayfly (Hexagenia

Table 1-15. Major fall foods (≥ 1% of total volume) of 378 lesser scaups from Pool 19, Mississippi River, 1979-1982.

Food Item	% Frequency	% Volume
Fingernail clam (*Musculium transversum*)	18.52	18.73
Unclassified snails (Gastropoda)	28.84	14.68
Unclassified fingernail clams (*Sphaerium* sp., *Musculium* sp.)	17.46	14.67
Fingernail clam (*Sphaerium striatinum*)	10.05	9.37
Freshwater snail (*Amnicola lustrica*)	19.05	8.15
Unclassified clams (Pelecypoda)	11.11	5.08
Unclassified mollusks (Mollusca)	11.38	5.00
Freshwater snail (*Viviparus* sp.)	8.99	3.59
Burrowing mayfly (*Hexagenia* sp.)	12.17	3.08
Freshwater snail (*Campeloma crassula*)	6.88	3.02
American bulrush (*Scirpus americanus*)	12.70	1.37
Leafy pondweed (*Potamogeton foliosus*)	12.70	1.29
Freshwater snail (*Lioplax* sp.)	3.44	1.13
Total plant		10.21%
Total animal		89.79%
$\bar{X}$ food vol./gizzard		1.33ml
$\bar{X}$ grit vol./gizzard		3.20ml

Table 1-16. Major fall foods (> 1% of total volume) of lesser scaups from Pool 19 on the Mississippi River during annual collection periods, 1979-1982.

Food Item	1979 N = 19		1980 N = 51		1981 N = 150		1982 N = 158	
	% Freq.	% Vol.	% Freq.	% Vol.	% Freq.	% Vol.	% Freq.	% Vol.
Unclassified snails (Gastropoda)	57.89	39.95	68.63	40.08	22.67	6.23	18.35	10.54
Burrowing mayfly (Hexagenia sp.)	68.42	23.81	23.53	3.23	2.00	0.05	11.39	4.17
Unclassified fingernail clams (Sphaerium sp., Musculium sp.)	26.32	16.23	33.33	15.63	21.33	17.49	7.59	7.77
Unclassified clams (Pelecypoda)	31.58	11.14	15.69	4.66	12.67	4.76	5.70	4.50
Leafy pondweed (Potamogeton foliosus)	21.05	2.30	9.80	0.21	7.33	0.58	18.35	3.21
Freshwater snail (Amnicola lustrica)	15.79	2.22	35.29	10.07	19.33	8.12	13.92	8.53
Freshwater snail (Viviparus sp.)	0	0	13.73	4.92	16.00	4.68	1.90	1.38
Unclassified mussels (Unionidae)	5.26	0.63	13.73	4.07	2.67	0.30	1.90	0.63
Unclassified mollusks (Mollusca)	5.26	0.95	7.84	3.61	15.33	5.79	9.49	5.21
Freshwater snail (Campeloma crassula)	10.53	0.44	13.73	3.41	7.33	3.94	3.80	1.51
American bulrush (Scirpus americanus)	26.32	0.30	17.65	3.06	13.33	0.97	9.49	1.42
Curlyleaf pondweed (Potamogeton crispus)	0	0	1.96	1.43	0	0	0.63	0.08
Fingernail clam (Musculium transversum)	10.53	0.32	0	0	23.33	23.91	20.89	23.94
Fingernail clam (Sphaerium striatinum)	0	0	3.92	0.18	20.67	15.04	3.16	5.45
Freshwater snail (Lioplax sp.)	0	0	0	0	6.00	1.35	2.53	1.63
Baby pondweed (Potamogeton pusillus)	5.26	0.10	1.96	0.05	3.33	1.18	1.27	0.17
Sago pondweed (Potamogeton pectinatus)	10.53	0.22	3.92	0.12	6.00	0.09	14.56	2.33
Great bulrush (Scirpus heterochaetus)	0	0	1.96	0.08	0	0	10.13	1.70
Freshwater snails (Pleurocera spp.)	5.26	0.32	9.80	0.59	2.00	0.29	3.80	1.54
Widgeongrass (Ruppia maritima)	0	0	1.96	0.08	1.33	0.02	12.03	1.26
Virginia wild rye (Elymus virginicus)	0	0	0	0	0	0	1.27	1.15
Water milfoil (Myriophyllum sp.)	31.58	0.24	9.80	0.18	7.33	0.32	14.56	1.05
Freshwater snails (Physa spp.)	0	0	0	0	0	0	1.27	1.03
Softstem bulrush (Scirpus validus)	21.05	0.16	5.88	0.25	15.33	0.36	17.72	1.02
Total plant		3.93%		8.11%		7.40%		18.89%
Total animal		96.07%		91.89%		92.60%		81.11%
$\bar{X}$ food vol./gizzard		1.66ml		1.52ml		1.77ml		0.80ml

sp.), was the only other animal food recorded as a principal food item during the 4-year period. Its use by scaup varied greatly from a low of 0.05% of the total food volume in 1981 to a high of 23.81% in 1979 when it ranked second (Table 1-16). The proportion of plant foods in the diet ranged from 3.93% in 1979 to 18.89% in 1982 (Table 1-16). The increased use of plant foods in 1982 resulted in higher diversity of principal food items.

The observed diet of lesser scaup at Horsehoe Lake in Madison County (Table 1-17) was a dramatic contrast to that found in Pool 19. Plant material comprised 67.33% of the diet and Japanese millet and junglerice were the most important foods. Lesser scaup were probably unsuccessful in locating sufficient food resources at this location as suggested by the facts that 28 food items each made up 1% or more of the diet, the average volume of food per gizzard was very low (0.49 ml), and some very hard seeds which do not occur on the area, such as widgeongrass, were present in relatively high proportions. The average grit volume per gizzard was also low (1.07 ml).

Food habits of lesser scaup from Collins Lake (Table 1-18) in northeastern Illinois reflected much the same conditions as those found at Horseshoe Lake. Although the aquatic insect, water boatmen, was the top food item, plants composed 80.39% of the diet and the average volume of food was the lowest of any location (0.47 ml per gizzard). Widgeongrass seeds were the

Table 1-17. Major fall foods (≥ 1% of total volume) of 98 lesser scaups from Horseshoe Lake, Madison County, Illinois, 1981-1982.

Food Item	% Frequency	% Volume
Japanese millet (Echinochloa frumentacea)	3.06	9.80
Junglerice (Echinochloa colonum)	1.02	7.34
Unclassified mollusks (Mollusca)	6.12	5.18
Unclassified mussels (Unionidae)	3.06	4.97
Unclassified snails (Gastropoda)	12.24	4.89
Common bur-reed (Sparganium androcladum)	9.18	4.16
Baby pondweed (Potamogeton pusillus)	8.16	4.00
Leafy pondweed (Potamogeton foliosus)	23.47	3.69
Water milfoil (Myriophyllum sp.)	13.27	3.69
Great bulrush (Scirpus heterochaetus)	13.26	3.60
Rice cutgrass (Leersia oryzoides)	1.02	3.46
Nodding smartweed (Polygonum lapathifolium)	12.24	3.44
Wheat (Triticum aestivum)	3.06	3.15
Unclassified clams (Pelecypoda)	7.14	3.11
Midge larvae (Chironomidae)	2.04	2.80
Unidentified fish parts (Osteichthyes)	2.34	2.34
Least naiad (Najas minor)	5.10	2.30
Duck potato (Sagittaria latifolia)	7.14	2.24
Bryozoan statoblasts (Pectinatella sp.)	4.08	2.12
Pondweed (Potamogeton praelongus)	2.04	1.70
Whirligig beetles (Gyrinidae)	3.06	1.70
Freshwater snails (Pleurocera spp.)	1.02	1.66
Floatingleaf pondweed (Potamogeton natans)	2.04	1.47
Fingernail clams (Sphaerium sp., Musculium sp.)	2.04	1.43
Longleaf pondweed (Potamogeton nodosus)	7.14	1.22
Widgeongrass (Ruppia maritima)	6.12	1.12
Largeseed smartweed (Polygonum pensylvanicum)	9.18	1.12
Softstem bulrush (Scirpus validus)	9.18	1.12
Total plant		67.33%
Total animal		33.67%
$\bar{X}$ food vol./gizzard		0.49ml
$\bar{X}$ grit vol./gizzard		1.07ml

Table 1-18. Major fall foods (≥ 1% of total volume) of 75 lesser scaup from Collins Lake, Grundy County, Illinois, 1981-1982.

Food Item	% Frequency	% Volume
Water boatmen (Corixidae)	4.00	8.82
Widgeongrass (Ruppia maritima)	8.00	7.96
Unclassified clams (Pelecypoda)	10.67	7.54
Slender naiad (Najas flexilis)	4.00	6.11
Duck potato (Sagittaria latifolia)	1.33	5.97
Leafy pondweed (Potamogeton foliosus)	34.67	5.75
Nodding smartweed (Polygonum lapathifolium)	12.00	5.57
Sago pondweed (Potamogeton pectinatus)	14.67	4.49
Algae	5.33	4.38
Softstem bulrush (Scirpus validus)	21.33	4.35
Largeseed smartweed (Potamogeton pensylvanicum)	12.00	3.73
Floatingleaf pondweed (Potamogeton natans)	2.67	3.64
Longleaf pondweed (Potamogeton nodosus)	10.67	3.21
Blackberry (Rubus sp.)	8.00	3.19
Baby pondweed (Potamogeton pusillus)	2.67	2.96
Water milfoil (Myriophyllum sp.)	13.33	2.76
Unclassified snails (Gastropoda)	6.67	2.36
Pondweeds (Potamogeton spp.)	2.67	1.62
Great bulrush (Scirpus heterochaetus)	9.33	1.51
Wheat (Triticum aestivum)	1.33	1.28
Total plant		80.39%
Total animal		19.61%
$\bar{X}$ food vol./gizzard		0.47ml
$\bar{X}$ grit vol./gizzard		2.80ml

second highest food item by volume (7.96%). This aquatic plant grows only in saline waters, and the very hard seeds were probably picked up prior to migration in alkaline areas of the prairie pothole region and retained in the gizzard. The average grit volume was 2.80 ml.

Similar to Pool 19, animal matter dominated the diet (83.54%) of lesser scaup collected from Lake Michigan (Table 1-19). The most important food item was the freshwater snail, Elimia livescens, and snails as a group composed 61.51% of the total food volume. Other important animal foods included caddisfly larvae (Hydropsyche sp.) and amphipods. The important plant foods eaten were leaves and stems of muskgrass and naiads. Samples from this area reflected the highest average volume of food (3.12 ml per gizzard) and grit (4.53 ml), suggesting an abundant food resource was available to migrating scaup.

Food habits of 28 lesser scaup collected from Pools 13 and 16 of the Mississippi River and Calumet Lake were similar to Pool 19 in that fingernail clams were the most important food item, but differed in other respects (Table 1-20). Plant foods accounted for 9 of the 17 principal food items and comprised 39.32% of the total food volume. Because the average food volume per gizzard was low (0.68 ml) and the sample size was small (28), this may not be an accurate representation of scaup foods at those locations. Principal food items not recorded from other

Table 1-19. Major fall foods (≥ 1% of total volume) of 37 lesser scaups from southwestern Lake Michigan, 1981-1982.

Food Item	% Frequency	% Volume
Freshwater snail (Elimia livescens)	40.54	36.73
Freshwater snail (Valvata sp.)	43.24	15.21
Muskgrass (Chara sp.)	21.62	12.56
Unclassified clams (Pelecypoda)	32.43	8.16
Freshwater snail (Pleurocera sp.)	5.41	6.57
Caddisfly larvae (Hydropsyche sp.)	13.51	6.36
Unclassified snail (Gastropoda)	24.32	3.00
Fingernail clams (Pisidium spp.)	16.22	2.76
Unclassified mollusks (Mollusca)	13.51	1.64
Naiad (Najas sp.)	10.81	1.60
Amphipods (Amphipoda)	10.81	1.31
Total plant		16.46%
Total animal		83.54%
$\bar{X}$ food vol./gizzard		3.12ml
$\bar{X}$ grit vol./gizzard		4.53ml

Table 1-20. Major fall foods (≥ 1% of total volume) of 28 lesser scaups from Pools 13 and 16 of the Mississippi River and Calumet Lake, 1981.

Food Item	% Frequency	% Volume
Fingernail clam (Musculium transversum)	3.57	23.60
Unclassified clams (Pelecypoda)	17.86	13.53
Unclassified snails (Gastropoda)	21.43	8.08
Duckweed (Lemna sp.)	7.14	8.08
Longleaf pondweed (Potamogeton nodosus)	21.43	6.71
Softstem bulrush (Scirpus validus)	21.43	6.03
Unclassified snails (Physa spp.)	3.57	5.77
River bulrush (Scirpus fluviatilis)	7.14	2.94
Unclassified mussels (Unionidae)	7.14	2.62
Unclassified fingernail clams (Sphaerium sp., Musculium sp.)	3.57	2.62
Pondweed (Potamogeton praelongus)	7.14	2.25
Common bur-reed (Sparganium androcladium)	3.57	2.10
Leafy pondweed (Potamogeton foliosus)	10.71	1.78
Freshwater snail (Elimia livescens)	3.57	1.73
Coontail (Ceratophyllum demersum)	3.57	1.42
American bulrush (Scirpus americanus)	7.14	1.26
Freshwater snail (Amnicola sp.)	3.57	1.05
Total plant		39.32%
Total animal		60.68%
$\bar{X}$ food vol./gizzard		0.68ml
$\bar{X}$ grit vol./gizzard		1.98ml

locations included duckweed, river bulrush, freshwater snails (Physa sp.), and coontail.

Wood Duck

Of the 265 wood duck gizzards collected during 1978-1983, 165 were from a commercial picker in Manito, 32 from Spring Lake, 27 from Rice Lake, 21 from Quiver Creek in Mason County, 5 from Oakwood Bottoms greentree reservoir, and 13 from Pool 13 and 2 from Pool 14 of the Mississippi River (Figure 1-1). Corn was the most prevalent food item occurring in 53.21% of the gizzards and comprising 57.43% of the total volume (Table 1-21). Anderson (1959) also reported corn to be the main food item of wood ducks in Illinois during 1938-1940 when it comprised 48.38% of the diet. Pin oak acorns, which ranked second, were the top food item at 2 locations and were a major food at 4 of the sites. Unclassified acorns ranked third and pin oak acorns fourth during 1938-1940 (Anderson 1959). Sweet (1976) found pin oak acorns to make up 87.22% of the total volume of wood duck foods at Oakwood Bottoms greentree reservoir in southern Illinois. Pin oaks undoubtedly replaced corn as the major staple of the wood duck diet in areas where it is readily available. Rice cutgrass ranked seventh during the current study and eighth during 1938-1940 (Anderson 1959). No other food item comprised 1% or more of the diet during both studies. It was notable that longleaf pondweed and coontail made up 10.76% of the diet in the earlier study, but no submergent or floating-leaved aquatic plants were

Table 1-21. Major fall foods (≥ 1% of total volume) of 265 wood ducks in Illinois, 1978-1983.

Food Item	% Frequency	% Volume
Corn (*Zea mays*)	53.21	57.43
Pin oak (*Quercus palustris*)	5.28	4.40
Water hemp (*Amaranthus tamariscinus*)	7.92	3.84
Gray dogwood (*Cornus racemosa*)	15.09	2.30
Giant foxtail (*Setaria faberi*)	4.53	1.98
Rice cutgrass (*Leersia oryzoides*)	11.32	1.78
Arrowhead (*Sagittaria calycina*)	1.88	1.66
Lady's thumb (*Polygonum persicaria*)	3.40	1.61
Buckwheat (*Fagopyrum esculentum*)	3.77	1.59
Marsh pepper smartweed (*Polygonum hydropiper*)	4.91	1.48
Giant bur-reed (*Sparganium eurycarpum*)	3.40	1.48
Hackberry (*Celtis occidentalis*)	1.89	1.26
Total plant		98.72%
Total animal		1.28%
$\bar{X}$ food vol./gizzard		2.08ml
$\bar{X}$ grit vol./gizzard		1.6ml

major foods in the current investigation because of the scarcity of those plants in the Illinois River valley where the majority of wood duck gizzards were collected during this study. Other principal food items during 1978-1983 were water hemp, gray dogwood, giant foxtail, arrowhead, lady's thumb, buckwheat, marsh pepper smartweed, giant bur-reed, and hackberry (Table 1-21). Seeds of gray dogwood, giant bur-reed, and hackberry, are very hard and their actual importance to wood ducks is probably somewhat less than indicated by their relative volume. However, these seeds were found broken up much more often in wood duck gizzards than in mallards, and the few intact seeds were well-worn, indicating that retention time for hard seeds may be less in wood ducks than in mallards.

Green-winged Teal

Green-winged teal gizzards were collected during 1978 and 1979 from Spring Lake (N=183) and Rice Lake (N=35), both along the Illinois River (Figure 1-1). The most important food item was red-rooted nutgrass, occurring in 55.05% of the gizzards and constituting 46.75% of the total volume (Table 1-22). Nutgrasses (Cyperus sp.) as a group accounted for 68.96% of the total food volume in green-winged teal. Red-rooted nutgrass was also the most important food item for green-winged teal in Illinois during 1938-1940 (Anderson 1959). Other principal food items during both studies were chufa, nodding smartweed, Walter's millet,

Table 1-22. Major fall foods (≥ 1% of total volume) of 218 green-winged teal in Illinois, 1978-1979.

Food Item	% Frequency	% Volume
Red-rooted nutgrass (Cyperus erythrorhizos)	55.05	46.75
Coarse nutgrass (Cyperus ferruginescens)	52.29	14.29
Arrowhead (Sagittaria calycina)	9.63	6.41
Unclassified nutgrass (Cyperus sp.)	17.43	5.01
Chufa (Cyperus esculentus)	9.63	2.91
Nodding smartweed (Polygonum lapathifolium)	41.74	2.15
Curlyleaf pondweed (Potamogeton crispus)	1.83	2.08
Unclassified insects (Insecta)	4.13	1.86
Muskgrass (Chara sp.)	3.21	1.69
Walter's millet (Echinochloa walteri)	4.59	1.61
Leafy pondweed (Potamogeton foliosus)	8.26	1.59
Water hemp (Amaranthus tamariscinus)	6.42	1.09
Rice cutgrass (Leersia oryzoides)	4.13	1.01
Total plant		96.89%
Total animal		3.11%
$\bar{X}$ food vol./gizzard		0.70ml
$\bar{X}$ grit vol./gizzard		0.5ml

water hemp, and rice cutgrass. While most of the major food items were small-seeded moist-soil plants, the seeds and vegetative parts of curlyleaf and leafy pondweeds and muskgrass were also important. Unclassified insects accounted for 1.86% of the total food volume and animal matter collectively comprised 3.11% of the diet. This was a higher proportion of animal matter than recorded for any of the other dabbling ducks during this investigation, but lower than the 15.04% reported by Anderson (1959).

It is noteworthy that all of the principal food items of green-winged teal were natural moist-soil and aquatic plants and animal matter. Even though Japanese millet was sown at both collection sites and was readily available, it was not utilized as a principal food item. Likewise, waste corn available from nearby agricultural fields was also unimportant. Bellrose et al. (1979) found a significant correlation between fall green-winged teal use-days and the abundance of wetland plants in the Illinois River valley. It seems apparent that sufficient natural wetland plant food resources is a critical factor in maintaining populations of green-winged teal in Illinois.

