NOTE TO USERS

FOOD HABITS OF SHOREBIRDS

(CHARADRIIFORMES)

IN NORTHWESTERN IOWA

by

Gerald Bishop Spawn

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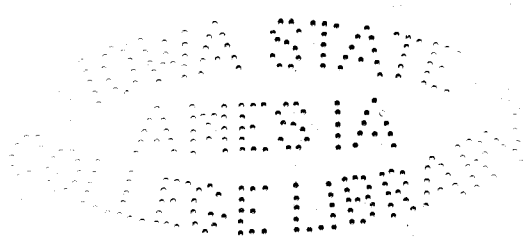

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

Head of Major Department

Signature was redacted for privacy.

Dean of Graduate College

Iowa State College

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I. INTRODUCTION

The past several decades in the history of North American migratory birds have shown that the shorebirds (Charadriiformes), like several other orders, have suffered great reductions in numbers. These birds, at one time very abundant, as legitimate game were taken in large numbers by market hunters, a practice which contributed greatly to their steady decline. Several species have become either extinct, as the eskimo curlew, Phaeopus borealis (Forster), is now thought to be, or have become very rare, such as the black-bellied plover, Squatarola squatarola (Linnaeus), Roberts (1932, Vol. 1, pp. 486 and 470).

The Migratory Bird Treaty Act of 1918 remedied somewhat the deplorable situation of the shorebirds. All species except Wilson's snipe, Capella delicata (Ord.), and the American woodcock, Philohela minor (Gmelin), were placed on the permanently protected list. In 1941 the Wilson's snipe was taken off the "open-season" list, leaving the woodcock as the only member of the group to be taken legally during the hunting season.

The system of migratory bird refuges established by the United States Fish and Wildlife Service, primarily benefitting ducks and geese, has also been an important step toward increasing the shorebird breeding stock. While most species go far north of the United States to nest, several species nest in the northern part of this country and the system of refuges mentioned has offered increased breeding grounds for these species.

However, from the standpoint of management designed specifically for shorebirds, little has been done except in the passage of certain laws, such as the Migratory Bird Treaty Act of 1918 as amended by Act of 1936. This is

an act to give effect to the conventions between the United States and Great Britain for the protection of migratory birds concluded at Washington, D. C. in 1916, and between the United States and the United Mexican States for the protection of migratory birds and game mammals concluded at the city of Mexico in 1936.

A knowledge of the food habits of a species of bird is quite essential in the establishment of an effective management program. Most references to the food of shorebirds apply to the United States as a whole, and with a few noteworthy exceptions, Sperry (1940) and Wetmore (1925), the statements relative to food habits are apparently based upon specimens taken from the country at large rather than from any one specific locality. In most cases the foods taken are merely listed by name and give no information on the percentage of birds taking the various food items. Recommendations for management should be made only after consideration of conditions which are more local in nature. Different areas will contain different species of plants and animals and the service rendered a species by a refuge will vary with the geographic location of the refuge; hence, local studies are necessary in order that recommendations may be based upon facts which pertain to those localities.

The desire to solve this problem, at least in part, supplied the main incentive for the northwest Iowa shorebird food habits studies. It is the author's sincere hope that the information contained in this treatise may aid materially in the laying of the groundwork for a shorebird management program in this and similar localities.

In this investigation 152 shorebird stomachs were examined. This number represents four species: (1) Wilson's snipe, Capella delicata (Ord.); (2) dowitchers, Limnodromus griseus subspecies griseus (Gmelin) and scolopaceus (Say) ; (3) lesser yellowlegs, Totanus flavipes (Gmelin); and, (4) greater yellowlegs, Totanus melanoleucus (Gmelin).

At the time these studies were begun (1934) the Wilson's snipe, commonly called jacksnipe, was legal game during the hunting season and because of this it was selected for food habits investigation.

Dowitchers, with no attempt to separate them into eastern and long-billed forms, were chosen because of their morphological similarity to snipe. This was done to determine the similarity or dissimilarity of the feeding habits of these two species. The bills and legs of the birds are very much alike making the probing and wading possibilities approximately equal. The habitat preferences, however, are considerably different.

The lesser yellowlegs, as a third species, was chosen because of the structural differences between it and the two species mentioned above. In comparison with snipe and dowitchers the bill of the yellowlegs is much shorter and possibly less sensitive, whereas the legs are much longer and more typical of the wading type. On the basis of structure, this would reduce the possibilities of probing and increase those of wading for the yellowlegs as compared with snipe and dowitchers.

Lastly, the three stomachs of greater yellowlegs were included because of the near relationship of these birds to the lesser yellowlegs. The writer realizes that nothing conclusive can be drawn from the examination of

only three stomachs. They were available and were therefore included for whatever value the records might afford.

The results of the analyses of the stomachs are given in table 1, in which is shown the number of birds of each species containing the various food items found. Tables 3, 5, and 7 show for snipe, dowitchers, and lesser yellowlegs, respectively, the kinds of food taken, the numbers of birds in which each item occurred, the total number of specimens of each item taken and the percentage of birds, in each case, in which these were found.

II. REVIEW OF LITERATURE

Earlier investigators have published numerous general statements, but very little specific information, regarding the food habits of shorebirds. Such general statements, with certain exceptions, sum up the food habits of the birds for the whole of North America north of Mexico.

Wilson (1840), with reference to dowitchers, stated that "they frequent the sand bars and mud flats at low water, in search of food." Concerning the lesser yellowlegs, he said,

> It inhabits our sea coasts and salt marshes during summer; frequents the flats at low water, and seems particularly fond of walking among the mud, where it doubtless finds its favorite food in abundance.

Coues (1874) mentioned having seen dowitchers ". . . probing for the various water bugs, leeches, worms, and soft mollusks, which form their food, as well as the seeds of various water plants."

Florence M. Bailey (1908) quotes Vernon Bailey as follows:

> The plump jack snipe with the striped back is a prober rather than a wader, as his short legs and long bill attest. He pokes about in the muddy bottoms, under grass, flags and tules, fishing up his food from the soft mud, the sensitive tip of his long bill enabling him to select the choicest worms and other dainty morsels.

The following statement regarding dowitchers is given:

> In their migrations . . . usually found in little flocks along the coasts or among the prairie sloughs or marshes, flying swiftly low over the ground, or feeding in close bunches.

Nothing is said about the kinds of food taken in the latter case.

Treating shorebirds of Massachusetts and adjacent states, Forbush (1912) writes concerning snipe,

> Their food consists largely of insects, including grasshoppers, locusts, cutworms and beetles, with such others as may be picked up from cultivated fields and marshes. Earthworms, leeches, seeds of smartweed and other plants, together with roots and other vegetable matter, have been found in their stomachs. Enough is known of their food habits to place them among the beneficial species,

and states that the dowitcher " . . . is fond of sea-worms and other forms of marine life, for which it probes with its long bill." About the greater yellowlegs, he says that it " . . . picks up little minnows and other aquatic forms of life. It seems to be very fond of both land and water insects and must do considerable good as an insect eater," and of the lesser yellowlegs, "Its habits are similar to those of the greater yellowlegs, and it feeds largely on insects, including ants."

Chapman (1914) writes of the snipe,

> Two things are essential to its requirements--ground so thoroughly water-soaked as to afford slight resistance to its long and highly sensitive bill when probing, and such concealment as tussocks, hillocks, or long grass afford, for, . . . the snipe rarely ventures out on bare mud flats, save under cover of darkness. It feeds and migrates chiefly by night or in "thick weather,"

and comments as follows regarding dowitchers, "Mud flats and bars exposed by the falling tides are their chosen feeding grounds."

Wetmore (1925), while on the staff of the U. S. Biological Survey, prepared a report on the food of American phalaropes, avocets, and stilts. This was a detailed report and tables were included to show the kinds of food taken and the numbers of each item consumed. His tables are on a comparable basis with those of the author, but the species involved in the investigation are different. The specimens examined by Dr. Wetmore came from widely distributed areas.