Blue-winged and Green-winged Teals

A combined sample of 164 blue-winged and green-winged teals was collected at Carlyle Lake (Figure 1-1) during the September teal season, 12-21 September 1981. The majority of the sample was from blue-winged teal which comprise approximately 80% of the harvest during teal season. Nodding smartweed was the most

important food, occurring in almost every gizzard examined (95.12%) and comprising 39.27% of the total food volume (Table 1-23). Junglerice was also a very important food, with a frequency of 54.88% and accounting for 34.23% of the total volume. Largeseed smartweed, which ranked third, occurred in more gizzards than junglerice (71.34%), but constituted only 8.52% of the diet. As a group, smartweeds (Polygonum sp.) and millets (Echinochloa sp.) accounted for 88.01% of all foods consumed. Three other foods, fall panicum, salt meadow grass, and caddisfly larvae, were recorded as principal items. By comparison, wild millet was the only major food item of blue-winged teal, and wild millet and nodding smartweed were the only foods of green-winged teal also reported by Anderson (1959). The fact that Anderson's (1959) samples were collected mainly from the Illinois River may account for many the observed differences. Although Japanese millet did occur as a major food item (1.87%), the teals' diet was dominated by natural foods similar to the situation observed for green-winged teal during the regular season (Table 1-22).

The fact that the percent frequency values of nodding and largeseed smartweeds were much higher than the percent volume (Table 1-23) indicates the seeds of smartweeds may be retained in the gizzards of teal for a longer period than the other major foods. However, if seeds of these common plants were ingested often, and they regularly constituted only a fraction of a

Table 1-23. Major foods (≥ 1% of total volume) of 164 teals during early teal season, 12-21 September 1981, at Carlyle Lake, Illinois.

Food Item	% Frequency	% Volume
Nodding smartweed (Polygonum lapathifolium)	95.12	39.27
Junglerice (Echinochloa colonum)	54.88	34.23
Largeseed smartweed (Polygonum pensylvanicum)	71.34	8.52
Wild millet (Echinochloa crusgalli)	18.90	4.12
Fall panicum (Panicum dichotomiflorum)	8.54	1.87
Japanese millet (Echinochloa frumentacea)	3.66	1.87
Salt meadow grass (Leptochloa fascicularis)	4.27	1.67
Caddisfly larvae (Trichoptera)	3.05	1.01
Total plant		98.34%
Total animal		1.66%
$\bar{X}$ food vol./gizzard		1.66ml
$\bar{X}$ grit vol./gizzard		0.6ml

complete feeding as suggested by Anderson (1959), the same situation would result. In reality, a combination of these 2 factors probably accounted for the observed frequency-volume relationship.

Redhead

A total of 39 redhead gizzards was collected from Pools 13 and 19 of the Mississippi River during 1980-1982. The redhead is generally considered largely vegetarian in the fall, with various studies reporting plant foods comprising 77.9-98.8% of the total food volume (Cottam 1939, Korschgen 1955, Anderson 1959, Quay and Critcher 1962, Stieglitz 1966). However, animal matter predominated in the food habits of redheads during this study accounting for 64.65% of the diet (Table 1-24). The animal portion of the diet was diverse with 6 different groups of invertebrates occurring as principal food items including midge larvae, fingernail clams, mayfly nymphs, dragonfly nymphs, snails, and caddisfly larvae. This differs from the largely molluscan diet of lesser scaups on the Mississippi River. Anderson (1959) also recorded midge larvae and caddisfly larvae as important redhead foods, but other animal foods were recorded in only minor amounts.

Plant foods of redheads were dominated by seeds and vegetation of 3 species of pondweeds which collectively made up 15.02% of the food volume. Other plant foods comprising 1% or more of the diet were duck potato, nodding smartweed, duckweed, coontail, and widgeongrass. As noted for lesser scaup, seeds of

Table 1-24. Major fall foods (≥ 1% of total volume) of 39 redheads in Illinois, 1980-1982.

Food Item	% Frequency	% Volume
Midge larvae (Chironomidae)	5.13	10.80
Fingernail clam (Musculium transversum)	10.26	9.77
Burrowing mayfly (Hexagenia sp.)	20.51	9.30
Dragonfly nymph (Aeshnidae)	10.26	7.97
Pondweed vegetation (Potamogeton sp.)	5.13	7.67
Unclassified snails (Gastropoda)	20.51	6.46
Duck potato (Sagittaria latifolia)	10.26	6.36
Fingernail clams (Sphaerium sp., Musculium sp.)	10.26	6.20
Caddisfly larvae (Trichoptera)	2.56	6.10
Nodding smartweed (Polygonum lapathifolium)	12.82	3.44
Leafy pondweed (Potamogeton foliosus)	15.38	3.26
Baby pondweed (Potamogeton pusillus)	15.38	2.83
Duckweed (Lemna sp.)	12.82	2.45
Coontail (Ceratophyllum demersum)	10.26	2.34
Freshwater snails (Viviparus spp.)	10.26	2.15
Sago pondweed (Potamogeton pectinatus)	15.38	1.26
Widgeongrass (Ruppia maritima)	5.13	1.12
Freshwater snail (Amnicola lustrica)	7.69	1.05
Unclassified mollusks (Mollusca)	7.69	1.00
Total plant		35.35%
Total animal		64.65%
$\bar{X}$ food vol./gizzard		1.47ml
$\bar{X}$ grit vol./gizzard		2.9ml

widgeongrass, which does not grow in Illinois, were apparently consumed prior to migration and retained in the gizzard. Important plant foods consumed by redheads during 1938-1940 on the Illinois and Mississippi rivers included pondweeds, coontail, wild millet, corn, marsh smartweed, softstem bulrush, and unclassified ragweeds (Anderson 1959).

Pintail

A total of 26 pintail gizzards was collected from Rice Lake and Spring Lake along the Illinois River, and 11 from Pools 12 and 13 of the Mississippi River during 1978-1981 (Figure 1-1). Corn was the most important food item, occurring in 10.91% of the gizzards and comprising 19.26% of the diet (Table 1-25). Vegetation and some seeds of the submergent aquatic plant, least naiad, ranked second and accounted for 14.07% of the food volume. Largeseed and nodding smartweeds ranked third and fourth and made up 13.89% and 9.08% of the diet, respectively; smartweeds as a group (4 species) comprised 28.7% of the total food volume. Other principal food items of pintails were leafy pondweed, Walter's millet, longleaf pondweed, marsh pepper smartweed, muskgrass vegetation, coarse nutgrass, marsh smartweed, chufa, duckweed, duck potato, rice cutgrass, and water hemp. Of the 16 principal food items observed during this study, 9 were also major foods of pintails during 1938-1940 (Anderson 1959), including rice cutgrass, corn, Walter's millet, marsh smartweed,

Table 1-25. Major fall foods (≥ 1% of total volume) of 37 pintails in Illinois, 1978-1981.

Food Item	% Frequency	% Volume
Corn (*Zea mays*)	10.81	19.26
Least naiad (*Najas minor*)	13.51	14.07
Largeseed smartweed (*Polygonum pensylvanicum*)	37.84	13.89
Nodding smartweed (*Polygonum lapathifolium*)	35.14	9.08
Leafy pondweed (*Potamogeton foliosus*)	27.03	7.48
Walter's millet (*Echinochloa walteri*)	16.22	5.69
Longleaf pondweed (*Potamogeton nodosus*)	13.51	3.63
Marsh pepper smartweed (*Polygonum hydropiper*)	2.70	3.17
Muskgrass (*Chara* sp.)	5.41	3.09
Coarse nutgrass (*Cyperus ferruginescens*)	13.51	2.81
Marsh smartweed (*Polygonum coccineum*)	2.70	2.56
Chufa (*Cyperus esculentus*)	5.41	1.99
Duckweed (*Lemna* sp.)	13.51	1.76
Duck potato (*Sagittaria latifolia*)	10.81	1.75
Rice cutgrass (*Leersia oryzoides*)	10.81	1.66
Water hemp (*Amaranthus tamariscinus*)	8.11	1.40
Total plant		99.28%
Total animal		0.72%]
$\bar{X}$ food vol./gizzard		1.79ml
$\bar{X}$ grit vol./gizzard		1.7ml

water hemp, chufa, longleaf pondweed, nodding smartweed, and duck potato.

Wigeon

During 1978-1981 nine wigeon gizzards were collected from Pool 13 of the Mississippi River, and 22 from Spring Lake and Rice Lake along the Illinois River (Figure 1-1). Corn was ranked first, comprising 27.38% of the total food volume, but this food occurred in only 2 of the 31 wigeon gizzards collected (Table 1-26). Corn may not typically be an important food item of wigeons in Illinois, although it occasionally may be consumed in large quantities in field feeding situations. Submerged and floating-leaved aquatic plants which generally compose the bulk of wigeon foods during the fall (Bellrose 1980) accounted for 40.43% of the diet during this study. Principal representatives of this group in descending order of importance were muskgrass, southern naiad, least naiad, leafy pondweed, longleaf pondweed, algae, and duckweed. In addition, unclassified vegetation occurred in 22.58% of the wigeon gizzards and made up 8.79% of the food volume; most of this material consisted of small bits of aquatic vegetation. Anderson (1959) reported that submerged and floating-leaved aquatic plants represented 77.80% of the wigeon diet in Illinois during 1938-1940. Several of the important aquatic plants were recorded during both studies. However, coontail, which comprised 69.91% of the food volume during 1938-1940, was not important in the current investigation. This favored aquatic plant is

Table 1-26. Major fall foods (≥ 1% of total volume) of 31 wigeons in Illinois, 1978-1981.

Food Item	% Frequency	% Volume
Corn (*Zea mays*)	6.45	27.38
Muskgrass (*Chara* sp.)	6.45	11.61
Southern naiad (*Najas guadalupensis*)	12.90	9.19
Least naiad (*Najas minor*)	3.23	7.66
Common cattail (*Typha latifolia*)	3.23	5.89
Duck potato (*Sagittaria latifolia*)	22.58	4.88
Leafy pondweed (*Potamogeton foliosus*)	6.45	4.84
Red-rooted nutgrass (*Cyperus erythrorhizos*)	3.23	3.10
Longleaf pondweed (*Potamogeton nodosus*)	12.90	2.86
Algae	3.23	2.66
American bulrush (*Scirpus americanus*)	6.45	2.10
Duckweed (*Lemna* sp.)	12.90	1.61
Nodding smartweed (*Polygonum lapathifolium*)	9.68	1.13
Coarse nutgrass (*Cyperus ferruginescens*)	9.68	1.13
Water striders (Gerridae)	3.23	1.01
Total plant		98.59%
Total animal		1.41%
$\bar{X}$ food vol./gizzard		0.80ml
$\bar{X}$ grit vol./gizzard		2.7ml

virtually absent from the Illinois River valley today. Although the sample size was small, it appeared that wigeon fed primarily upon aquatic vegetation in the Mississippi River valley, and primarily upon moist-soil plant seeds and secondarily on corn in the Illinois River valley.

Gadwall

Of the 22 gadwall gizzards collected, 12 were from Pool 13 of the Mississippi River and 10 from Spring Lake along the Illinois River (Figure 1-1). Vegetative parts and some seeds of submerged and floating-leaved aquatic plants comprised 69.67% of the total food volume (Table 1-27). The most important food item was least naiad, occurring in 27.27% of the samples and accounting for 29.13% of the diet. Sago pondweed ranked second by volume (15.49%), but occurred in only 1 gizzard. Other principal food items were duckweed, seeds of duck potato, water hemp seeds, unclassified pondweed vegetation, vegetation and seeds of leafy pondweed and coontail, seeds of Small's spike rush and softstem bulrush, and the seeds and rootstocks of rice cutgrass. Aquatic plants (mainly coontail) also formed the bulk of gadwall foods during 1938-1940 in Illinois (Anderson 1959). Based on this small sample of gizzards, gadwalls appear to be more dependent on aquatic plant food resources in the fall than any other species of duck investigated.

Table 1-27. Major fall foods (≥ 1% of total volume) of 22 gadwalls in Illinois, 1979-1981.

Food Item	% Frequency	% Volume
Least naiad (Najas minor)	27.27	29.13
Sago pondweed (Potamogeton pectinatus)	4.55	15.49
Duckweed (Lemna sp.)	27.27	14.47
Duck potato (Sagittaria latifolia)	36.36	9.18
Water hemp (Amaranthus tamariscinus)	4.55	7.42
Unclassified pondweeds (Potamogeton spp.)	4.55	4.64
Leafy pondweed (Potamogeton foliosus)	22.73	3.71
Coontail (Ceratophyllum demersum)	9.09	2.23
Small's spike rush (Eleocharis smallii)	4.55	1.86
Softstem bulrush (Scirpus validus)	22.73	1.67
Rice cutgrass (Leersia oryzoides)	9.09	1.11
Total plant		99.07%
Total animal		0.93%
$\bar{X}$ food vol./gizzard		0.49ml
$\bar{X}$ grit vol./gizzard		2.8ml

Ruddy Duck

Sixteen ruddy duck gizzards were collected from Pool 13 of the Mississippi River in 1981 (Figure 1-1). Few conclusions can be drawn from the sample because the total food volume per gizzard averaged only 0.18 ml (Table 1-28); 5 of the gizzards were devoid of food. Animal matter predominated in the samples, comprising 73.45% of the total food volume. Dragonfly nymphs of the family Aeshnidae occurred in 4 of the gizzards and accounted for 42.11% of the total volume. Other food items which made up 1% or more of the diet were duckweed, unclassified mayfly nymphs, amphipods, freshwater snails (Amnicola lustrica), midge larvae, fingernail clams, and water milfoil seeds. Fragments of unidentified aquatic vegetation comprised 14.04% of the food volume, and unidentified animal matter accounted for 2.81%. Animal matter, mostly midge larvae, constituted 76.67% of the food contents of 5 ruddy duck gizzards examined by Anderson (1959), but Bellrose (1980) reported plant foods to be the main food of ruddy ducks recorded by most investigators.

Ring-necked Duck

Eight ring-necked duck gizzards were collected from Pool 19, 6 from Pool 13, and 1 from Pool 14 of the Mississippi River during 1981-1982 (Figure 1-1). Plant foods constituted 94.28% of the diet (Table 1-29). Coontail was the top food item, accounting for 26.64% of the food volume, but it occurred in only 2 of the 15 gizzards. Coontail was also the most important food item

Table 1-28. Major fall foods (≥ 1% of total volume) of 16 ruddy ducks in Illinois, 1981.

Food Item	% Frequency	% Volume
Dragonfly nymphs (Aeshnidae)	25.00	42.11
Duckweed (*Lemna* sp.)	25.00	10.88
Unclassified mayfly nymphs (Ephemeroptera)	18.75	8.42
Amphipods (Amphipoda)	6.25	7.02
Freshwater snail (*Amnicola lustrica*)	6.25	5.26
Midge larvae (Chironomidae)	6.25	3.86
Fingernail clams (*Sphaerium* sp., *Musculium* sp.)	6.25	3.51
Water milfoil (*Myriophyllum* sp.)	25.00	1.40
Total plant		26.55%
Total animal		73.45%
$\bar{X}$ food vol./gizzard		0.18ml
$\bar{X}$ grit vol./gizzard		1.9ml

Table 1-29. Major fall foods (≥ 1% of total volume) of 15 ring-necked ducks in Illinois, 1981-1982.

Food Item	% Frequency	% Volume
Coontail (*Ceratophyllum demersum*)	13.33	26.64
Leafy pondweed (*Potamogeton foliosus*)	26.67	22.91
Water star grass (*Zosterella dubia*)	20.00	15.02
Duckweed (*Lemna* sp.)	33.33	11.97
Watershield (*Brasenia schreberi*)	13.33	3.46
American bulrush (*Scirpus americanus*)	6.67	3.46
Common bur-reed (*Sparganium androcladum*)	20.00	2.70
Longleaf pondweed (*Potamogeton nodosus*)	26.67	2.35
Softstem bulrush (*Scirpus validus*)	6.67	1.73
Burrowing mayfly (*Hexagenia* sp.)	6.67	1.73
Fingernail clams (*Sphaerium* sp., *Musculium* sp.)	6.67	1.52
Unclassified mollusks (Mollusca)	15.33	1.31
Total plant		94.28%
Total animal		5.72%
$\bar{X}$ food vol./gizzard		0.96ml
$\bar{X}$ grit vol./gizzard		1.7ml

reported by Anderson (1959), but animal foods represented a higher proportion of the diet (34.07%) than recorded from the small sample during this study. Other principal food items during the current study included leafy pondweed seeds and foliage, water star grass vegetation, duckweed, watershield seeds, American bulrush seeds, common bur-reed seeds, longleaf pondweed seeds, softstem bulrush seeds, burrowing mayfly nymphs, fingernail clams, and unclassified mollusks.

Canada geese

A total of 512 Canada goose gizzards was collected; 156 from Rend Lake during 1981-1982, 184 from Union County Conservation area during 1982, and 172 from Horseshoe Lake during 1982 (Figure 1-1). Winter wheat vegetation was the most important food item, occurring in 26.37% of the gizzards and comprising 25.79% of the total food volume (Table 1-30). Corn ranked second with similar values of frequency (26.17%) and volume (20.99%). Other important foods were blunt spike rush, nodding smartweed, white clover, Johnson grass, largeseed smartweed, fall panicum, barnyardgrass, wild millet, rice cutgrass, milo, buttonbush, American lotus, and nutgrasses. Care was taken to separate vegetative parts from seeds and these were recorded separately to determine which plant parts were more important. The stems, leaves, and rootstocks of principal food items collectively comprised 43.62% of the total food volume, and seeds accounted for 37.20%. Seeds and foliage of natural moist-soil plants

Table 1-30. Major fall and winter foods (≥ 1% of total volume) of 512 Canada geese in southern Illinois, 1981-1982.

Food Item	% Frequency	% Volume
Winter wheat veg. (Triticum aestivum)	26.37	25.79
Corn (Zea mays)	26.17	20.99
Blunt spike rush veg. (Eleocharis obtusa)	9.38	5.94
Unidentified grass veg. (Poaceae)	9.38	3.56
Nodding smartweed (Polygonum lapathifolium)	23.44	2.61
White clover veg. (Trifolium repens)	2.53	2.57
Unidentified veg. (other than grasses)	9.77	2.15
Unidentified rootstocks	4.49	2.15
Johnson grass (Sorghum halepense)	10.35	2.04
Largeseed smartweed (Polygonum pensylvanicum)	28.91	1.97
Fall panicum (Panicum dichotomiflorum)	20.51	1.75
Barnyardgrass (Echinochloa muricata)	4.10	1.53
Fall panicum veg. (Panicum dichotomiflorum)	2.93	1.44
Wild millet (Echinochloa crusgalli)	8.40	1.42
Rice cutgrass (Leersia oryzoides)	6.05	1.37
Milo (Sorghum bicolor)	4.69	1.25
Rice cutgrass veg. (Leersia oryzoides)	2.15	1.17
Buttonbush (Cephalanthus occidentalis)	11.52	1.15
American lotus (Nelumbo lutea)	1.95	1.12
Nutgrass veg. (Cyperus sp.)	2.54	1.06
Total plant		99.98%
Total animal		0.02%
$\bar{X}$ food vol./gizzard		6.72ml

including spike rush, smartweeds, millets, fall panicum, rice cutgrass, and nutgrasses comprised 20.26% of the total food volume. This is surprising considering the low availability of these food plants compared to that of agricultural foods which are intensively managed for geese on these sites.

Soybeans, which were the most important food item of Canada geese collected near Horseshoe Lake during 1953-1954 (Bell and Klimstra 1970), were not a principal item during the current study. Corn comprised a similar percentage of the food volume during the previous study (25.6%), but winter wheat comprised a much lower proportion of the diet (1.8%). Natural moist-soil plants were also used in lesser amounts during 1953-1954 (11.6%).