Bent (1927) writes,

> Earthworms probably constitute the principal food of the Wilson snipe, but it also eats cutworms, wireworms, leeches, grasshoppers, locusts, beetles, mosquitoes, other insects and their larvae, and some seeds of marsh plants.

Concerning the lesser yellowlegs, he states,

> The favorite feeding grounds . . . are on flat marshes near the coast where the grass is short and where the high course of tides or heavy rains leave the marshes partially covered, or dotted, with shallow pools or splashes; away from the coast it is equally at home in wet, short-grass marshes, mud flats, shallow ponds and even wet places in cultivated fields.

He indicates that other investigators have found the birds feeding " . . . mainly on insects, including ants, bugs, flies, and grasshoppers, and on small crustaceans, small fishes and worms," and states further that Dr. Alexander Wetmore, reporting on the food of four birds taken in Porto Rico, says that,

> . . . water boatmen found in each of the four made 57.5 per cent, and two stomachs contained nothing else. Crustacean remains, among which were several crabs, were identified in two stomachs, and make the remainder, 42.5 per cent.

Bent, (1927) states,

> The greater yellowlegs seems to prefer to feed in shallow water; its long legs enable it to wade in deeper water than most other waders, and it is often seen using them to their fullest extent in water up to its body . . . Much of its food seems to consist of small minnows . . . I have occasionally seen greater yellowlegs on damp, grassy meadows where they were probably feeding on insects or their larvae, snails, worms or crustaceans, all of which have been found in their stomachs.

Bent (1929) says regarding dowitchers,

> Various observers have noted among the food items of the dowitcher grasshoppers, beetles, flies, maggots, marine

> worms, oyster worms, leeches, water bugs, fish eggs, small mollusks, seeds of aquatic plants and the roots of eel-grass.

Roberts (1932) quotes Bent on the food habits of snipe. He lists the food of dowitchers as, "The larvae of midges, flies and dragonflies; leeches, certain mollusks and also seeds."; for greater yellowlegs, he records, "Small fish, snails, insects and larvae, worms, crustaceans, etc.," and for lesser yellowlegs, "Grasshoppers, flies, ants, water boat-men, worms, crustaceans, etc. Of service economically."

Pearson (1940) states,

> The food of Wilson's snipe is known to include crane-flies ("leather jackets"), locusts, grasshoppers, crawfishes and the predaceous diving beetles which cause trouble in fish hatcheries and destroy much of the natural insect food of fishes.

His statements about the food of the dowitcher are very much the same as for snipe except that he adds to the list " . . . various marine worms which prey upon oysters." Concerning the greater yellowlegs, he writes, "Their food consists of minnows and such insects and other small forms of life as are obtainable in and about the water," and about the food habits of lesser yellowlegs he quotes Forbush (1912).

Sperry (1940) gives a detailed account of the food habits of Wilson's snipe, dowitchers, woodcock and knot. The stomachs analyzed were obtained from most of the States, Alaska and several Canadian Provinces. In some instances a number of specimens were taken from one locality but in analytical treatment all the birds of one species were grouped together thus making the discussions general for the entire country rather than specific for any particular locality. Sperry lists the foods eaten and

discusses the amounts taken, especially of the most important items. Insects are stated to be by far the most important items of diet for Wilson's snipe and dowitchers. Table 1, of this dissertation, is directly comparable to table 2, p. 22, of Sperry's bulletin (1940), except for the species of birds examined. Both studies, however, include Wilson's snipe and dowitchers.

III. DESCRIPTION OF COLLECTING AREAS

The shore birds considered in this paper were collected mainly at eight different areas, one of which (Lost Island Lake) was subdivided into three separate areas. General descriptions of the collecting grounds, as they were during the fall of 1934, are given below. Plate I is a map of the Ruthven area, in which the northwest Iowa collections of shorebirds were made.

Whitford Slough

Whitford Slough lies just south of highway No. 18, about two miles west of Ruthven, in Clay County, Iowa, (see Plate I.). It is an area approximately a quarter of a mile wide and between one-half and three-quarters of a mile long.

In 1934 the slough formed a part of a moderately large pasture and livestock grazed the margins of the area at will. The strip of land, varying in width from approximately ten to sixty feet, from the shore line to the edge of the upland area surrounding the marsh was considered as the margin of the slough.

At the time the collections of birds treated in this dissertation were made, the slough contained about three to nine inches of water.

Over the entire area the vegetation was that typical of low, moist

land to marsh. On the northeast margin of the slough the vegetation was mainly of marsh grass or cordgrass (Spartina sp.). At the north end of the area and along the west side sedges, (Carex spp. and some Cyperus spp.), made up most of the vegetation. Along the east edge and the south end was a margin of bulrushes (Scirpus spp.). These plants also grew in clumps throughout the central part of the slough. They formed what might be called a dispersed phase or type of vegetation with a combination of sedges making up the continuous phase or type. There was very little open water within the area. At the time most of the collecting was done (October and November, 1934) the vegetation had fallen to within from one to eight inches of the surface of the water, except for isolated patches of bulrushes and some cat-tails (Typha sp.), and there were formed numerous tufts of vegetation interspersed with mats of leaves and stems. All in all, a very rough and shaggy appearance was presented by the plant growth.

Snipe were flushed from the entire area although most frequently from that part within fifty yards of the margins. This may or may not be taken to indicate, on the part of snipe, an "edge effect" such as is shown by other groups of birds, e.g., upland game species.

Snipe were far more numerous in this locality than was any other species of shorebird observed. The slough was similar to descriptions given by other writers as typical for snipe. These facts and the apparent scarcity of snipe at other areas, except those very similar to Whitford Slough, indicate a very decided preference on the part of this species of bird for the type of area described above and the slough was consequently considered