Black Scoter

Six black scoter gizzards were collected, 3 from Lake Michigan in 1980 and 3 from Collins Lake in 1981 (Figure 1-1). Two of the gizzards from Collins Lake contained no food and the other had only 0.1 ml of food. The 3 gizzards from Lake Michigan contained a total of 1.1 ml of food. Fragments of unidentified aquatic vegetation were present in 3 of the 4 gizzards containing food and constituted 49.17% of all food volume. Animal matter made up the remaining foods in the Lake Michigan sample, and included fingernail clams (Pisidium sp., 0.33 ml), freshwater snails (Valvata sp., 0.17 ml), and unclassified beetle parts (Coleoptera, 0.01 ml). The one gizzard with food from Collins Lake contained traces of seeds from 4 plants, longleaf pondweed,

curly dock, largeseed smartweed, and crabgrass. The average grit volume in all 6 gizzards was 1.2 ml. Bellrose (1980) reported that black scoter foods on the main wintering areas consist largely of molluscan fauna.

Shot Ingestion

The number of mallard gizzards containing ingested lead and steel shot was summarized by week of the hunting season for 9,300 gizzards collected throughout Illinois from 1979-1982 (Table 1-31). An overall ingestion rate of 4.9% occurred for lead shot and 1.2% for steel shot, for a total ingestion rate of 6.1%. Both the rate of ingested lead shot and steel shot remained somewhat consistent for each week of the hunting season with the rate of ingested lead shot varying between 4.0 and 5.9% and that for steel shot between 0.9 and 1.5%. No significant difference ($P>0.05$) occurred for the rate of ingestion of lead or steel shot between the weeks of the season. Thus, the risk of mallards ingesting shot was prevalent throughout the hunting season.

Table 1-31. Number and percentage of mallard gizzards with ingested lead and steel shot by week of hunting season in in Illinois, 1979-1982.

Week of hunting season	No. Gizzards Examined	Gizzards With Lead Shot		Gizzards With Steel Shot	
		No.	%	No.	%
1	443	20	4.5	4	0.9
2	1,389	56	4.0	17	1.2
3	1,277	65	5.1	12	0.9
4	1,236	63	5.1	15	1.2
5	1,148	64	5.6	15	1.3
6	1,274	69	5.4	18	1.4
7	978	48	4.9	7	0.7
8	541	32	5.9	8	1.5
Undated	1,014	36	3.6	18	1.8
Total	9,300	453	4.9	114	1.2

Summary

Illinois is a major migration area for waterfowl in the Mississippi Flyway. The last comprehensive study of the food habits of waterfowl during fall migration in Illinois was conducted in 1938-1940. Since then, the wetlands and croplands of the midwest have undergone dramatic changes.

During the hunting seasons of 1979-1982, 9,300 mallard gizzards were collected by weekly periods from 48 sites throughout Illinois. Emphasis was placed on the mallard because it comprises approximately 86% and 47% of waterfowl use in the fall of the Illinois and Mississippi rivers, respectively, and makes up about 50% of the Illinois duck harvest. The mallard gizzards were examined to determine (1) the principal foods used, (2) changes in food habits since 1940, (3) variation of major food items within the state, and (4) variation of food habits within and between years.

The researchers identified a variety of food items in the gizzard contents, including 300 plant species, 65 invertebrate taxa, and 1 vertebrate group. Examination of food habits indicated that the Illinois River region and Mississippi River region bordering central Illinois had similar use by mallards of corn (48% and 49% by aggregate volume, respectively). Corn is generally available to mallards as waste grain in agricultural fields or on areas managed for waterfowl. The volumes of moist-soil plant seeds were also similar in gizzards collected from the

Illinois River (25.1%) and the Mississippi River (20.9%). Moist-soil plants are naturally occurring annual plants that become established on exposed mud flats during the summer months. There were some striking differences, however, in diets of mallards utilizing the Mississippi and Illinois river valleys. Managed or cultivated agricultural foods, such as buckwheat, Japanese millet, and milo represented 10.5% of the diet on the Illinois River as compared to only 1.3% for the Mississippi. In contrast, submergent and emergent aquatic plants such as coontail and pondweeds were more prevalent in mallard gizzards from the Mississippi River (10.1%) than in those collected from the Illinois Valley (trace). These differences can be explained by the virtual elimination of aquatic plants from the Illinois River as a result of sedimentation and its devastating effects on aquatic communities during the past three decades. The degradation of the aquatic habitat via sedimentation has not been as severe in the Mississippi River. Consequently, aquatic plants are still common among mallard diets in the Mississippi River valley, but they have been replaced in the diets of mallards frequenting the Illinois River by cultivated agricultural foods provided by private and public managed waterfowl areas.

Similar results appeared when the mallard food habits from the Illinois River valley were compared between 1938-1940 and 1979-1982. During both periods corn was the leading food item

(48% during both periods) followed by moist-soil plants (24% vs 25%, respectively). However, the managed agricultural foods of Japanese millet, buckwheat, and milo did not occur in the mallard diets of 1938-1940 whereas aquatic plants represented 15% of the diet. In 1979-1982, managed agricultural foods represented 10.5% of the diet of mallards and aquatic plants were essentially non-existent. Migrant mallard populations utilizing the Illinois Valley are now heavily dependent upon waste grain or managed foods while increasing their body reserves before resuming their southward trek toward wintering areas.

Analyses of mallard diets also uncovered another interesting finding. Generally the amount of corn in the diet increased during the fall in most regions of Illinois. For example, the percentage of corn in the diet increased from an average of about 35% in late October in the Illinois Valley to about 65% by early December. Corn contains a high percentage of carbohydrates and, therefore, is relatively high in energy content, but many natural foods provide similar caloric values. However, a large amount of corn can usually be eaten quickly and satisfy mallards' energy requirements in a short period of time. The late season switch to corn did not occur in the diet of mallards utilizing the confluence region of the Illinois and Mississippi rivers. In the confluence region, seeds of moist-soil plants made up approximately 50% of the diet throughout the fall while corn consisted of only about 10%. Apparently natural vegetation was

so abundant in this region that mallards did not utilize corn to the same degree as in other areas of Illinois. This finding might provide some insight into the diet of mallards in mid-latitude migration areas before corn was cultivated in presettlement times. Perhaps corn is replacing acorns and other mast that is no longer available to mallards as it once was in the vast expanse of timber that graced the bottomlands.

In addition to the extensive sample of mallard gizzards analyzed for food habits in Illinois, gizzard samples from 14 other waterfowl species were also examined for food habits. The species and number of samples examined are as follows: Canada goose 512, lesser scaup 616, wood duck 265, green-winged teal 218, redhead 39, pintail 37, wigeon 31, gadwall 22, ruddy duck 16, ring-necked duck 15, black scoter 6. A sample of 164 teal, blue-winged and green-winged combined, from a September teal season was also examined.

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Appendix 1-1. Percent of total volume for all mallard foods identified in gizzard samples collected in Illinois, 1979-1981, summarized by region.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
ANIMALS									
Acrididae	grasshoppers	0.02	T			0.01			
Amnicola lustrica	snail		T[a]						
Amphipoda	amphipods	0.02	0.01	0.44		0.22	0.23		
Anisoptera	dragonflies	0.02	T	0.05		0.01	0.08		0.08
Araneae	spiders	T		T					T
Carabidae	ground beetles	T		T		0.02	0.05		0.02
Chironomidae	midges	0.01		T		T			
Coccinellidae	lady beetles	T							
Coleoptera	beetles	0.04	0.01	0.01		T	0.02		0.07
Corixidae	water boatmen	0.05	0.03	0.09		T	0.03	0.01	
Curculionidae	snout beetles	0.01	0.01	0.01			0.03		
Decapoda	crayfish	0.10	0.02	0.02		T		0.06	0.14
Diptera	flies (pupae or cases)	0.01	0.01	0.02	T	T	T		
Dytiscidae	predaceous diving beetles	T				T	0.03		
Ephemeroptera	mayflies	T		T			T		
Formicidae	ants	0.01	T	0.01					
Gastropoda	snails	T	T		T	T	0.01	T	
Gerridae	water striders	T	T						
Gyrinidae	whirligig beetles	T				0.02			
Haliplidae	crawling water beetles	T		T		T	T	T	
Hemiptera	true bugs	T	0.04	0.01	0.31	T	0.12	0.09	0.10
Homoptera	leafhoppers	T							
Hydrophilidae	water scavenger beetles	T	0.02	T	0.05		0.01		
Hymenoptera	bees, wasps	T							
Insecta	insects	0.07	0.04	0.01	0.05	0.01	0.17	0.17	T
Lepidoptera	butterflies	T							
Lymnaea spp.	snails	0.01	T	0.01			0.03		

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
N/A[b]	unidentified fish parts	0.06	0.05	0.04		0.02			
N/A	unidentified animal matter	0.01	0.09	0.02		0.02	0.04	0.02	0.04
Neoplea striola	pygmy backswimmer								T
Neuroptera	lacewings	T							
Notonectidae	backswimmers	T		0.02		T			0.01
Odonata	dragonflies, damselflies	T						0.02	0.01
Orthotrichia spp.	caddisflies			0.01					0.77
Ostracoda	ostracods	0.06	0.04			0.35			
Pectinatella magnifica	bryozoan (statoblasts)	0.03	T	0.01		0.08	0.05		0.01
Pelecypoda	bivalve mollusks	T	T	T	T	T			0.01
Pentatomidae	stink bugs	T	0.01	0.01		0.01	0.01	0.17	
Physidae	snails	0.02	0.04	0.02	T	0.01	T	0.09	0.01
Planorbidae	orb snails	T	0.01		0.01			T	0.01
Pleurocera spp.	snails	0.01							
Sphaerium spp.	fingernail clams						0.01		
Stratiomyidae	soldier flies		T						
Tetrigidae	pygmy locusts	T							
Trichoptera	caddisflies	0.05	T	T		0.52	0.01		T
Viviparus spp.	snails		T	0.01		0.01	0.06		
Zygoptera	damselflies	T	0.01						0.52
PLANTS									
Abutilon theophrastii	velvetleaf	0.10	0.02	0.06	0.02	0.01		0.03	T
Acalypha rhomboidea	three-seeded Mercury	T							
Alisma plantago-aquatica	water plantain		0.06				0.02		
Amaranthus hybridus	green pigweed	0.02	T						
Amaranthus retroflexus	rough pigweed	0.56	0.02			0.17		0.02	0.04
Amaranthus tamariscinus	water hemp	0.48	0.21		T	0.07			
Amaranthus spp.	pigweeds	0.01				T			

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
Ambrosia artemisiifolia	common ragweed	0.04	0.21	0.05	0.01	0.11	0.33	0.01	T
Ambrosia trifida	giant ragweed	1.41	2.74	1.62	0.05	0.08	0.67	0.43	T
Ammannia coccinea	long-leaved Ammannia								1.29
Ampelopsis cordata	peppervine	T	0.02	0.01		0.10	0.10		
Andropogon virginicus	broom sedge		T					T	
Aralia spp.	spikenards								T
Asclepias incarnata	swamp milkweed	0.01		T					T
Asclepias spp.	milkweeds	T	0.01	T					
Bidens cernua	nodding bur marigold	T		0.05	0.09				
Bidens comosa	common beggar-ticks	0.21	0.63	0.20	0.01	0.18	2.17	0.04	3.67
Bidens connata	swamp beggar-ticks						0.50		
Bidens coronata	tall swamp marigold		0.26	0.02			0.81		
Bidens discoidea	swamp beggar-ticks						0.30		
Bidens frondosa	devil's beggar-ticks		0.12				1.40		
Bidens spp.	beggar-ticks	0.02	0.34	0.14	0.05	0.01	2.66		0.58
Boehmeria cylindrica	false nettle	0.01	0.06	T		T	0.05		
Brasenia schreberi	watershield	0.01	T	0.01	T	0.10	0.02		0.01
Bromus spp.	brome grasses		0.01						
Calystegia sepium	American bindweed	T							
Cannabis sativa	marijuana	0.03							
Carex annectens	yellow-fruited sedge	T	T	0.21		T			T
Carex atherodes	awned sedge					T			
Carex cristatella	crested sedge	T	T						T
Carex crus-corvi	raven's-foot sedge						0.01		
Carex debilis	white-edged sedge	T	0.02	T					
Carex frankii	Frank's sedge	T	T			0.02		0.01	
Carex hirsutella	hirsute sedge	T							
Carex lupuliformis	hop-like sedge	T	T	T			0.22		
Carex lupulina	hop sedge	T	0.02	0.01		T	0.18	0.01	0.01
Carex lurida	sallow sedge	0.06	0.12	0.06	T	0.01	0.39	T	T

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
Carex muhlenbergii	Muhlenberg's sedge						T		
Carex squarrosa	squarrose sedge						T		
Carex tribuloides	blunt broom sedge	T	0.32	0.43		T	0.17		T
Carex typhina	sedge		T	0.01					
Carex vulpinoidea	fox sedge	T	T	0.01			T		
Carex spp.	sedges	0.01	T	0.02	T	0.01	0.01	T	
Carpinus caroliniana	blue beech								T
Cassia nictitans	partridge pea		0.12	0.04					
Ceanothus americanus	New Jersey tea		T						
Celtis laevigata	sugarberry		0.03	0.01		0.12			0.09
Celtis occidentalis	common hackberry	0.03	T	0.12		0.01	0.01		
Cephalanthus occidentalis	buttonbush	1.14	1.75	0.57	T	2.02	7.21	0.12	4.55
Ceratophyllum demersum	coontail	0.10	0.21	1.05	0.16	0.47	1.12	0.15	0.17
Chamaesyce maculata	nodding spurge	T	T						
Chara spp.	muskgrasses	0.04	0.07		0.22	1.15			0.02
Chenopodium album	lamb's quarters	0.01	0.03	0.01					T
Cirsium arvense	Canada thistle			T					
Cladium mariscoides	twig rush	T	0.01	T	T	0.01	0.02	T	
Commelina virginica	day flower	0.04	0.01				0.01		
Cornus florida	flowering dogwood		T						
Cornus obliqua	pale dogwood	0.01	T	T					
Cornus racemosa	gray dogwood	0.25	0.42	0.45	0.01	0.04	0.03	0.16	0.12
Crataegus spp.	hawthorns	0.02	0.20	0.04	0.33	0.12	0.09	0.08	0.05
Cuscuta spp.	dodders	0.06	0.29	0.02	0.05	0.13	0.12	T	0.33
Cyperus erythrorhizos	red-rooted nutgrass	0.38	0.93	0.32		0.13	T		
Cyperus esculentus	tubers of chufa	3.45	1.36	0.52	0.27	1.01	0.88	0.04	0.06
Cyperus esculentus	chufa	1.19	0.12	0.09	T	0.07	0.01		0.04
Cyperus ferruginescens	coarse nutgrass	1.79	0.39	0.01		0.08	0.08	T	
Cyperus rivularis	shining nutgrass	T							
Cyperus schweinitzii	nutgrass						0.06		

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
Cyperus strigosus	straw-colored nutgrass	T	0.09	T		T	0.07		T
Cyperus spp.	nutgrasses	T	0.04	0.08					
Datura stramonium	Jimsonweed	T	T					T	
Decodon verticillatus	water willow	T					0.43		0.04
Digitaria filiformis	slender crabgrass	0.02	T	T		0.03	T		
Digitaria ischaemum	smooth crabgrass						0.07		
Digitaria sanguinalis	common crabgrass	0.02	0.15	T		0.02	0.18	T	
Dulichium arundinaceum	three-way sedge	T		T		T			
Echinochloa colonum	junglerice	0.03	0.02	0.03	0.02	1.27			
Echinochloa crusgalli	wild millet	2.30	3.07	1.89	0.80	4.95	1.66	0.04	4.83
Echinochloa frumentacea	Japanese millet	4.93	5.87	0.68	0.38	7.66	1.47		9.34
Echinochloa muricata	barnyardgrass	0.01	0.39	0.02		0.08	0.49	0.06	
Echinochloa walteri	Walter's millet	3.09	0.29	0.01	T	T		T	
Echinochloa spp.	millets	0.45	0.68	T	0.12	0.33	0.10	0.08	1.44
Eclipta alba	Yerba de Tajo						T		
Eleocharis albida	white spike rush	T							
Eleocharis obtusa	blunt spike rush	0.06	0.20	0.02	0.02	0.15	0.01	T	0.12
Eleocharis smallii	Small's spike rush	0.14	0.27	0.22	0.20	0.22	0.10	T	
Eleusine indica	goose grass	T	T						
Ellisia nyctelea	Aunt Lucy	T							
Elodea sp.	waterweed	0.02		T	0.17	0.01			
Elymus virginicus	Virginia wild rye	0.05	0.01	0.11					
Elymus spp.	wild rye	T			T				
Eragrostis hypnoides	teal grass	0.01	T			0.01			
Euphorbia dentata	toothed spurge		T						
Fagopyrum esculentum	buckwheat	3.91	0.01		1.68	0.12	0.41	0.05	2.42
Fragaria virginiana	wild strawberry	T							
Galium aparine	goosegrass	T							
Geranium carolinianum	wild cranesbill		T					T	T
Glycine max	soybean	0.11	0.23	0.23		0.03	0.01	0.07	0.35

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
Gratiola neglecta	clammy hedge hyssop	T							
Heliotropium indicum	Indian heliotrope					T	0.01		2.20
Hibiscus militaris	marsh mallow	0.04	0.04	T			0.07		T
Hibiscus trionum	flower-of-an-hour	0.01	0.03	T	T			T	
Hippuris vulgaris	mare's-tail			0.01					
Ilex decidua	swamp holly	0.01	0.33	T		0.02	0.21		0.15
Ipomoea hederacea	ivy-leaved morning-glory	0.03	0.07	T		0.04	0.10	0.01	0.03
Ipomoea lacunosa	small white morning-glory		T				T		
Ipomoea pandurata	wild sweet potato vine						0.01		
Ipomoea spp.	morning-glories						T		
Iva annua	marsh-elder		0.04	0.01		T	0.01		
Juniperus virginiana	red cedar	T				T			
Jussiaea repens	creeping water primrose	0.27	3.41	0.83		0.41	0.62		0.17
Leersia lenticularis	catchfly grass	0.20		0.02		T	0.47		
Leersia oryzoides	rice cutgrass	5.46	14.44	9.12	5.04	7.53	1.81	0.35	0.59
Leersia virginica	white grass	0.09		T		T	T		
Leersia spp.	cutgrasses	0.01							
Lemna spp.	duckweeds	0.25	1.08	2.41	0.71	1.37	1.85		0.39
Leptochloa fascicularis	salt meadow grass	0.13	0.33	0.15					
Lippia lanceolata	fog-fruit	0.04	0.02	T		0.01	0.06		0.02
Liquidambar styraciflua	sweet gum						0.05		
Lithospermum arvense	corn gromwell		T						
Ludwigia palustris	marsh purslane			T					
Maclura pomifera	osage orange	0.03							
Malva neglecta	common mallow							T	
Melilotus officinalis	yellow sweet clover	T							
Myriophyllum spp.	water milfoils	0.10	0.38	0.34	1.30	0.75	0.09	T	0.18
N/A	algae	0.43	0.72	0.80	0.73	1.58	0.34	0.18	0.01
N/A	unidentified rootstocks	0.60	0.79	0.44	0.20	0.62	0.19	0.59	0.01
N/A	unidentified vegetation	2.01	2.77	2.51	4.17	1.57	1.22	1.31	0.64

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
N/A	unidentified tubers	0.11	0.01	0.62					
Najas flexilis	slender naiad				T				
Najas gracillima	thread-like naiad		0.13	0.03					
Najas quadalupensis	southern naiad	0.22	0.12	0.35	0.25	0.35		0.53	44.78
Najas minor	least naiad	0.09		1.44		0.03	0.22	21.03	
Najas spp.	naiads	0.09	0.07	0.32		0.04	0.08	1.20	
Nelumbo lutea	American lotus	0.06	0.06	0.14		0.05	0.06	0.62	0.77
Nuphar luteum	yellow water lily	T					0.11		
Nymphaea tuberosa	white water lily	0.10							
Nyssa sylvatica	sour gum		T						0.25
Oryza sativa	rice					0.18	0.12		
Panicum capillare	witchgrass	0.14	0.03		0.01	0.02			T
Panicum dichotomiflorum	fall panicum	1.88	1.36	0.83	0.02	3.63	1.46	T	0.01
Panicum miliaceum	proso	0.01							
Panicum rigidulum	red-top panicum		0.07				0.01		
Panicum spp.	panicums	T							
Parthenocissus quinquefolia	Virginia creeper	T	T						0.01
Paspalum ciliatifolium	fringeleaf bead grass		T					0.16	
Paspalum laeve	field bead grass					0.02	0.03		
Paspalum spp.	bead grasses		0.01						
Phalaris arundinacea	reed canary grass			T	0.06				
Physalis virginiana	ground cherry					0.02			
Phytolacca americana	pokeweed	T	T			T			0.02
Pilea pumila	Canada clearweed	T							
Plantago cordata	heartleaf plantain		T						
Polanisia dodecandra	clammyweed	T							
Polygonum aviculare	knotweed	T	0.01	0.01			T		
Polygonum coccineum	marsh smartweed	0.38	0.58	0.17	0.11	0.33	0.01	0.05	0.27
Polygonum convolvulus	black bindweed	T	T	T					
Polygonum hydropiper	marsh pepper smartweed	0.27	1.13	1.49	0.46	2.49	1.27	0.30	

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
Polygonum hydropiperoides	swamp smartweed	0.19	3.13	0.35	0.68	0.09	0.21	0.01	0.33
Polygonum lapathifolium	nodding smartweed	1.18	12.15	1.63	2.01	10.46	1.04	0.50	1.25
Polygonum pensylvanicum	largeseed smartweed	3.25	12.32	3.25	1.13	8.02	3.12	0.46	1.38
Polygonum persicaria	lady's thumb	0.05	0.04	0.08	0.65	0.19	0.36	T	T
Polygonum punctatum	dotted smartweed	0.14	0.19	0.16		0.42	0.01		
Polygonum sagittatum	arrowleaf tear thumb	T							
Polygonum scandens	false buckwheat	0.04	0.04	0.02		0.19	T		
Polygonum spp.	smartweeds	0.02	0.01	T		0.01			
Pontederia cordata	pickerelweed	0.06							0.25
Populus deltoides	cottonwood				0.04				
Portulaca oleracea	purslane	T				T			
Potamogeton epihydrus	ribbonleaf pondweed			T					
Potamogeton foliosus	leafy pondweed	0.40	0.50	0.42	0.86	0.68	0.01	0.14	0.30
Potamogeton natans	floatingleaf pondweed	0.05	0.04	0.10		0.13	0.03		
Potamogeton nodosus	longleaf pondweed	0.31	0.55	1.50	0.10	0.84	0.17	9.51	0.07
Potamogeton pectinatus	sago pondweed	0.31	0.49	0.70	0.80	0.34	0.02	T	0.01
Potamogeton praelongus	whitestem pondweed		T						
Potamogeton pulcher	pondweed		T						
Potamogeton pusillus	baby pondweed	0.05	0.14	0.07	0.24	0.01	0.01	0.04	0.03
Potamogeton spp.	pondweeds	0.08	0.02	0.24		0.13			T
Proserpinaca palustris	mermaidweed	0.01		T	0.01		0.04		
Prunella vulgaris	self-heal						0.02		
Prunus serotina	wild black cherry	T		0.03		T		T	
Prunus spp.	cherries	T	0.03	T	0.02				
Quercus palustris	pin oak	0.08	0.87	0.27		0.54	36.33		
Quercus spp.	oaks	0.03	0.31	0.50	0.01	0.37	4.12		0.03
Ranunculus septentrionalis	swamp buttercup	T							
Rhus copallina	dwarf sumac	T	T	T					
Rhus glabra	smooth sumac	T	0.02	T		0.01	0.05	T	0.01
Rosa multiflora	multiflora rose	T	T	0.01	0.02				

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
Rubus strigosus	red raspberry				T				0.03
Rubus spp.	blackberries	T	0.01	0.02	T	0.04	0.01	0.02	0.01
Rudbeckia hirta	black-eyed susan	T	T			0.01	0.02		T
Rumex altissimus	pale dock	0.02	0.01	0.08		T	0.01		
Rumex crispus	curly dock	T	T	T	T	0.27			T
Rumex patientia	patience dock		T						
Rumex spp.	docks	T	T						
Sagittaria latifolia	duck potato	0.52	0.46	1.12	0.04	0.19		0.02	0.01
Sagittaria platyphylla	delta duck potato					T			
Sagittaria spp.	arrowheads		0.01						
Sambucus canadensis	elderberry	0.01							
Saururus cernuus	lizard's-tail						T		
Scirpus acutus	hardstem bulrush	0.07	0.01	0.02	0.13	T		T	
Scirpus americanus	American bulrush	0.13	0.58	0.17	0.31	0.03	T	0.05	T
Scirpus atrovirens	common bulrush	T							
Scirpus fluviatilis	river bulrush	0.32	0.29	1.25	1.94	0.07	0.03	0.05	0.03
Scirpus heterochaetus	great bulrush				T				
Scirpus validus	softstem bulrush	0.43	1.27	1.26	1.05	0.73	0.04	0.43	0.04
Scirpus spp.	bulrushes	0.01	0.21	0.07	0.10	0.21		0.22	
Scutellaria lateriflora	mad-dog skullcap							T	
Setaria faberi	giant foxtail	0.49	0.45	1.97	0.14	0.29	0.70	0.04	
Setaria lutescens	yellow foxtail	T	0.18	0.22	0.01	0.02			
Setaria verticillata	bristly foxtail	0.01		T	T	T	0.02		
Setaria viridis	green foxtail	T	T	T					
Setaria spp.	foxtails	0.01							
Sicyos angulatus	bur cucumber	0.12	0.01						
Sida spinosa	prickly sida	0.06	0.32	0.05	T	0.11	0.07	0.01	0.04
Smilacina racemosa	false Solomon's seal	T							
Solanum americanum	black nightshade	T	T			0.02	T		
Solanum carolinense	horse-nettle	T							

Appendix 1-1 continued.

Animal and Plant Taxa	Common Name	Upper Ill. River	Ill. Miss. River Confl.	Upper Miss. River	NE Illinois	Kaskaskia River	Big Muddy	Lake Sangchris	Mermet
Solidago canadensis	goldenrod					T			
Sorghum bicolor	milo	1.74	0.16	0.02	T	2.70	4.63	0.20	6.92
Sorghum halepense	Johnson grass	0.02							
Sorghum spp.	sorghums	T	T						
Sparganium americanum	American bur-reed	T		0.01		0.01			
Sparganium androcladum	common bur-reed	0.21	0.11	0.37	0.15	0.31	0.71	0.14	0.33
Sparganium eurycarpum	giant bur-reed	0.49	0.39	0.58	1.24	0.39	0.46	0.45	0.44
Sparganium spp.	bur-reeds	0.01							
Spirodela polyrhiza	giant duckweed	0.07	0.93	0.67		1.10	1.56		0.18
Sporobolus spp.	dropseeds		T						
Symphoricarpos orbiculatus	coralberry		0.04	T					
Thlaspi arvense	field penny cress				T				
Toxicodendron radicans	poison ivy	0.02	0.07	0.01		0.09	0.29	T	0.02
Trifolium pratense	red clover	T	T	0.01	0.01	0.03		T	
Triticum aestivum	wheat	0.47	1.34	1.34	0.22	0.91	0.27	0.20	
Utricularia spp.	bladderworts					0.04			
Verbena bracteata	creeping vervain							0.01	
Verbena hastata	blue vervain	T	T	T		T	0.01	T	
Vitis riparia	riverbank grape	0.20	0.11	0.17	0.01	0.14	0.10	0.01	0.03
Vitis spp.	wild grapes	0.01	0.07						
Xanthium strumarium	common cocklebur		T						
Zannichellia palustris	horned pondweed	0.01				0.07		0.85	
Zea mays	corn	47.97	11.14	48.95	69.78	26.29	8.36	58.25	6.33

[a] Trace, <0.01.
[b] Not applicable.

Appendix 1-2. Energy (cal/g) and nutritional characteristics (% dry weight) of seeds found in waterfowl gizzards.

Plant Species	Gross Energy (cal/g)	Percentage								
		Fiber	Fat	N. free extr. (Carbohydrate)	Protein	Ash	P	Ca	N	K
Abutilon theophrastii	5,029									
Amaranthus retroflexus	4,623	21.29	2.66	43.21	22.06	10.75	0.60	1.72	3.53	2.36
Amaranthus sp.	4,165	8.1; 25.1	0.7; 18.7	50.3; 51.6	14.4; 17.9	4,6; 7.9	0.36; 0.67	0.17; 0.45		
Ambrosia artemisiifolia	5,286; 5,360									
Ambrosia trifida	(H)5,802[a]									
Bidens frondosa	5,177	20.8	18.0		23.5	5.6				
Bidens sp.	5,140; 5,180									
Carex lanuginosa		31.1	4.7	47.6	11.1	5.5				
Carex strigosus	3,686									
Carex tribuloides		20.2	5.4		9.63	7.9				
Carex sp.	4,788									
Cephalanthus occidentalis		46.9	6.7	34.2	8.9	3.3				
Cyperus erythrorhizos	5,196									
Cyperus esculentus		11.1	4.3	68.5	4.1	11.9	0.27	0.18		
Cyperus sp.	3,690-5,300	19.9	2.8	61.1	8.9	7.2	0.43	0.16		
Digitaria ischaemum	5,068									
Digitaria sanguinalis	4,380	14.1	2.4	63.0	14.0	6.5	0.36	0.10		
Echinochloa crusgalli	(W)3,635; 4,422[b]									
	(H)4,819	22.2; 22.7	1.4; 2.6	40.5	7.56; 9.7	6.2-26.2	0.33	0.06		
Echinochloa frumentacea	4,531									
Echinochloa walteri	4,560	14.2	3.6	61.4	16.3	4.4	0.41	0.05		
Echinochloa sp.	3,640-4,560									
Eleocharis obtusa	3,285									
Eleocharis sp.		38.9	2.1	40.2	6.8	11.9	0.18	0.07		
Fagopyrum esculentum	4,499									
Glycine max	5,328; 5,488									
Jussiaea repens		41.8	10.0		14.25	4.3				
Leersia oryzoides	3,738-4,470	10.7	2.0		11.0	10.2				
Leptochloa panicoides	2,834									
Lespedeza stipulacea	4,965									

Appendix 1-2 continued.

Plant Species	Gross Energy (cal/g)	Percentage								
		Fiber	Fat	N. free extr. (Carbohydrate)	Protein	Ash	P	Ca	N	K
Melilotus alba	4,687									
Panicum dichotomiflorum	3,362; 4,647	19.9	4.1	51.7	15.2	9.4	0.34	0.13		
Panicum sp.	4,650; 5,210									
Polygonum lapathifolium	4,264; 4,740	22.7; 23.64	2.7; 3.48	58.13	7.56; 11.78	2.94; 13.9	0.46	0.22	1.88	0.74
Polygonum pensylvanicum	4,183-4,610									
Potamogeton pectinatus		38.0-45.2	6.3-6.9	31.1-37.7	9.6-12.2	7.6-9.9				
Potamogeton sp.		46.48	3.53	37.44	8.51	4.01	0.32	0.30	1.36	1.26
Quercus palustris		27.5	6.7	57.8	5.6	2.6				
Rumex crispus	4,024; 4,786	20.4	1.2		10.38	6.9				
Sagittaria latifolia	5,000; 5,150									
Sagittaria sp.		23.0	15.3	21.4	22.8	17.3	0.85	0.37		
Scirpus validus	4,870; 4,910									
Setaria faberi	(W)4,468 (H)4,585									
Setaria lutescens	4,494									
Setaria magna		17.1	1.5	61.2	14.2	3.9	0.27	0.06		
Sida spinosa	(W)4,100; 4,946 (H)5,045									
Sorghum halepense		17.99	4.39	54.82	12.51	10.28	0.47	0.26	2.00	0.73
Sorghum spp.	4,400	2.2	3.1		11.94	2.7				
Sparganium eurycarpum	4,510-4,710									
Trifolium pratense	4,980									
Triticum aestivum	4,347									
Zea mays	4,320-4,700	3.57	5.04	79.68	9.70	1.94	0.37	0.06	1.55	0.47

a Hulled
b Whole

Appendix 1-3. Energy (cal/g) and nutritional characteristics (% dry weight) of vegetative parts of plants found in waterfowl gizzards.

Plant Species	Gross Energy (cal/g)	Percentage						
		Fiber	Fat	N. free extr. (Carbohydrate)	Protein	Ash	P	Ca
Andropogon virginicus	4,316							
Ceratophyllum demersum	2,180							
Cyperus esculentus (tubers)	4,256							
Lemna minor	4,090	8.8	4.2	37.1	37.1	12.8	1.2	1.2
Lemna trisulca	2,470	7.7	0.8	56.2	15.2	20.1	0.8	2.0
Myriophyllum spicatum	2,880							
Potamogeton crispus	3,670							
Potamogeton pectinatus	3,740	14.7	0.9	57.8	13.3	13.3	0.6	2.0
Potamogeton pectinatus (tubers)		5.1-5.9	0.9-1.1	74.4-75.8	12.6-13.6	5.1-5.8		
(foliage)		28.9-40.3	0.5-2.7	16.1-29.9	10.2-11.5	23.6-43.7		
Zannichellia palustris (foliage and seeds)	4,060	1.3	9.2	47.6	20.3	21.6	0.7	1.5

Appendix 1-4. Energy (cal/g) and nutritional characteristics (% dry weight) of animal foods found in waterfowl gizzards.

Animal Taxa	Gross Energy (cal/g)	Percentage						
		Fiber	Fat	N. free extr. (Carbohydrate)	Protein	Ash	P	Ca
Amphipoda: Gammarus sp.	4,020	8.4	5.9	16.5	47.0	22.2		
Coleoptera (adults and larva)	5,930							
Diptera: Chironomidae	4,300				56.0			
Gastropoda: Lymnaeidae	920	12.4	0.7	5.8	16.9	64.2	0.3	26.1
Hemiptera: Corixidae (adults)	5,310	11.5	9.2	0.7	71.5	7.1	1.0	0.7
Zygoptera (naiads)	5,720							

SECTION 2: HARVEST OF WATERFOWL IN ILLINOIS

The sport hunting of waterfowl in Illinois is a lucrative and popular recreational activity. Because of the abundance of food associated with the Illinois and Mississippi river floodplains and other important wetlands, waterfowl have frequented the aquatic habitats of the state for centuries during the fall and spring migration. Consequently the large numbers of waterfowl passing through Illinois attracted much interest as the human population increased and aquatic habitat declined. Many private waterfowl clubs were established in the late 1800's.

This report provides historical and current information on the harvest of waterfowl in Illinois. Indeed, few states are fortunate to have documentation of the tradition of waterfowl hunting begun over 100 years ago.

Public Areas, Private Clubs, and Statewide Estimates

Total Harvest

Illinois is unique in that the Department of Conservation 1) requires private duck clubs to be registered and record their harvest (Figure 2-1); 2) maintains check stations at some state waterfowl hunting areas and estimates harvest at others (Figure 2-2); and 3) estimates the statewide waterfowl harvest by two different mail questionnaires. In addition, harvest estimates are provided on a county basis by the U.S. Fish and Wildlife Service for Illinois as well as for all states (Figure 2-3).

By comparison, harvest data in neighboring states from areas

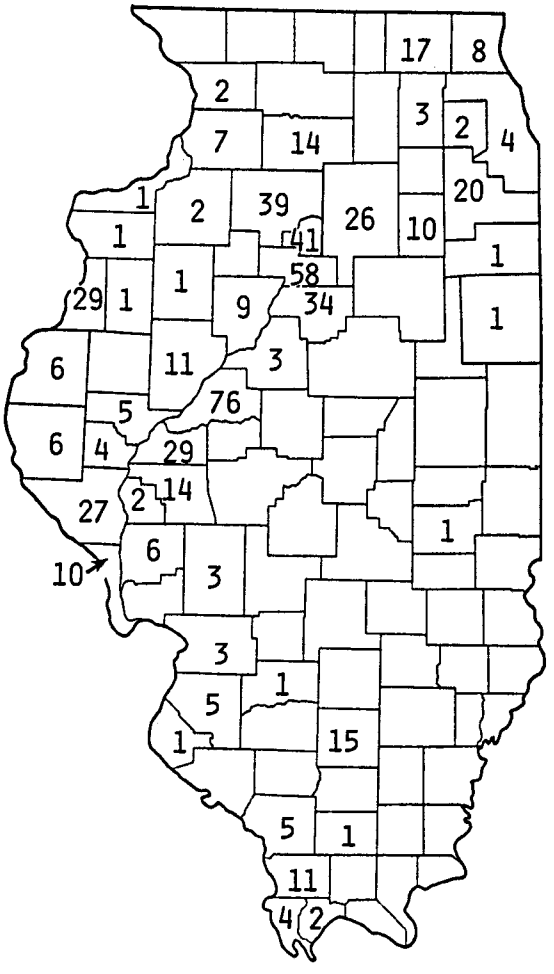

Figure 2-1. The number by county of private duck hunting clubs licensed with the Illinois Department of Conservation from 1975 - 1981.

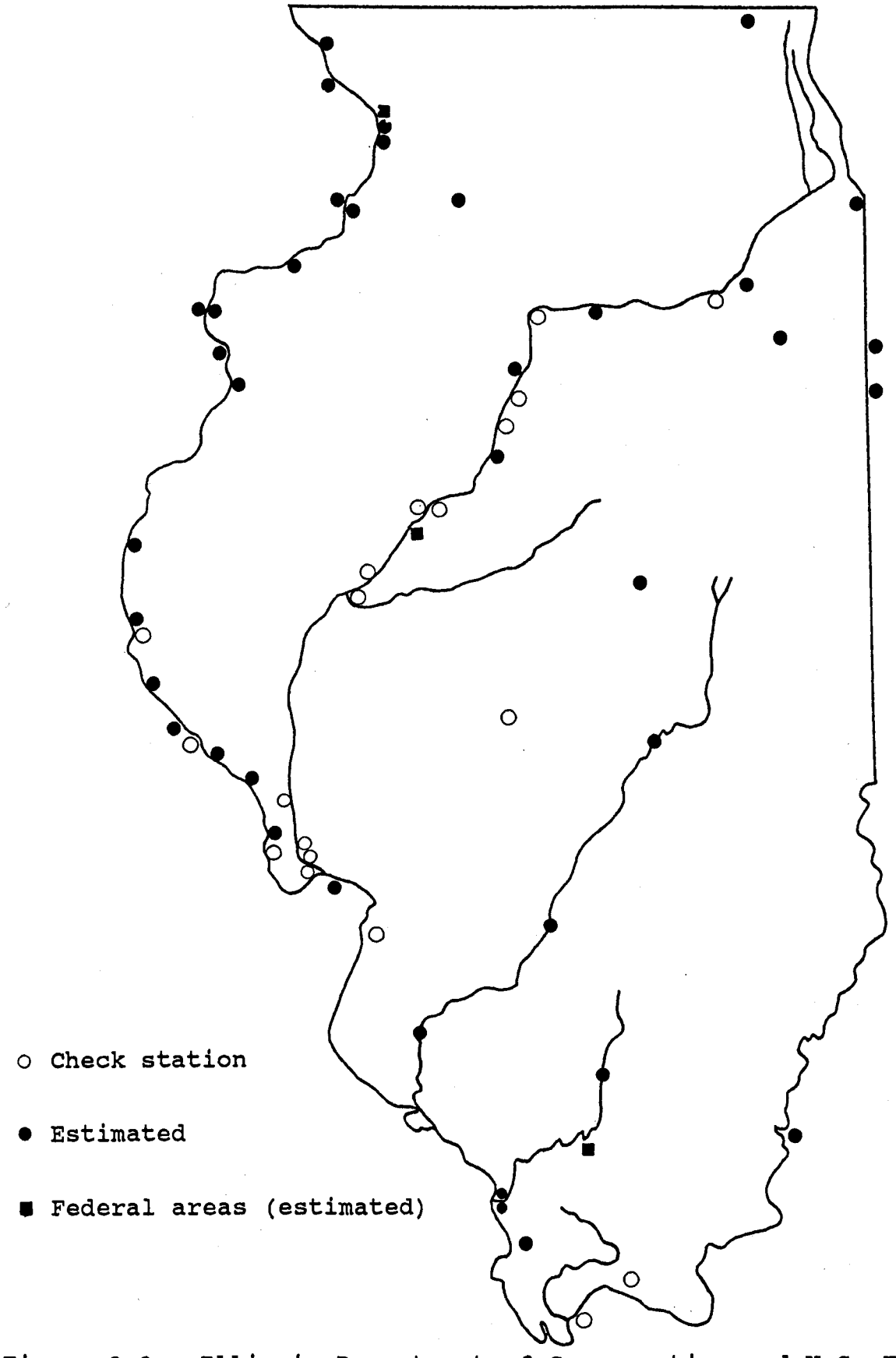

Figure 2-2. Illinois Department of Conservation and U.S. Fish and Wildlife Service public hunting areas in Illinois, 1977-1981.