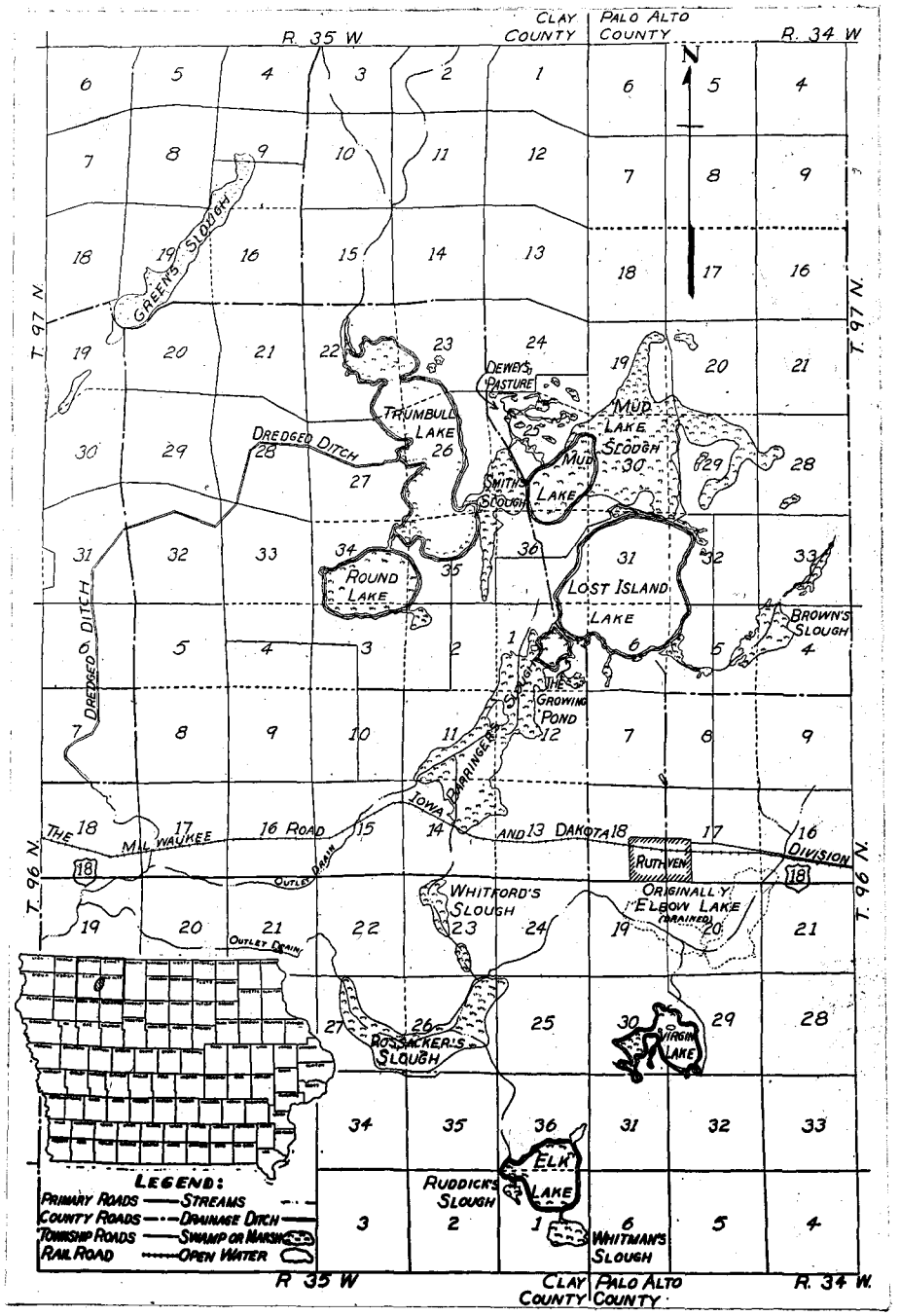

Plate I. The Ruthven Area

(Courtesy of Collegiate Press, Ames, Iowa)

to be ideal for Wilson's snipe.

Lost Island Lake

Lost Island Lake lies 2.5 miles north of Ruthven. It is an open water lake about 1.5 miles long and of approximately the same width at the widest part. About the west one-fifth of the lake area lies in Clay County; the remainder is in Palo Alto County (Plate I.).

Collections of birds were made from three shore areas designated as: Lost Island Lake, Clay County; Lost Island Lake, Palo Alto County; and Electric Park.

Electric Park is at the south side of the lake. The few birds collected from this location were taken from an area of white sand beach. Sedges grew from shore line, in some places, back for a distance of approximately 30 feet from the water. At other places there was practically no vegetation along the shore.

The Clay County collecting area consisted of a strip of sand and mud beach about a quarter of a mile in length, just north-east of the area designated, on Plate I, as the Growing Pond. The shore of the lake and in general the area from the shore back for a distance of 5 to 30 feet supported no vegetation. Back from this strip sedges and spike rush (Eleocharis sp.) as well as several kinds of grasses (Gramineae) grew rather abundantly.

The Palo Alto County collecting area extended over approximately one-half mile of shore along the north side of the lake. The beach was of mixed sand and mud over the entire distance. It also included one small, rather rocky point which extended rather bluntly out into the lake for a short distance. Here again, the shore line and a narrow adjacent strip eight to ten feet wide were almost devoid of vegetation. Back from this strip sedges, spike rush, sweet clover (Melilotus spp.) and several species of grasses grew abundantly. The sweet clover growths made a fine blind from which to observe the shore birds. Sago pondweed (Potamogeton pectinatus) and other aquatic vegetation grew rather profusely in the shallow water which extended out into the lake for some distance at this particular shore.

The latter two areas on Lost Island Lake were the best to be found for shore bird observations, other than of snipe, and most of the studies were conducted there.

Mud Lake Bridge Pond

This pond is located at the bridge between Smith's Slough and Mud Lake, (Plate I.), northwest of Lost Island Lake, in Clay County. It is a mud-bottomed pond and at the time sedges and cordgrass (Spartina spp.) made up the major portion of the immediately surrounding vegetation. At only a short distance from the pond, however, bulrushes, cat-tails and sedges grew

abundantly.