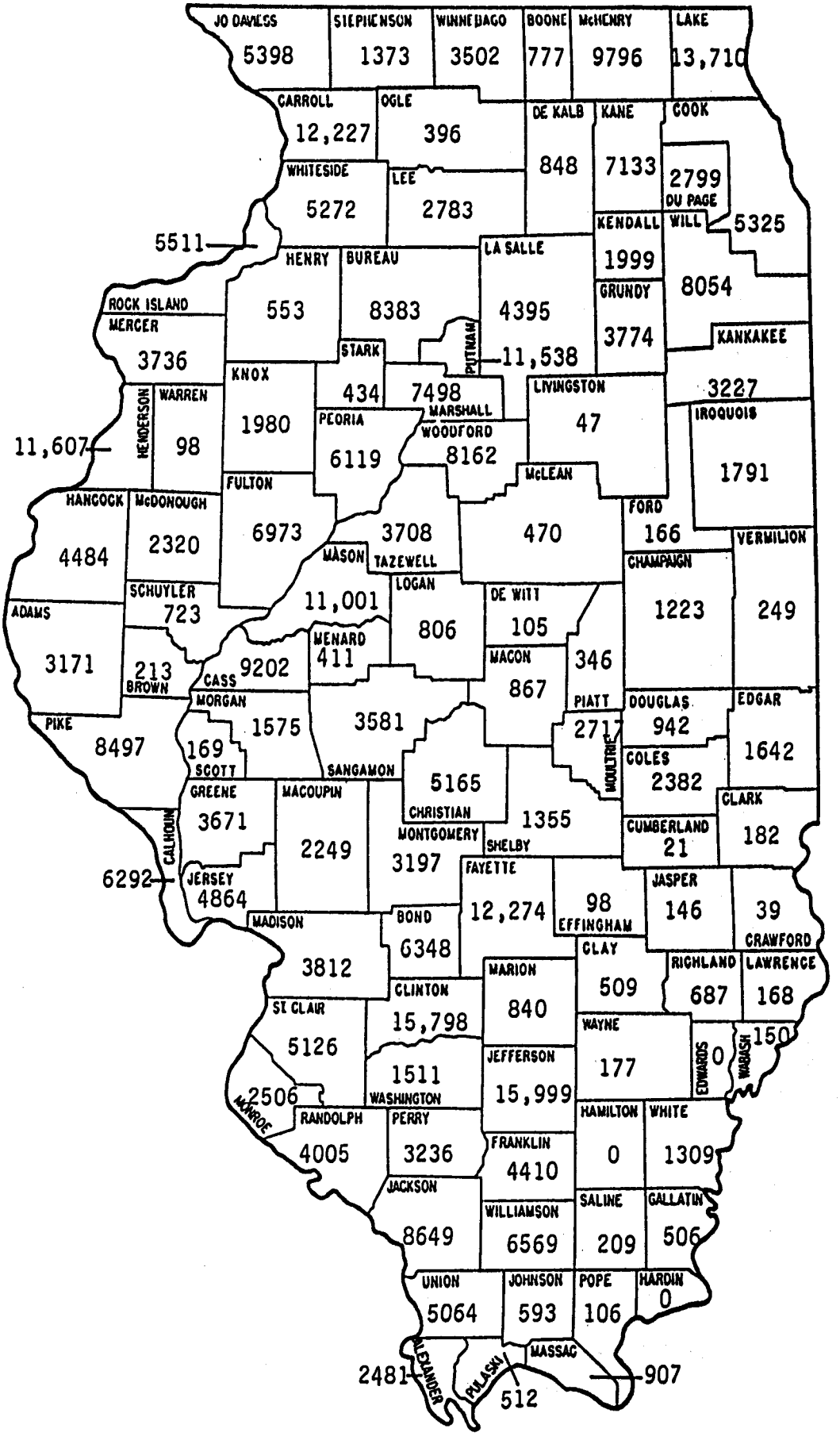

Figure 2-3. Average duck harvest by county as estimated by the U.S. Fish and Wildlife Service, 1971-1980 (Carney et al. 1983a).

near the borders of Illinois are available only on public areas (Figure 2-2). These areas include three sites in Missouri, four in Iowa, three in Indiana, and one in Kentucky. The waterfowl harvests are estimated rather than monitored by check stations at the majority of these areas.

During the period of 1975-1981, there were 582 different private duck hunting clubs registered in Illinois (Figure 2-1) as compared to 792 in 1941 (Bellrose 1944). In 1963, Illinois had an estimated 1,413 private waterfowl hunting clubs, more than any other state in the Mississippi Flyway (Barclay and Bednarik 1968). At that time, an estimated 5,000 private waterfowl clubs controlled a minimum of 2.5 million acres of waterfowl habitat in the Mississippi Flyway and as much as 22% of the moderate-to-high value wetland habitat existing in the Flyway was under private duck club control, thereby playing an essential role in maintaining critical waterfowl habitat (Barclay and Bednarik 1968). In 1963, about 50% of the private waterfowl clubs were membership clubs, 28% were owner-guest clubs, and 19% were daily fee clubs. For an average private club during that era, only 62% of the annual man-days of use was spent hunting waterfowl whereas 38% was devoted to other types of outdoor recreation such as fishing, bird-watching, and picnicking (Barlay and Bednarik 1968).

The majority of today's clubs are clustered along the Illinois River (Figure 2-1). During 1975-1982, private duck clubs existed in 49 of the 102 counties in Illinois with the most

clubs occurring in Mason County (78), followed by Marshall (58), Bureau (39), and Woodford (34) counties. Of the 582 licensed private duck clubs, between 301 and 382 reported their harvest each year from 1977-1981.

The Illinois Department of Conservation monitored duck harvest on 32 public hunting areas and on river blinds in Pools 12-14, 16-18, 20-22, and 24-26 on the Mississippi River and in Peoria and Starved Rock pools on the Illinois River during 1977-1981 (Figure 2-2). Bag check stations were maintained at 17 of these IDOC areas. In addition, the U.S. Fish and Wildlife Service estimated the harvest of ducks at three sites (Figure 2-2).

The harvest of ducks in Illinois is monitored by three mailing questionnaires. The IDOC estimated harvest through two questionnaires. One IDOC questionnaire is circulated among a random sample of duck hunters purchasing Illinois hunting licenses and is a part of the on-going annual IDOC Surveys and Investigation Projects directed by Jack A. Ellis. This estimate is not corrected for reporting bias. Following the 1981 hunting season, William L. Anderson of the IDOC implemented another mail-letter questionnaire program to a random sample of waterfowl hunters purchasing Illinois duck stamps. Anderson's questionnaire results are adjusted for reporting bias. The USFWS estimates the duck harvest by county in Illinois by 10-year intervals

(Figure 2-3). The USFWS estimates, based on samples of hunters purchasing federal duck stamps, is adjusted for reporting bias.

According to federal estimate of duck harvest in Illinois (Figure 2-3), the county with the highest number of ducks harvested during the 1971-1980 period was Jefferson (15,999) followed closely by Clinton (15,798). Rend Lake public hunting area is located in Jefferson County and Carlyle Lake hunting public area is located in Clinton and Fayette (12,274) counties. Other counties with large duck kills include Lake (13,710) in the glacial lakes region, Carroll (12,227) and Henderson (11,607) along the Mississippi River, and Putnam (11,538) and Mason (11,001) along the Illinois River.

The six counties in Illinois with the highest duck harvest on private clubs for each year of the 1977-1981 period are presented with their reported harvests in Table 2-1. Ten counties were among the top six counties in the annual duck harvest for this 5-year period. However, 8 of the 10 were counties bordering the Illinois River and only 2, Henderson and Madison, were associated with the Mississippi River. Historically the Illinois River has hosted higher numbers of ducks during the fall migration because of its numerous bottomland lakes as well as the advent of refuges associated with the private duck clubs. Mason, Putnam, Woodford, and Marshall counties were among the 6 counties with the highest duck harvest each of the 5 years.

Table 2-1. The counties with highest duck harvest at private duck clubs in Illinois, 1977-1981. The number of harvested ducks reported is in parentheses.

Year	Counties					
1977	Mason (6,313)	Putnam (6,298)	Woodford (5,395)	Cass (2,065)	Marshall (1,679)	LaSalle (1,631)
1978	Mason (7,924)	Woodford (6,683)	Putnam (4,623)	Madison (2,991)	Marshall (2,712)	Cass (2,685)
1979	Woodford (7,301)	Mason (6,914)	Putnam (5,151)	Bureau (3,279)	Marshall (2,755)	Will (2,266)
1980	Putnam (6,629)	Woodford (5,937)	Mason (5,470)	Bureau (3,646)	Henderson (2,861)	Marshall (2,685)
1981	Putnam (9,529)	Woodford (6,489)	Mason (5,761)	Marshall (2,167)	Henderson (1,992)	Cass (1,822)

Cass County appeared in the top 6 counties for 3 of the 5 years, whereas the other 5 counties were among the top 6 counties for 1 or 2 years.

For the period of 1977-1981, the top 10 counties in Illinois with the highest duck harvest on private clubs were Mason, Putnam, Woodford, Marshall, Cass, Will, Henderson, Madison, LaSalle, and Bureau. For the 5-year period, Mason County averaged a total duck kill of 6,476 per year on 52 reporting clubs, Putnam averaged a harvest of 6,446 on 23 reporting clubs, Woodford averaged 6,361 ducks on 24 clubs, Marshall County averaged 2,400 ducks on 28 reporting clubs, Cass averaged 2,337 on 19 clubs, Will averaged 1,642 on 11 reporting clubs, Henderson averaged 2,120 on 21 clubs, Madison averaged 1,769 on 2 clubs, LaSalle averaged 2,363 on 24 clubs, and Bureau averaged 2,446 harvested ducks on 19 reporting clubs. The neighboring counties of Putnam, Bureau, LaSalle, Marshall, and Woodford in Peoria Pool of the Illinois River provided the best private duck club hunting in Illinois with regards to harvest for the 1977-1981 period. The adjacent counties of Mason and Cass in LaGrange Pool of the Illinois River was the area that provided the next highest harvest of ducks at private duck clubs in Illinois.

Over the years, the hunting season in Illinois has changed dramatically (Table 2-2) in response to fluctuating waterfowl populations and new regulations. Approximations for the number of ducks harvested statewide and on private and public hunting

Table 2-2. Open seasons and bag limits for ducks in Illinois, 1853-1984. Prior to 1916, Illinois formulated its own regulations whereas in subsequent years regulations were set by the federal government.

Year	Season Dates	Season Length	Daily Bag Limit
1853	Open		None
1855	Open		None
1865	Aug 15 - Apr 15	244 days	None
1867	Aug 15 - Apr 14	245 days	None
1873	Aug 15 - Apr 14	244 days	None
1877	Aug 15 - Apr 30	260 days	None
1883	Aug 15 - Apr 30	260 days	None
1885	Aug 15 - Apr 30	259 days	None
1887	Aug 15 - Apr 30	260 days	None
1889	Sep 15 - Apr 14	212 days	None
1891	Sep 15 - Apr 14	212 days	None
1893	Sep 15 - Apr 14	213 days	None
1895	Sep 15 - Apr 14	213 days	None
1896	Sep 15 - Apr 14	212 days	None
1899	Sep 15 - Apr 14	213 days	None
1901	Sep 1 - Apr 14	226 days	None
1903	Sep 1 - Apr 14	227 days	50
1905	Sep 1 - Apr 14	226 days	35
1907	Sep 1 - Apr 14	227 days	20
1909	Sep 2 - Apr 14	225 days	15
1911	Sep 2 - Apr 14	226 days	15
1913	Sep 2 - Dec 15	105 days	15
1915	Sep 1 - Dec 15	106 days	15
1916	Sep 16 - Dec 15	91 days	15
1916-18	Sep 16 - Dec 15	91 days	15
1919-25	Sep 16 - Dec 31	107 days	15
1926-27	Oct 1 - Jan 15	107 days	15
1928	Sep 16 - Dec 31	107 days	25
1929	Sep 24 - Jan 7	106 days	25
1930	Sep 24 - Jan 7	106 days	15
1931	Nov 1 - Nov 30	30 days	15
1932	Oct 16 - Dec 15	61 days	15
1933	Oct 16 - Dec 15	61 days	12
1934	Saturdays & Sundays (only) from Oct 6 through Jan 13	30 days	12
1935	Oct 21 - Nov 19	30 days	10
1936-37	Nov 1 - Nov 30	30 days	10
1938	Oct 15 - Nov 28	45 days	10

Table 2-2 continued.

Year	Season Dates	Season Length	Daily Bag Limit
1939	Oct 22 - Dec 5	45 days	10
1940-41	Oct 16 - Dec 14	60 days	10
1942-43	Oct 15 - Dec 23	70 days	10
1944	Oct 14 - Jan 1	80 days	10
1945	Oct 13 - Dec 31	80 days	10
1946	Oct 26 - Dec 9	45 days	7
1947	Nov 4 - Dec 3	30 days	4
1948-49	Oct 29 - Nov 27	30 days	4
1949-50	Nov 4 - Dec 13	40 days	4
1950-51	Nov 3 - Dec 7	35 days	4
1951-52	Oct 26 - Dec 9	45 days	4
1952-53	Oct 20 - Dec 13	55 days	4
1953-54	Oct 23 - Dec 16	55 days	4
1954-55	Oct 22 - Dec 15	55 days	4
1955-56	Oct 15 - Dec 23	70 days	4
1956-57	Oct 13 - Dec 21	70 days	4
1957-58	Oct 19 - Dec 27	70 days	4
1958-59	Oct 18 - Dec 26	70 days	4
1959-60	Oct 30 - Dec 8	40 days	4
1960-61	Oct 28 - Dec 6	40 days	4
1961-62	Oct 28 - Nov 26	30 days	2
1962-63	Oct 26 - Nov 19	25 days	2 (1)[a]
1963-64	Nov 1 - Dec 5	35 days	4 (2)
1964-65	Oct 31 - Dec 9	40 days	4 (2)
1965-66	Oct 30 - Dec 8	40 days	4 (1)
1966-67	Oct 22 - Dec 5	45 days	4 (2)
1967-68	Oct 28 - Dec 6	40 days	4 (2)
1968-69	Nov 2 - Dec 1	30 days	3 (1)
1969-70	Nov 1 - Nov 30	30 days	4 (2)
1970-71	Oct 17 - Dec 10	55 days	Point System
1971-72	Oct 28 - Dec 11	50 days	Point System
1972-73	Oct 28 - Dec 16	50 days	Point System
1973-74	Oct 20 - Dec 3	45 days	Point System
1974-75	Oct 23 - Dec 11	50 days	Point System
1975-76	Oct 22 - Dec 10	50 days	Point System
1976-77	Oct 23 - Dec 11	50 days	Point System
1977-78	Oct 22 - Dec 5 (N)[b]		
	Nov 5 - Dec 19 (S)	45 days	Point System
1978-79	Oct 19 - Dec 7 (N)		
	Nov 2 - Dec 21 (S)	50 days	Point System
1979-80	Oct 17 - Dec 5 (N)		

Table 2-2 continued.

Year	Season Dates	Season Length	Daily Bag Limit
	Oct 31 - Dec 19 (S)	50 days	Point System
1980-81	Oct 14 - Dec 2 (N)		
	Oct 23 - Dec 11 (C)		
	Oct 30 - Dec 18 (S)	50 days	Point System
1981-82	Oct 14 - Dec 2 (N)		
	Oct 22 - Dec 10 (C)		
	Oct 29 - Dec 7 (S)	50 days	Point System
1982-83	Oct 13 - Dec 1 (N)		
	Oct 21 - Dec 9 (C)		
	Oct 28 - Dec 16 (S)	50 days	Point System
1983-84	Oct 12 - Nov 30 (N)		
	Oct 20 - Dec 8 (C)		
	Oct 27 - Dec 15 (S)	50 days	Point System
1984-85	Oct 10 - Nov 28 (N)		
	Oct 24 - Dec 12 (C)		
	Nov 1 - Dec 20 (S)	50 days	Point System

[a] Mallard limits shown in parentheses when different than basic limit.
[b] Zones: N = North, C = Central, S = South.

areas are presented for the period of 1977-1983 in Table 2-3. In recent years, the number of ducks harvested in Illinois has ranged between 318,000 and 475,000, according to estimates by USFWS and Anderson of the IDOC. For the 1977-1981 period, the average number of ducks harvested annually according to private duck club records was 44,736. For the same interval, an average of 56,646 was recorded and estimated to be harvested each year on public hunting areas. The total of 101,382 ducks harvested annually from these two sources is only 27.2% of the average Illinois annual harvest of 372,939 estimated for the same period by the USFWS.

Anderson (1984a) found from his mail questionnaire that 22.9% of the Illinois duck harvest occurred on private duck clubs, 37.3% on public hunting areas, and 39.8% on other areas. Both Anderson's estimate of the total duck harvest in Illinois and the same estimate by the USFWS are similar in magnitude (Table 2-3). However, Anderson found that 60.2% of the Illinois duck harvest occurred on both public areas and private duck clubs combined as compared to the 27.2% recorded on private duck club kill sheets and recorded and estimated at public hunting areas. It appears that many ducks shot at private clubs are not being recorded and, to some degree, those shot on public areas are not being accurately reported or estimated. From contacting several private clubs, we believe only about half of the duck kill on

Table 2-3. Illinois duck harvest recorded on private duck club registers, recorded and estimated for state and federal areas, and estimated by mail by the U.S. Fish and Wildlife Service and the Illinois Department of Conservation, 1977-1983.