Pritchard's Pasture Pond

Pritchard's Pasture lies just north of Dewey's Pasture (See Plate I.), Clay County, Iowa.

The pasture contains a mud-bottomed pond of about a half an acre in area around which the collecting was done. This was one of the areas from which relatively few birds were taken. The shore of the east one-third of the pond was practically devoid of vegetation, leaving coverless, mud flats, of from two feet to about 25 feet in width, surrounding the water. This type of shore is used extensively at times by almost all species of shore-birds. The remainder of the shore area of this pond supported growths of sedges, some smartweed (Polygonum sp.) and cordgrass. The latter occurred also on hummocks just southwest of the pond.

Round Lake

Round Lake lies two miles west of Lost Island Lake, or three miles north and three miles west of Ruthven. It is an area of some open water but with many patches of bulrushes scattered throughout the open portion of the lake. The margin of the lake, except for part of the south side, was heavily grown to bulrushes, cat-tails and cane (Phragmites sp.). The south

side of the lake presented, in 1934, a partly open shore line of mud and sand beach with sedges (Carex sp.) and some spike rush a few feet back from the shore proper. All specimens collected at Round Lake were taken from the south side.

Roland's Farm Pond

Roland's Farm is located three miles west and two and one-half miles north of Ruthven, Clay County, Iowa, or, to give its location slightly more exactly with regard to lake areas, it is approximately one-half mile southwest of Round Lake.

The pond, in the fall of 1934, was from 60 to 75 feet wide and approximately 150 feet long. It was situated within the farmyard pasture about 200 feet from the barn. Except at the southwest end of the pond there was no vegetation other than that of a well-grazed pasture. At the southwest end there were a few low hummocks crowned by a sparse growth of cordgrass. Most of the snipe observed in this locality were seen at this end of the pond. A narrow mud-flat shore, approximately eight feet wide and sixty feet long, surrounded the north-east part of the water area. Farm stock used the pond as a water-hole and the shore was very much cut up by hoof marks in which, in a number of cases, snipe were found to be hiding.

Elk Lake

Elk Lake lies just west of the Clay-Palo Alto County line, in Clay County, Iowa, (Plate I.). It is one-half mile west and three miles south of Ruthven. The lake itself covers an area of not quite half a section.

The shore of the lake is bordered by bulrushes on the north where they also extend out into the water. Isolated patches of rushes appear in the open water along the east and southeast sides of the lake. Pasture land extends to the shore line. Along the east and south sides the beach is, in part, of white sand.

At the northeast side of the lake, near the sand beach, is a slight ridge of soil which may have been formed by ice pressure from the lake. This ridge has caused the formation of a small area where run-off water from heavy rains collected to form a temporary pond which then had a bottom covered with pasture grasses. The small pond formed in this way was about 25 feet from the lake proper. The specimens collected from Elk Lake were taken from the pond described above, a temporary pond.

Virgin Lake

Virgin Lake lies about a mile and a half straight south of Ruthven, (Plate I.). It is an open water area with patches of bulrushes growing in some parts where the water is shallow. The shore and beach of the lake are

of white sand. At the southeast side of the lake there is a small area of swamp which supports a growth of sedges around the margin with water smartweed, pondweed, and some bulrushes over the inner areas of the pond. The shores are grass covered, and there are no mud flats adjacent to this particular small body of water. Virgin Lake specimens were taken at this pond.

IV. METHOD OF FOOD HABITS ANALYSIS

The system used in making the analysis of stomach contents may be termed the taxonomic specimen-enumeration method. Each food item was classified into its lowest possible group and the number of such specimens found in each bird was recorded. These are listed in the various tables.

The stomachs of the birds, as the specimens were collected, were preserved in 50 percent alcohol. The same strength alcohol was used for dilution of the preserved material when the analyses were made. This procedure prevented to a considerable extent the breakage of insect specimens, etc., which had been taken as food. Separation of the material was made by the aid of a dissection binocular.