Year	Private Duck Clubs	Public Hunting Areas	Private Plus Public Areas	Mail Estimates		
				Federal	IDOC Ellis[a]	IDOC Anderson[b]
1977	38,898	58,439	97,337	330,502	694,480	
1978	48,785	72,444	121,229	417,250	855,821	
1979	47,384	54,625	102,009	404,368	633,298	
1980	46,085	46,855	92,940	323,289	568,532	
1981	42,528	50,867	93,395	389,284	707,695	397,208
1982				318,281	747,733	384,457
1983				456,860	845,416	474,105

[a] (Ellis, 1984)
[b] (Anderson, 1985)

private clubs is being recorded. In years with low harvest, possibly upwards to 75% to 80% of the private club kill is documented. Similarly, Anderson (1985) found that the number of duck hunters checked through an IDOC public hunting area was only 50.1% as great as the number of ducks reported on a questionnaire sent to hunters who registered at that area. Some club operators believe that in some regions comparable numbers of ducks are shot in corn fields as on private duck clubs.

Prior to 1940 most of the duck hunting in Illinois occurred on streams, rivers, farm ponds, corn fields, private duck clubs, and daily fee clubs. Public waterfowl hunting areas began to appear in the 1940's and their importance has increased over the years. Anderson (1983) found that only 18% of the days afield for hunting ducks occurred on private clubs in Illinois during the 1981 season as compared with 40.3% on public hunting areas and 41.7% on other areas. Accordingly, the percentage of the total Illinois harvest of ducks on private clubs is lower (22.9%) than public hunting areas (37.7%) and other areas (39.8%) (Anderson 1984a).

In conjunction with harvesting ducks in Illinois, crippling losses occur. Anderson (1985) estimated that 85,667 ducks were shot but not retrieved during the 1983 hunting season, or 18.1% of the ducks killed. Carney et al. (1984) found a crippling loss of 17.8% for ducks in the Mississippi Flyway for the 1983 season.

Number of Hunters and Days Afield

Duck hunting is a popular sport in Illinois. Anderson (1983, 1984a, 1985) estimated that between 44,590 and 48,395 people hunted ducks in Illinois between 1981 and 1983 and spent between 575,851 and 621,936 days afield. Ellis (1984) estimated at between 60,956 and 75,734 hunters spent between 557,622 and 745,601 days afield pursuing ducks between 1975 to 1983.

September Teal Season

The September teal season was implemented in 1965 in Illinois to provide hunters opportunities to harvest the early migrating blue-winged teal (Table 2-4). According to Anderson (1983, 1984a, 1985), between 11,753 and 13,139 hunters, or about 21-23% of state duck stamp purchasers, pursued teal during the September season between 1981 and 1983. These hunters harvested an estimated 26,956 to 34,499 birds statewide. Hunting success ranged from 2.57 to 2.94 teal per hunter during the average 2.06 to 2.97 days spent afield, or an average of 0.79 to 0.99 teal per hunter-day. For comparison, the USFWS estimated that between 13,200 and 22,100 teals were harvested during the September season for this same period and that blue-wings constituted 79.5 to 93.3 % of the teal harvest (Carney et al. 1983[b], 1984, 1985).

For the period 1977 to 1981, 7% of the private duck clubs recorded teal harvest and about 25% of the IDOC public hunting areas with check stations. Blue-winged teal constituted 82% and

Table 2-4. Season dates and daily bag limits for the September teal season in Illinois, 1965-1985.

Year	September Season Dates	Bag Limit
1965	18-26	4
1966	17-25	4
1967	16-24	4
1968	No season in Flyway	
1969	6-14	4
1970	19-27	4
1971	18-26	4
1972	15-23	4
1973	15-23	4
1974	No season in Illinois	
1975	13-21	4
1976	11-19	4
1977	10-18	4
1978	9-17	4
1979	8-16	4
1980	13-21	4
1981	12-20	4
1982	11-19	4
1983	10-18	4
1984	8-16	4
1985	7-15	4

79.8% of the teal harvest on private clubs and public areas, respectively, for the period. The average number of teal shot per hunter-day was 2.2 for private duck clubs and 0.94 for IDOC public areas.

Historical Private Club Records

The Illinois River Valley is rich in the duck club tradition. Some private duck clubs were established in the 1880's and their old records provide some insights into the success and species composition of the harvest during the days of legalized spring hunting, baiting, and live decoys.

The Duck Island Preserve is located in Fulton County on the Illinois River. Hunting records date back to 1885 for this private club (Table 2-5). Generally the kill per hunter trip varied between 10 and 15 from 1885-1938 while legal limits varied from 10 to 50. Exceptional hunter success occurred in 1894, 1928, and 1929 (Table 2-5). In 1935, the lowering of the daily legal limit to 10, the prohibition of baiting and live decoys, and the 3-shell limit resulted from depressed continental numbers of ducks during the severe drought conditions in the 1930's. Lower harvest success is reflected in the lower kill per hunter day (8.6-8.7) for 1935-1938 (Table 2-5).

Percentages of the species composition of the duck harvest for three time periods at the Duck Island Club are presented in Table 2-6. During the 1885-1900 period, spring shooting and

Table 2-5. Duck harvest and kill per hunter/day at Duck Island Club, 1885-1938.

Year	Harvest	Kill/Hunter-day
1885	1,086	4.5
1886	3,360	14.5
1887	1,375	11.0
1888	1,478	13.1
1894	1,112	30.9
1895	2,441	9.1
1896	7,148	11.8
1897	3,476	8.5
1898	5,007	10.7
1899	8,863	12.9
1900	3,491	8.3
1901	258	15.2
1914	1,273	12.4
1915	1,375	10.0
1916	2,996	11.5
1917	3,819	14.1
1918	1,023	13.1
1919	3,022	12.6
1920	2,684	12.3
1921	3,161	12.0
1922	2,206	13.3
1923	1,774	9.6
1924	1,159	12.3
1925	2,288	9.2
1926	1,317	10.1
1927	2,058	9.6
1928	4,555	19.7
1929	3,426	18.7
1930	2,287	10.9
1931	2,242	12.4
1932	1,946	13.6
1933	1,949	11.0
1934	1,486	10.6
1935	1,259	8.7
1936	1,540	8.6
1938	1,669	8.6

harvesting of wood ducks were legal. During the 1914-1925 and 1926-1938 periods both spring hunting and the shooting of wood ducks were prohibited. The spring hunting season of ducks ended in 1914 and the taking of wood ducks was illegal in Illinois from 1918-1941 and then again during the 1954 and 1956-1958 hunting seasons (Bellrose 1976). The percentage of mallards in the duck harvest at the Duck Island Club is noticeably lower (42.9%) during the 1885-1900 period as compared with 1914-1925 and 1926-1938, and the percentages of teals and diving ducks (scaup, ring-necks, canvasbacks (Aythya valisineria), and redheads) are higher during the 1885-1900 period (Table 2-6). The differences in species composition during the 1885-1900 period when spring hunting was legal are a reflection of the difference in the spring migration chronology, and, therefore, the harvest of the various species of ducks. Mallards pass through Illinois very rapidly in the spring whereas teals and diving ducks, particularly scaup and ring-necks, linger for longer periods. Consequently, a lower percentage of mallards and a higher percentage of teals, scaup, and ring-necks were shot in the spring than in the fall.

Analyses of hunting success at the New Crystal Lake Club from 1889-1908 disclosed that an average of 3.2 ducks per hunter-day were harvested during the fall as compared to 5.4 in the spring. Not only was hunter success higher in the spring, but an average of 58.4 hunter days was expended in the spring as

Table 2-6. Percentage of species composition of the duck harvest at Duck Island Club for 1885-1900, 1914-1925, and 1926-1938.

Species	Years		
	1885-1900	1914-1925	1926-1938
Mallard	442.9	72.7	82.3
Black		0.1	0.6
Pintail	6.8	7.0	8.0
Blue-winged teal	23.1	9.8	2.7
Green-winged teal		3.2	2.5
Wigeon	1.3	3.0	1.4
Gadwall	0.2	1.2	0.6
Scaup	10.6	0.2	0.1
Ring-necked	7.9	0.8	1.0
Canvasback	1.4	0.5	0.1
Redhead	1.7	0.3	0.1
Wood duck	4.1	Season closed	Season closed
Total harvest	37,686	26,780	26,990

compared to 41.6 in the fall. Both the higher success rate and more hunting days expended in the spring would heavily influence the species composition of the harvest prior to the prohibition of spring hunting in 1914. The elimination of the shooting of wood ducks in the spring greatly aided their comeback in the U.S. (Bellrose 1985).

The Swan Lake Club located along the Illinois River in Marshall County also has a long and rich hunting tradition. The club was established in 1884. In 1928, the duck season opened on 15 September and during that season hunters at the Swan Lake Club harvested 6,777 ducks or 19.3 ducks per hunter-day (Table 2-7). One member alone shot 666 ducks. The major species in the kill were principally mallards (67.9%), pintails (18.7%), and ring-necks (black-heads) (6.4%) (Table 2-7). A somewhat similar species composition was reported for 1929 when the club harvested 4,289 ducks (Table 2-7). The number of ducks per hunter-day harvested at the Swan Lake Club varied between 9.5 and 11.9 from 1930 to 1934. In 1939, with the effects of the dust bowl era apparent, 6.4 ducks were harvested per hunter-day and the total duck harvest of 869 was composed mainly of mallards (76.5%) and pintails (9.3%). For comparison, the harvest at the Swan Lake Club during the period of 1976-1981 averaged 58.7% mallards, 15.1% green-winged teal, 11.3% wood ducks, 9.9% black ducks (Anas rubripes) and the number of ducks per hunter-day varied between

Table 2-7. Total duck harvest, species composition of the harvest, and kill per hunter-day at the Swan Lake Club in Marshall County for periods from 1928 to 1981.

Year	Total Harvest	Kill/hunter-day	Composition of harvest	
			Species	% of total
1928	6,777	19.3	Mallard	67.9
			Pintail	18.7
			Ring-necked	6.4
			Wigeon	2.5
1929	4,289	-	Mallard	67.0
			Pintail	13.7
			Ring-necked	9.0
			Black	2.4
1930	2,638	10.4	-	
1931	1,437	-	-	
1932	2,481	11.9	-	
1933	2,011	9.5	-	
1934	2,013	10.4	-	
1939	869	6.4	Mallard	76.5
			Pintail	9.3
			Green-winged teal	8.2
1976-1981	234	2.2	Mallard	58.7
			Green-winged teal	15.1
			Wood duck	11.3
			Black	9.9
			Wigeon	4.9
			Pintail	3.3

1.0 and 3.0. Thus, in recent years, mallards still comprised the majority of the harvest, but wood ducks, green-winged teal, and black ducks (black mallards) replaced the numbers of pintails and ring-necks shot. The diets of pintails and ring-necks are principally vegetation, and consequently it stands to reason that their populations and subsequent harvest decreased following the loss of aquatic vegetation in this region of the Illinois River valley during the 1950's.

The Swan Lake Club also had some historical records on the amount and cost of grain used for bait during various hunting seasons. In 1928, the club used 3,018 bushels of ear corn at a cost of $0.95/bu. Ear corn was preferred because it took longer for the ducks to consume the grain than if shelled corn were used. In 1929, 1,911 bu of corn were used for bait at a cost of $1.00/bu. In 1930, the club fed 1,317 bu of corn at $1.00/bu, but also fed 198 bu of rye that cost between $0.58 and $0.65/bu. By 1932, the price of corn was down to $0.21/bu and baiting was supplemented with barley that cost $0.25 to $0.26/bu. In 1934, the duck kill on the club was 2,013, or 10.4 per hunter trip, and the price of corn increased to $0.78 to $0.80/bu.

The Swan Lake Club would distribute their ducks used for live decoys to farmers in the area for keeping until the next hunting season. In 1930, the club dispensed their drake and hen live decoys in January to four farmers in the area and the same number of ducks were to be returned on 1 September. The farmers

would keep any young that hatched during the year and the club was spared the expense of feeding the ducks from January through August. The club also sold some excess drakes used as live decoys in January of 1930 for $0.10/pound.

Harvest Per Hunter-Day

Bellrose (1944:366) reported that an average of 6.1 ducks were killed per hunter-day at 248 reporting private duck clubs for the period of 1935-1942. The clubs averaged a total kill of 64,132 ducks for this period. Recent harvest analyses for 354 reporting private clubs for the period of 1977-1981 indicated an average yearly kill of 44,736 ducks and 1.85 ducks per hunter-day. Hunter success on private clubs measured by kill per hunter days has decreased noticeably from the 1935-1942 era.

Of the 301-382 private duck clubs that reported their harvest from 1977-1981 an average of 140 per year or 39.5% of these clubs shot at least 50 ducks or more each year. The clubs that shot 50 or more ducks per year accounted for 62.3% of the recorded harvest of all private duck clubs. Thus, over 60% of the ducks harvested at private clubs in Illinois are shot on approximately 40% of the clubs, undoubtedly a direct result of better management practices.

Hunter success on private clubs has traditionally been higher than on public shooting areas. For example, the number of ducks killed per hunter-trip on four public areas (Sparland,

Woodford County, Spring Lake, and the Liverpool area) for the 1941 and 1942 seasons averaged 1.26 as compared to an average of 6.1 for 244 private clubs in Illinois. Anderson Lake in Fulton County was a private club before becoming a public hunting area in the 1940's. From 1923-1938, the harvest at Anderson Lake averaged 7.4 ducks per hunter-day when it was a private club, but the success rate decreased to 0.7 ducks per hunter-day from 1968-1983 several years after becoming a public hunting area. Private hunting clubs have higher success in harvesting ducks because of guides (pushers), fewer hunters, generally better management for waterfowl on large clubs in terms of food resources, water manipulation, and rest days, and perhaps a larger proportion of better hunters. From a survey conducted in 1963, Barclay and Bednarik (1968) concluded that private club hunters hunted less frequently during a season, shot more ducks per day, and bagged fewer ducks per man than the typical flyway hunter. Barclay and Bednarik (1968) concluded that private club hunters did not secure a disproportionate share of the yearly waterfowl harvest but that hunting on private clubs did yield more productive results with regards to effort expended.

The average number of total ducks harvested annually and the average annual number of ducks killed per hunter-day at IDOC public hunting areas with check stations from 1962-1983 are presented in Table 2-8. For these sites, the areas with the highest annual average of ducks harvested for this period were

Table 2-8. Average annual number of ducks harvested and ducks bagged per hunter-day at Illinois Department of Conservation public hunting areas with check stations, 1962-1983.

Area	Years	Average Annual No. Ducks Harvested	Ducks/hunter-day
Anderson Lake	1968-1983	644	0.63
Batchtown	1962-1983	5,246	0.95
Calhoun Point	1964-1983	1,006	0.55
Collins	1978-1983	260	0.37
DePue	1975-1983	667	0.97
Glades	1965-1983	1,209	0.63
Godar	1962-1983	2,345	0.95
Horseshoe Lake	1974, 1975, 1977-1980, 1982, 1983	1,221	0.88
Marshall County	1972-1983	1,281	0.61
Mermet	1972-1983	1,349	0.61
Quincy Bay	1968-1972, 1974	1,151	0.51
Rice Lake	1968-1983	948	0.60
Sanganois	1968-1983	2,270	0.95
Spring Lake	1968-1983	979	0.59
Stump Lake	1962-1983	2,618	0.78
Woodford County	1973-1983	1,887	0.86

Batchtown (5,246), Stump Lake (2,618), Godar (2,345), and Sanganois (2,270) (Table 2-8). The areas with the highest yearly average of the number of ducks per hunter-day were DePue (0.97), Batchtown (0.95), Godar (0.95), and Sanganois (0.95) (Table 2-8). The yearly average of the number of ducks per hunter-day for the IDOC areas with check stations was 0.73 from 1968-1983. For all IDOC public hunting areas where the duck harvest is monitored by check stations or estimated, the average annual number of ducks per hunter-day was also 0.73 from 1972-1983. This value is noticeably lower than the average 1.85 ducks per hunter-day for private duck clubs from 1977-1981.

Species Composition of the Harvest

The average percentage species composition of the total duck harvest in Illinois from 1977-1981 was examined from three sources of harvest data. These sources were 1) the U.S. Fish and Wildlife estimates of the duck harvest, 2) private duck club kill sheets required by the IDOC, and 3) the harvest on IDOC public areas which maintain a bag check station. Results of the major species comprising the Illinois duck harvest are presented in Table 2-9.

Results from the three sources agree that the top five species in the duck harvest for this period in Illinois are mallards, wood ducks, green-winged teal, wigeon, and lesser scaup. All sources rank the mallard, wood duck, and green-winged

Table 2-9. Duck species comprising the highest percentages of the total duck harvest in Illinois from 1977-1981 according to USFWS Federal Harvest statewide estimates, private duck club kill registers, and Illinois Department of Conservation check station records for the public areas, and from 1935-1942 for private duck clubs in the Illinois River valley.

	Percentage of Total Duck Harvest			
	1977-1981			1935-1942[a]
Species	USFWS Statewide Estimates	Private Duck Clubs	IDOC Public Areas	Private Duck Clubs
Mallard	49.8	67.2	53.2	70.6[b]
Green-winged teal	7.1	6.6	6.3	4.1
Wigeon	4.8	4.3	3.5	2.7
Gadwall	4.5	2.7	3.2	1.6
Pintail	2.6	2.6	3.3	9.3[b]
Black	1.6	1.3	0.9	
Blue-winged teal	1.3	1.1	1.5	1.7
Shoveler	0.9	0.5	1.1	1.5
DABBLERS	72.9	86.3	72.9	91.5
Wood duck	13.7	7.5	13.5	[c]
Scaup	5.0	3.3	6.5	4.4
Ring-necked	3.8	1.2	3.0	1.8
Redhead	0.9	0.5	0.7	-
Bufflehead	0.8	0.4	0.8	-
Canvasback	0.7	0[d]	0.7	0.8
Merganser	0.7	T[d]	0.4	-
Goldeneye	0.6	T	0.2	-
Ruddy	0.4	0.2	0.6	0.5
DIVERS	13.0	6.0	12.9	7.0

[a] Bellrose 1944.
[b] Mallard and black duck % harvest combined.
[c] Closed season.
[d] Trace kill of <0.05%.

teal as the top three species in the harvest comprising a combined total average of between 70.6 and 81.3% of the harvest. Mallards were the number one duck in the harvest representing an average of between 49.8 and 67.2% of the total bag, followed by wood ducks (7.5 to 13.7%) and green-winged teal (6.3 to 7.1%). The USFWS harvest estimates and the private duck club records rated wigeon (4.3 to 4.8%) as the fourth highest species in the harvest and lesser scaup (3.3 to 5.0%) as the fifth highest. The status of these two species, however, was reversed on the IDOC recorded harvest records for public areas.

Other species of ducks that represented more than 1% of the harvest estimates were gadwalls (2.7% to 4.5%), pintails (2.6 to 3.3%), ring-necks (1.2 to 3.8%), black ducks (0.9 to 1.6%), and blue-winged teal (1.1 to 1.5%) (Table 2-9). Species of divers, with the exception of scaup and ring-necks, represented less than 1% of the total harvest and collectively ranged between 6.0 and 13.0% of the total duck harvest (Table 2-9). According to these estimates (Table 2-9), the percentage of all species of divers in the Illinois duck harvest is almost identical to the percentage of the harvest represented by wood ducks.

The estimates of the percentage of species composition of the Illinois duck harvest for the 1977-1981 period were very similar for the USFWS estimates and the IDOC check station records, even in the percentage of dabblers and divers harvested (Table 2-9). Data from the private duck clubs indicate that mallards comprise

a larger percentage of the harvest and wood ducks a smaller percentage than occurs on IDOC public areas. Perhaps the clientele of duck clubs are more selective in shooting mallards, or management practices on private clubs are more conducive to attracting mallards. Among private duck clubs, there is also a difference in the species composition of the harvest. Clubs that harvested 50 or more ducks annually for the 1977-1981 period shot a higher percentage of mallards (70.3% vs 61.8%) and pintails (3.0% vs 1.7%) but fewer wood ducks (7.0% vs 8.3%), wigeon (3.8% vs 4.8%), gadwalls (2.4% vs 3.2%), green-winged teal (6.0% vs 7.6%), scaup (2.7% vs 3.5%), blue-winged teal (0.9% vs 1.9%) and ring-necks (0.9 vs 2.3%) compared to private clubs that harvested less than 50 ducks annually.

The species composition of the harvest of private clubs in the Illinois River valley from 1935-1942 compares surprisingly favorably with the kill percentages at private clubs in recent years (Table 2-9), especially when the prohibition of shooting wood ducks during the 1935-1942 period is considered. The percentage of the total duck harvest represented by dabblers at private clubs in the 1935-1942 period (91.5%) was slightly higher than for the 1977-1981 period (86.3%) whereas the percentage represented by divers was similar (7.0% vs 6.0%). Mallards and black ducks comprised 70.6% of the total harvest in the 1935-1942 period as compared to 68.5% in the 1977-1981 period. A consid-

erably higher percentage of pintails was shot in the earlier period (9.3%) as compared to the recent years (2.6%) and a lower percentage of green-winged teal was shot in the earlier period (4.1% vs 6.6%). Percentage difference was less than 2% for all other species in the duck harvest between these two time periods (Table 2-9).

The USFWS estimate of the percentage of mallards and wood ducks in the Illinois duck harvest from 1961-1984 is presented in Table 2-10. The percentage of the mallard in the duck harvest for this 2-year period varied between 27.4 and 62.9% for a mean of 51.2% (Table 2-10). The percentage of the wood ducks in the harvest varied between 5.1% and 18.0% with an average of 12.7%. Generally the percentage of the Illinois duck harvest represented by mallards has been decreasing since 1961 ($r = -0.21$) and the percentage represented by wood ducks has been increasing ($r = 0.38$) although neither trend is significant ($P>0.05$). A negative relationship exists between the percentage of mallards and the percentage of wood ducks in the USFWS estimates of the Illinois duck harvest (Table 2-10), but this relationship is also not significant ($r = -0.25$, $P>0.05$).

According to USFWS harvest estimates, mallards have always been the leading species in the Illinois duck harvest since 1961 and wood ducks have been second. For the 5-year period of 1977 to 1981, the USFWS estimated that mallards made up an average of 49.8% of the total duck harvest and wood ducks accounted for

Table 2-10. Percentage of mallards and wood ducks in the USFWS estimated duck harvest for Illinois, 1961-1984.

Year	Percentage of Harvest	
	Mallard	Wood duck
1961	62.9	6.5
1962	49.0	18.0
1963	55.3	14.2
1964	59.0	10.2
1965	47.4	13.1
1966	51.9	12.8
1967	59.1	5.1
1968	27.4	11.9
1969	57.6	11.2
1970	31.4	10.5
1971	59.5	11.7
1972	61.5	12.2
1973	54.1	16.7
1974	58.7	13.4
1975	51.0	14.5
1976	53.6	9.8
1977	53.2	10.8
1978	49.8	14.4
1979	47.5	10.7
1980	52.1	16.7
1981	46.6	15.9
1982	44.1	15.4
1983	48.5	16.8
1984	47.2	13.2
Mean	51.2	12.7

13.7%. These percentages equate to an average of 185,051 mallards and 50,907 wood ducks harvested annually in Illinois from 1977 to 1981.

Both banding and harvest data indicate that the Mississippi Flyway is the leading flyway with respect to the harvest of mallards. The Mississippi Flyway accounts for 43 to 46% the U.S. mallard harvest followed by 21 to 28% for both the Central and Pacific flyways, and 4 to 7% for the Atlantic Flyway (Munro and Kimball 1982). Arkansas is the leading state in the nation in the harvest of mallards claiming a harvest of 8.4 to 9.6% of the total U.S. mallard harvest. Other leading states with respect to the percentage of the U.S. mallard harvest are Washington (6.8 to 7.4%), California (3.6 to 7.2%), Louisiana (5.4 to 6.5%), Minnesota (6.0 to 6.1%), Idaho (4.2 to 5.2%), Colorado (2.1 to 7.4%), Illinois (4.1 to 4.7%), and Wisconsin (3.7 to 4.5%) (Munro and Kimball 1982).

The average percent of the total harvest of species of ducks by week of the hunting season for the period of 1977-1981 for private duck clubs and Department of Conservation public hunting areas is presented in Tables 2-11 and 2-12, respectively. The U.S. Fish and Wildlife Service estimates of the duck harvest are not available for weekly periods. Data indicate that mallards comprise a larger percentage and wood ducks a smaller percentage of the harvest by week on private duck clubs than occurs on IDOC

Table 2-11. Average percentage of the species composition of the total duck harvest for each week of the hunting season at private duck clubs in Illinois, 1977-1981.

Species	Teal Season	Weeks									
		Oct. 16-22	Oct. 23-29	Oct.30-Nov. 5	Nov. 6-12	Nov. 13-19	Nov. 20-26	Nov.27-Dec 3	Dec. 4-10	Dec. 11-17	Dec. 18-24
Mallard		46.3	53.1	60.5	69.4	74.8	78.4	85.3	86.8	66.9	74.2
Green-winged teal	18.0	12.1	10.4	7.0	5.5	5.8	4.4	2.4	1.0	0.7	
Wigeon		5.9	6.0	4.5	3.8	3.0	2.4	1.9	1.5	6.7	1.6
Gadwall		3.0	3.4	4.9	4.3	1.8	2.0	1.5	3.2	2.9	2.1
Pintail		4.3	4.8	3.2	2.6	1.9	1.3	1.0	0.5	3.2	
Black duck		0.5	0.9	0.9	1.0	1.4	1.3	1.3	1.9	1.8	2.6
Blue-winged teal	8.9	5.2	1.9	0.9	0.8	0.5	0.6	0.3	0.2	0.1	
Shoveler		0.8	0.5	0.4	0.5	0.4	0.5	0.3	0.2	6.0	
DABBLERS		78.0	80.8	82.4	86.4	89.5	91.1	93.9	95.2	88.4	80.5
Wood duck		15.4	13.9	10.4	6.8	5.0	3.6	2.1	1.6	1.1	9.5
Scaup		6.6	3.1	4.1	3.8	2.6	2.6	2.0	1.1	3.6	
Ring-necked		1.3	1.0	1.1	1.4	1.1	0.8	2.3	0.7	1.2	
Redhead		0.5	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.1	
Bufflehead		T[a]	0.2	0.2	0.3	0.4	0.6	0.3	0.3	0.3	2.9
Canvasback		0.1	0.2	0.3	0.4	0.3	0.3	0.4	1.7	1.6	1.4
Mergansers		T		0.1	T		T		T		
Goldeneye								0.1	T		
Ruddy duck		0.1	0.1	0.5	0.1	0.2	0.1	0.1	0.1	1.4	
DIVERS		8.6	5.0	6.7	6.3	5.0	4.6	3.3	2.7	8.2	4.2
Total[b]	99.9	102.0	100.0	99.3	101.1	99.5	99.1	101.5	100.5	97.6	94.3

[a] Trace kill of <0.05%.

[b] Total does not include unusual or unspecified species.

Table 2-12. Average percentage of the species composition of the total duck harvest for each week of the hunting season at Illinois Department of Conservation public hunting areas with check stations, 1977-1981.

		Weeks									
Species	Teal Season	Oct. 16-22	Oct. 23-29	Oct.30-Nov. 5	Nov. 6-12	Nov. 13-19	Nov. 20-26	Nov.27-Dec 3	Dec. 4-10	Dec. 11-17	Dec. 18-24
Mallard		24.8	34.3	48.7	58.8	65.0	70.3	75.7	75.2	76.0	67.6
Green-winged teal	20.2	8.9	8.8	5.3	4.6	4.0	2.7	2.3	2.2	1.8	
Wigeon		5.1	5.2	3.5	3.4	3.0	2.2	2.3	2.5	1.5	
Gadwall		3.6	4.5	3.5	3.3	2.5	2.3	1.9	1.9	3.6	13.2
Pintail		3.4	4.8	3.3	3.5	3.0	3.3	2.9	1.2	2.4	
Black duck		0.2	0.5	0.8	1.0	1.0	1.1	1.7	2.1	4.4	2.0
Blue-winged teal	79.8	7.5	2.5	0.8	0.5	0.4	0.3	0.4	0.4	0.8	
Shoveler		1.9	1.2	1.0	1.2	1.5	0.6	0.5	0.6	0.4	1.0
DABBLERS		55.3	61.8	67.0	76.4	80.2	82.7	87.6	85.7	85.8	83.7
Wood duck		38.2	27.4	17.2	8.8	6.6	3.3	1.9	2.6	3.9	
Scaup		3.6	5.2	8.2	7.0	5.7	6.0	5.1	4.8	0.3	1.0
Ring-necked		2.3	3.6	3.8	3.5	2.7	1.8	1.2	1.7	6.3	12.8
Redhead		0.4	1.1	1.0	0.8	0.5	0.5	0.4	0.2	0.1	
Bufflehead		T[a]	0.2	0.4	1.2	1.1	1.2	0.6	0.5	0.5	
Canvasback		0.1	0.5	0.5	0.6	0.7	0.7	0.4	0.9	0.1	
Mergansers			0.1	0.1	0.4	0.4	0.5	0.3	0.4		
Goldeneye			T	T	0.2	0.1	0.3	0.2	0.7		
Ruddy duck		T	0.3	0.6	0.6	0.7	0.8	0.5	0.4	0.1	
DIVERS		6.3	11.0	15.0	13.8	11.8	12.4	8.8	9.7	8.1	13.8
Total[b]	100.0	100.0	100.2	98.7	99.4	98.9	97.9	98.3	98.3	97.2	97.6

[a] Trace kill of <0.05%.

[b] Total does not include unusual or unspecified species.

public areas with the percentages of harvest of green-winged teal, wigeon, and lesser scaup being somewhat similar between the private clubs and IDOC areas.

Regarding the top five species in the Illinois harvest, the percentage of the total duck harvest represented by mallards each week increases throughout the season, whereas the percentages for wood ducks, green-winged teal, and wigeon decrease (Figures 2-4 and 2-5). The percentage of the total harvest represented by lesser scaup on private areas is highest during the first four weeks of the season after which the percentage slowly declines. On IDOC areas, the percentage of the kill attributed to lesser scaup peaked during the third and fourth week of the hunting season and then remained near the 5 percent level for the rest of the season.

The percentage of total harvest by weekly periods represented by the various species of ducks reflects the chronology of fall migration. Wood ducks, green-winged teal, and wigeon generally are most abundant early in the hunting season, large flights of lesser scaup usually appear in early November, and mallard numbers peak later in the season replacing the earlier migrants. Correspondingly, mallards comprised 24.8% of the harvest at IDOC areas for the week of 16-22 October and this increased to 75.7% for the week of 27 November-3 December while wood ducks decreased from 38.2% to 1.9% for the same periods (Table 2-12).

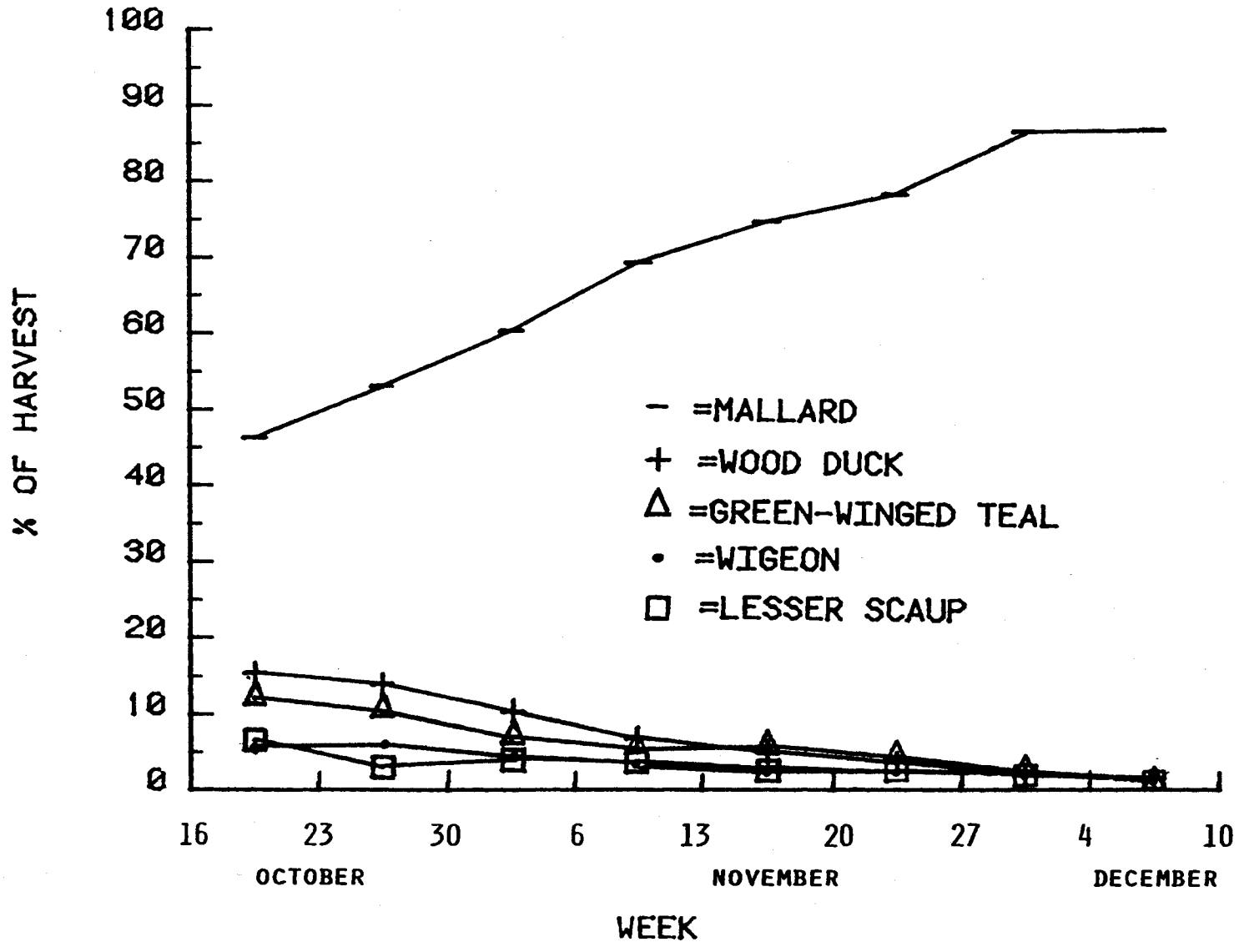

Figure 2-4. Average percentage of species harvest by week for private clubs, 1977-1981.

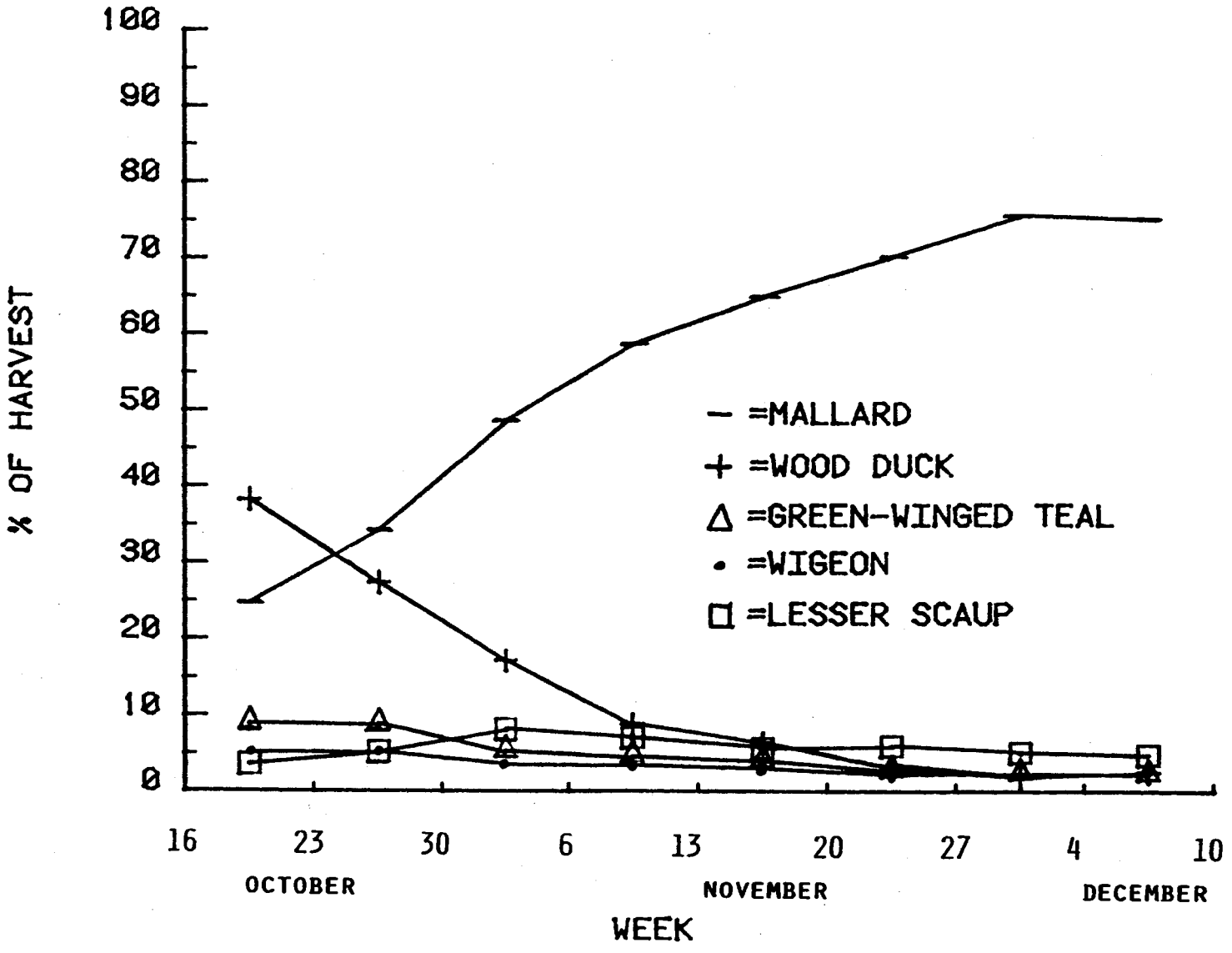

Figure 2-5. Average percentage of species harvest by week for IDOC public areas, 1977-1981.

The IDOC sites (Table 2-12) harvested a lower percentage of dabblers, and higher percentages of wood ducks and divers than private clubs (Table 2-11) on a weekly basis during the hunting season. The percentage of each species of divers and divers as a group harvested by week at IDOC sites was generally about twice the percentage of divers in the harvest shot at private clubs. The higher percentages of dabblers shot on private clubs (Table 2-11) by week of the hunting season as compared to IDOC sites (Table 2-12) was a result of higher proportions of mallards in the kill on private clubs.

Chronology of Harvest and Hunter Activity

It is beneficial for management and regulations to document hunting pressure and the chronology of harvest of each species of duck through the hunting season. Thus, if the mallard and pintail harvest needs to be reduced as is currently the situation, then a reduction of the harvest of species can be based on facts.

The chronology of hunters activity and species harvested expressed as a percentage by week of the hunting season at private duck clubs and IDOC areas with check stations are presented in Tables 2-13 and 2-14, respectively, for the period of 1977-1981. The percentage of hunter-days expended per week of the hunting season was similar in magnitude at both the private clubs and the IDOC sites.

Table 2-13. Hunter-days and species chronology of harvest expressed as an average percentage by week of the hunting season at private duck clubs, 1977-1981.