Identifiable material ranged in size from the almost microscopic statoblasts of bryozoa to larvae of predaceous diving beetles, one of which was 6 centimeters in length and alone practically filled the stomach of a jacksnipe.

The material was checked and classified as far as possible by the author. Certain of the specimens were then sent to specialists (see acknowledgments) for checking of the identifications and for further identification than the author was able to make. Comparisons were then made with the latter and specimens which were not sent to specialists.

Stones were separated from the remainder of the material and were counted. The entire mass of stones from each individual was also weighed by means of a chainomatic scale which gave accurate determination of weight to a ten-thousandth of a gram.

Snail shells and pieces of shells were also separated from other material and were weighed as mentioned above.

Table 1, below, gives a systematic list of the animal and plant food found in the stomachs examined.

Table 1. Systematic List of Foods Found in Shorebirds and the Number of Stomachs in which Found[1]

ANIMAL FOOD

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellow-legs	Greater Yellow-legs
Stomachs Examined	67	11	71	3
PORIFERA				
Haploscleridae				
Spongillinae(fresh-water sponges)				
Undetermined	16	1	1	
Carterius tubisperma Mills. (gemmules)			1	
NEMATHELMINTHES				
Nematoda			1	
BRYOZOA				
Plumatellidae				
Plumatella repens (P. arethusa Hyatt) (P. polymorpha Kraepelin)	14	1	2	

1. Animal foods listed systematically by Phylum and Class according to Pratt (1935). Orders, families, and genera listed alphabetically. Plant foods listed according to Hayden (1940).

Table 1. (continued)

ANIMAL FOOD

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
Stomachs Examined	67	11	71	3
ANNELIDA				
Oligochaeta				
Lumbricidae (earthworms)				
Lumbricus sp.			1	1
ARTHROPODA				
CRUSTACEA				
Branchiopoda				
Cladocera (water fleas)				
Daphnidae				
Moina macropa Straus (based on ephippia)	2	5	30	
Ostracoda (Ostracods)				
Cyprididae				
Cyclocypris sp.	12			
C. sharpei Furtos	2	2	4	
Amphipoda				
Talitridae (beach fleas)				
Hyalella azteca (Saussure)		1	1	
ARACHNIDA				
Araneae (spiders)	9		4	
Egg masses			2	
Acarina (mites)				
Galumnidae (horny or beetle mites)				
Eporibatula sp.	22		2	
HEXOPODA (INSECTA)				
Undetermined	4		2	
Coleoptera (beetles)				
Undetermined (including mere parts)	6		8	1

Table 1. (continued)

ANIMAL FOOD

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
Anthicidae (ant-like flower beetles)				
Anthicus sp.			1	
Carabidae (ground beetles)				
Undetermined	5		8	1
Cratacanthus dubius (?) (Beauv.)			2	
Chrysomelidae (leaf-beetles or chrysomelids)				
Undetermined	1		2	
Coptocycla bicolor Fabr. ("gold bug")				1
Glyptina sp.			1	
Orthaltica melina (?) Horn			1	
Systena elongata Fabr. or *S. taeniata* Say				2
Cicindellidae (tiger beetles)			2	
Coccinellidae (lady-bugs)				
Hyperaspis undulata Say			1	
Curculionidae (snout beetles)			6	
Dytiscidae (predaceous diving-beetles)	5	1	6	
Elateridae (click-beetles or elators)				
Undetermined			2	
Drasterius sp.			1	
Heteroceridae (variegated mud-loving beetles)				
Heterocerus undatus Melsh.			1	

Table 1. (continued)