Species	Weeks											
	Teal Season	Oct. 16-22	Oct. 23-29	Oct.30-Nov. 5	Nov. 6-12	Nov. 13-19	Nov. 20-26	Nov.27-Dec 3	Dec. 4-10	Dec. 11-17	Dec. 18-24	Total
Hunter-days	1.6	8.8	17.4	14.5	15.1	13.6	13.3	9.6	5.4	0.5	0.3	99.8
Mallard		7.5	14.8	12.9	15.3	15.6	14.0	12.0	7.6	0.3	T[a]	100.0
Green-winged teal	4.6	17.7	29.4	13.9	11.4	11.4	7.5	3.4	0.7	T		100.0
Wigeon	0.1	15.6	28.8	16.2	14.5	10.7	7.1	4.4	2.2	0.3	T	99.9
Gadwall	0.1	11.2	24.2	21.9	14.7	9.0	8.4	5.0	5.1	0.4	T	100.0
Pintail		16.8	30.2	16.7	14.3	10.2	6.8	3.5	1.2	0.3		100.0
Black duck		5.2	15.7	12.2	14.0	16.8	14.5	11.4	9.8	0.3	0.1	100.0
Blue-winged teal	54.0	17.3	13.0	5.0	4.4	2.3	2.7	0.9	0.3	T		99.9
Shoveler	0.1	19.0	21.3	12.0	13.5	12.1	10.9	5.8	4.1	1.2		100.0
Wood duck	T	21.1	33.3	17.5	12.0	7.3	5.0	2.4	1.2	0.1	T	99.9
Scaup	0.1	8.1	23.0	18.5	19.0	12.5	10.3	6.0	2.4	0.4		100.3
Ring-necked	0.2	8.6	19.3	16.2	22.2	15.2	10.0	5.2	3.6	0.2		100.7
Redhead	0.1	9.0	27.7	17.9	17.0	11.7	8.1	4.5	3.7	0.1		99.8
Bufflehead		1.3	12.3	11.1	17.2	18.1	23.0	8.8	7.5	0.1	0.7	100.1
Canvasback		3.4	15.6	15.0	18.4	20.0	10.9	11.3	4.0	1.0	0.4	100.0
Mergansers		3.1	7.5	28.8	24.6	5.6	17.5	1.3	11.8			100.2
Goldeneye				6.3		25.0	40.0	20.0	8.8			100.1
Ruddy duck		2.4	16.5	34.1	8.7	18.7	10.9	4.8	3.0	1.0		100.1
ALL DUCKS	2.0	10.3	18.5	13.9	14.5	13.7	11.7	9.3	5.8	0.3	T	100.0

[a] Trace kill of <0.05%.

Table 2-14. Hunter-days and species chronology of harvest expressed as an average percentage by week of the hunting season at Illinois Department of Conservation public hunting areas with check stations, 1977-1981.

	Weeks											
Species	Teal Season	Oct. 16-22	Oct. 23-29	Oct.30-Nov. 5	Nov. 6-12	Nov. 13-19	Nov. 20-26	Nov.27-Dec 3	Dec. 4-10	Dec. 11-17	Dec. 18-24	Total
Hunter-days	1.6	6.9	16.0	14.4	16.3	13.3	14.8	9.9	6.0	0.9	0.2	100.3
Mallard		4.2	11.9	13.0	18.0	16.1	16.8	12.6	6.9	0.6	0.1	100.2
Green-winged teal	6.6	14.5	30.2	13.7	13.5	9.5	6.3	3.8	1.7	0.2		100.0
Wigeon		12.0	27.7	16.7	16.1	11.2	8.0	5.5	2.6	0.2		100.0
Gadwall		9.1	26.5	16.2	18.0	11.5	9.3	5.7	3.2	0.4	0.1	100.0
Pintail		8.4	25.4	14.4	16.7	11.9	13.2	7.7	1.8	0.3		99.8
Black duck		2.8	10.5	12.9	16.0	15.8	15.1	16.2	8.6	2.1	0.2	100.2
Blue-winged teal	47.8	22.7	16.0	4.0	3.4	2.3	1.4	1.3	1.0	0.1		100.0
Shoveler		14.2	24.9	12.9	17.6	15.6	7.5	3.8	3.4	0.2	0.1	100.2
Wood duck		25.6	38.0	16.7	9.4	5.1	3.0	1.3	0.9	0.1		100.1
Scaup		3.2	19.6	19.0	20.2	13.7	13.9	7.1	3.6	T[a]	T	100.3
Ring-necked		6.9	24.9	18.6	21.0	13.2	8.4	4.0	2.1	0.7	0.4	100.1
Redhead		4.2	29.7	18.9	19.6	11.0	10.1	4.9	1.7	0.1		100.2
Bufflehead		0.4	6.6	7.6	22.5	19.9	30.7	7.6	4.4	0.4		100.1
Canvasback		0.8	16.1	11.4	16.5	17.7	20.4	8.5	8.6	0.1		100.1
Mergansers			6.1	8.5	25.9	15.9	28.6	8.6	6.4			100.0
Goldeneye		0.2	2.2	3.7	10.7	9.4	32.5	21.5	19.8			100.0
Ruddy duck		0.9	14.9	19.7	15.1	16.9	19.2	9.2	3.9	0.1		99.9
ALL DUCKS	1.9	8.7	18.9	14.0	16.3	13.2	12.9	8.8	4.8	0.4	0.1	100.0

[a] Trace kill of <0.05%.

The percentage of hunter days was highest shortly after the beginning of the season (16.0% to 17.4%) and remained above 10% for each week until the last few days of November (Tables 2-13 and 2-14, Figure 2-6). Some discrepancy exists for the percentage of hunter-days for the week of 16-22 October compared to the week of 23-29 October because opening day of the duck season varied during the 1977-1981 period (Table 2-2) and the number of days hunting was allowed in each of these two weeks differed among years.

A somewhat consistent level of hunting pressure for ducks occurred from the opening of the season through November (Figure 2-6). Analyses of kill data from the Duck Island Club from 1894 to 1938 demonstrated that an average of 70.5% of the hunter-days for the seasons were spent between 18 October and 28 November when for several years during that period the season opened in September (Table 2-2). Generally after Thanksgiving, many areas are troubled with colder temperatures, freeze-ups, fewer numbers and species of ducks, and hunter fatigue.

The percentage of the total number of ducks shot by week at IDOC and private clubs from 1977-1981 closely followed the pattern of hunter-days (Figure 2-6). On both private clubs and IDOC sites, 1.6% of the hunter-days expended annually during 1977-1981 occurred during the teal season (Tables 2-13 and 2-14).

The percentage of the harvest for each species by week of the hunting season is enlightening. For example, approximately

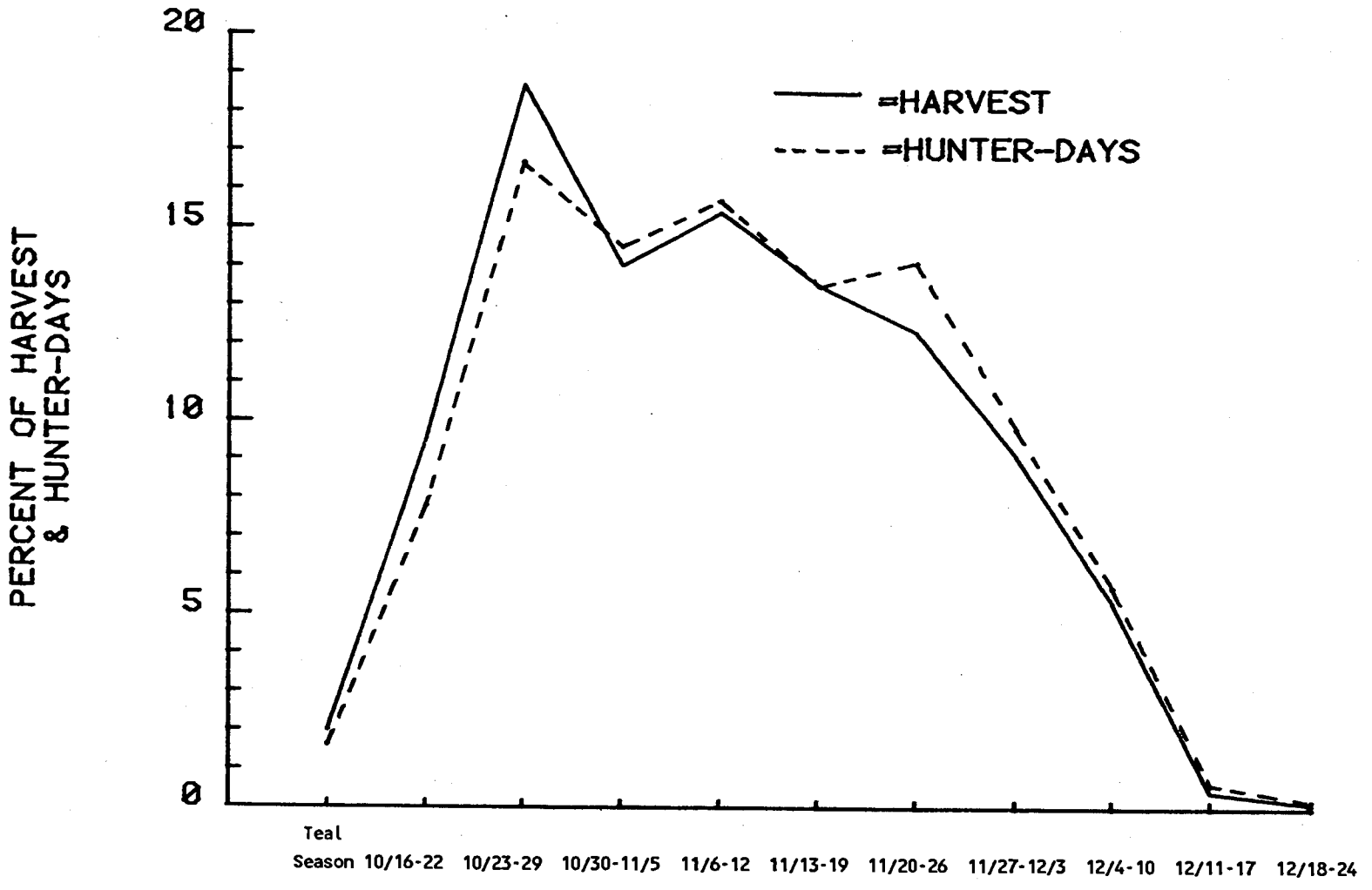

Figure 2-6. Average percentage by week of the total harvest of all duck and hunter-days at both IDOC public hunting areas with check stations and private duck clubs combined, 1977-1981.

12% or more of the total annual mallard harvest at private clubs (Table 2-13) and IDOC sites (Table 2-14) occurred each week from 23 October to 3 December with the highest percentages of kill generally occurring for the weeks during 6-26 November. During the three weeks of 6-26 November, 50.9% and 44.9% of the total mallards harvested occurred on IDOC sites and private clubs, respectively, for the 1977-1981 period (Tables 2-13 and 2-14). A similar pattern of harvest occurred at the Duck Island Club from 1914-1936.

Similarly, the critical time period during the hunting season when the majority of each species of duck was harvested can be obtained from Tables 2-13 and 2-14. The 21-day period representing the time frame when approximately 50% or more of the harvest for each species occurred was similar for most species shot on the private clubs (Table 2-13) and IDOC areas (Table 2-14) for the 1977-1981 period with a slight discrepancy of 1 week for wigeon and canvasbacks and 2 weeks for mergansers (Mergus spp.) occurring between IDOC areas and private clubs. According to Tables 2-13 and 2-14, 50% or more of the harvest of the species listed occurred during the respective 21-day period as follows: blue-winged teals -- teal season and 16-29 October; green-winged teals, pintails, shovelers (Anas clypeata), wood ducks -- 16 October to 5 November; wigeon, gadwalls, scaup, ringnecks, and redheads -- 23 October to 12 November; ruddy ducks -- 30 October to 19 November; black ducks, buffleheads (Bucephala

albeola), canvasbacks and mergansers -- 6 to 26 November; and goldeneyes (B. clangula) -- 13 November to 3 December. For all ducks the 21 day period from 23 October to 12 November represented an average of 46.9% of the total duck harvest at private duck clubs and 49.2% of the kill at IDOC sites from 1977-1981 (Tables 2-13 and 2-14).

Historical and Current Hunting Information

Waterfowl hunting has historically been a popular sport in Illinois. Through the years the sport has been affected by changes in wetland habitat and game laws and by decreasing numbers of waterfowl. A 1939 hunter questionnaire and a 1943 hunting-equipment inventory from the Havana Laboratory files revealed some interesting information about hunting styles in that era.

The 125 hunters that were questioned averaged 44 years of age (range: 25-76) and had been duck hunting for an average of 21 years (range: 1-65 years). When asked what types of shooting they did, 55% mentioned marsh shooting; 31%, river; 13%, dryland; 4%, pond; and less than 2% for each category of lake, creek, slough, and timber. Seventy percent of the hunters used decoys to attract ducks and 15% were assisted by professional "pushers" or guides who rowed or poled boats for hunting. Sixteen percent pass shot flying ducks and 14% jump shot ducks as they flushed from bodies of water.

The favorite brands of shotguns of the hunters questioned were Winchester, 38%; Remington, 32%; and Browning, 15%. Other brands reported included L.C. Smith, Savage, LeFever, Springfield, Stevens, Ithaca, Colt, Parker, and Ranger. The majority (43%) preferred double-barreled shotguns. Most chose 12 gauges. Sportsmen questioned used from 4 shells to 2 cases of shells (1,000) during the entire 1939 hunting season, which extended from 22 October to 5 December. That season compared in length to our current 50-day season, although Illinois now has 3 hunting zones with varied season dates. They reported killing from 1 to 515 ducks per man during the 1939 season for an average of 40 ducks per hunter. The daily limit in 1939 was 10 ducks, with no wood ducks and 3 canvasbacks allowed; today the 100-point system is used. Two dozen hunters reported shooting geese, coots (Fulica americana), and snipe (Capella gallinago) with an average kill per hunter of 9 geese, 11 coots, and 15 snipe.

According to the questionnaire, dogs were not widely used for duck hunting in 1939. Only 14% of the hunters mentioned dogs when questioned about their hunting methods. Spaniels of the American, springer, water, and cocker varieties were the most popular hunting dogs (62% of those reporting), followed by Irish setters (25%) and Labrador retrievers (20%). In recent years, the Labrador retriever has increased in favor with duck hunters.

In 1939, 125 hunters spent an average of $100 each for guns (range: $5-500), $44 each for hunting clothes and boots (range: $7-250), $110 each for boats and motors (range: $6-1,000), $46 each for those who used decoys, and $127 each for those who owned dogs. Unspecified transportation cost $24/hunter and room/board for those without their own cabins cost $33/man for the 1939 hunting season. The common rate for dressing bagged ducks was 17¢ duck (range: 10¢-25¢).

Among the historical records of the Senachwine Club near Henry on the Illinois River was a 1943 personal inventory list of the hunting equipment owned by one of the members: Parker 12-gauge double-barreled shotgun, $163; Super X 12-gauge #5 shot shells, 5 1/4¢ each; #2 shot shells, 6¢ each; wool trousers, $8; flannel-lined chamois leather shirt, $20; and a wool hunting coat, $15. In current catalogs, a set of wool trousers and coat, rarely used with the advent of insulated clothes, cost about $100, and genuine chamois-lined shirts are not even available from the sporting goods companies checked. A pair of hip boots costing only $8 in 1943 would sell for about $40-60 today; leather hunting gloves costing $1.50 would sell for $20-30 today; and duck calls comparable to the True-tone, Allen, and Browning calls listed at $1-3 would sell for about $5-10 today. Twenty-five dollars bought a dozen wooden decoys in 1943; today, a dozen plastic decoys costs about $35-60. A

final item of interest on the inventory was an unpriced set of decoy weights for live decoys.

In recent years, Anderson (1983) found that Illinois duck hunters averaged 36.2 years of age and more than half (56.3%) were in their twenties or thirties. Approximately 93% of those who hunt ducks in Illinois live in Illinois and 98.6% of Illinois duck hunters are male (Anderson 1983). Anderson (1985) revealed that 90% of Illinois waterfowl hunters used 12 gauge shotguns in 1984, 2% used 16 gauge, and about 8% indicated 10 gauge. Anderson (1985) also found that 42% of Illinois duck hunters used reloaded shotgun shells and 44% owned a boat used for waterfowl hunting. In addition, most Illinois duck hunters (48.1%) spent between $100 and $500 in 1981 to hunt ducks and the average amount of money spent by hunters who pursued ducks in Illinois in 1981 was $462 (Anderson 1983). The average duck hunter spent 12.9 days afield in 1981 and shot an average of 8.2 ducks (Anderson 1983). Thus, each day afield cost the Illinois duck hunter $35.95 on the average and each duck shot was worth $56.27. Anderson (1983) estimated that $25.6 million was spent for waterfowl hunting in Illinois for the 1981 season.

The Swan Lake Club had noted that out of 34 members in 1928, 29 (85.3%) used 12 gauge shotguns, 3 (8.8%) used 20 gauges, and 2 (5.9%) used both 12 and 20 gauges. The 12 gauge was as popular in that era as it is now (Anderson 1985).

Waterfowl Harvest and Regulations

The evaluation of the harvest of ducks shot at private clubs and public hunting areas from 1977-1981 included a change in the point system value of drake mallards. During the hunting seasons of 1977 and 1979-1981, the point value of drake mallards was 25 points. In 1978, the point value for drake mallards was 35 points. During the seasons of 1977-1979, Illinois had two waterfowl zones and during the 1980 and 1981 seasons, three zones were established. Complications derived from changing point values of drake mallards and changes in zoning made results from analyses of the effects of regulations on the duck harvest in Illinois difficult for the 5-year period of 1977-1981.

INHS census data and harvest data were used to evaluate zoning and determine its usefulness in managing waterfowl hunting in Illinois (Anderson 1984b). Findings demonstrated that zoning did not significantly increase the harvest of ducks in Illinois, but that the kill was distributed differently within the state (Anderson 1984b). A significant increase in the harvest occurred in the northern zone of Illinois, no change resulted in the central zone, and a significant decrease occurred in the southern zone (Anderson 1984b). Although the duck harvest and days afield increased in the northern zone, hunting success decreased. Any type of zoning in Illinois, whether two or three zones, had a significant adverse effect on the quantity and quality of duck hunting in southern Illinois whereas it appeared to favor hunters

in northern Illinois and had no effect in the central section of the state (Anderson 1984b).

The susceptibility to being shot, or vulnerability, varies among the species of ducks because of their inherent wariness, feeding habits, flight patterns, flocking behavior, as well as their desirability by hunters. Bellrose (1944) found that mallards and black ducks were the least vulnerable to being shot, followed by scaup, canvasbacks, ruddy ducks, ring-necks, pintails, wigeon, gadwalls, the teals, and finally shovelers which were the most vulnerable. The point system currently used in Illinois addresses the population status of the various species, their vulnerability, and their desirability by hunters. Thus, the point system, or other varieties of the restrictions governing the daily bag limit, is an effective means of management of the harvest of ducks in Illinois.

Besides the bag limit, the length of season and the timing of the season are important in the harvest of the various species of ducks. Generally, early migrant species were found to be the easiest species to shoot (Bellrose 1944). However, ducks of most species are the easiest to shoot during the early segment of the season because juveniles are most abundant then. By using the chronology of fall migration data and chronology of harvest data for each species presented in this report, season length and timing for each species can be effectively determined in Illinois

for regulation of the harvest. Although the total harvest of ducks does not vary directly to the number of days in the hunting season, varying the length of the season is an advisable way to regulate the duck kill.

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