ANIMAL FOOD

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
Stomachs Examined	67	11	71	3
Hydrophilidae (water-scavenger beetles)				
Undetermined	2	1		1
Tropisternus sp.	19		10	
T. glaber (?) Herbst.	1			
T. nimbatus Say			3	
Nitidulidae (sap-feeding beetles)				
Carpophilus niger Say			1	
Phalacridae (shining flower-beetles)				
Phalacrus politus Melsh.			2	
Scarabaeidae (scarabs or lamellicorn-beetles)				
Aphodius distinctus (Mull)			7	
Staphylinidae (rove beetles)				
Philonthus sp. (or near)	1		3	
Tenebrionidae (darkling beetles)			1	
Diptera (true flies)				
Undetermined	9		6	
Asilidae (robber flies)			1	
Borboridae (borborids)				
Leptocera sp.			1	
Sphaerocera sp.			1	
Ceratopogonidae (biting midges or "no-see-ums")				
Undetermined	1	2		
Palpomyia sp.		1		
Probezzia sp.	1			

Table 1. (continued)

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
	ANIMAL FOOD			
Stomachs Examined	67	11	71	3
Chironomidae (midges)				
Chironomus sp.	10	7	19	
Chloropidae (frit-flies)				
Meromyza americana Fitch			1	
Clusiidae	1			
Dolichopodidae (long-legged flies)				
Undetermined larvae	27		3	
Sarcionus sp.	1			
Metopiidae (flesh flies)				
Undetermined			3	
Lucilia sp.			2	
Muscidae (the muscids)				
Undetermined			4	
Limnophora sp.	11	1		
Stratiomyiidae (soldier-flies)				
Undetermined	2			
Odontomyia sp.	13	1	1	
Syrphidae (flower-flies or syrphus-flies)				
Undetermined			2	
Sphaerophoria (?) sp.			1	
Eristalis sp.			1	
Tabanidae (horse-flies)			1	
Tachinidae (the tachinids)			1	
Tipulidae (typical crane-flies) pupae			4	

Table 1. (continued)

ANIMAL FOOD

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
Stomachs Examined	67	11	71	3
Hemiptera (true bugs)				
Undetermined	1		6	
Coreidae (coreids)				
Aufeius sp.			10	
A. impressicollis Stal.			2	
Corizus sp.			5	
C. lateralis (Say)			1	
Corixidae (water boatmen)				
Undetermined genera			46	
Arctocorixa sp.			1	
Corixa reticulata Guerin			1	
Palmacorixa sp.			1	
Trichocorixa sp.			1	
Gerridae (water striders)				
Gerris sp.			1	
Lygaeidae (chinch-bug family)				
Cymus sp.			1	
C. luridus Stal.			1	
Geocoris sp.			19	
G. bullatus (Say)			3	
G. uliginosus (Say)			1	
Nysius ericae Schilling			9	
Peritrechus sp. (?)			2	
Mesoveliidae (the mesoveliids)				
Mesovelia bisignata (?) Uhler			1	
Miridae (leaf-bugs)	1		5	
Nabidae (the nabids)				
Nabis sp.	1		15	
N. alternatus Parshley			2	

Table 1. (continued)

ANIMAL FOOD

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
Stomachs Examined	67	11	71	3
Pentatomidae (stink bugs)				
Chlorochroa sp.			2	
Euschistus sp.			1	
Peribalus sp.			3	
Saldidae (shore bugs)				
Saldula sp.			1	
Tingidae (lace-bugs)				
Piesma cinerea Say			2	
Homoptera (Cicadas, leaf-hoppers, etc.)				
Cicadellidae (leaf-hoppers)				
Undetermined			21	
Agallia sp. (or near)			4	
Xerophloea sp.			2	
Fulgoridae (lantern-flies)				
Cixius sp.			7	
C. sp. (near *basalis* Van D.)			2	
Liburnia campestris Van D.			6	
L. ornata (Stal.)			1	
L. pellucida (Fabr.)			1	
Aphididae (plant lice)			5	
Hymenoptera (bees, wasps, ants, etc.)				
Undetermined			9	
Andrenidae (the andrenids)				
Halictus sp. (mining bees)			7	
Braconidae (the braconids)				
Meteorus sp.		1		

Table 1. (continued)

ANIMAL FOOD

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
Stomachs Examined	67	11	71	3
Formicidae (ants)				
Undetermined	1		24	
Formica sp.			2	
Monomorium sp.			1	
Myrmica sp.			3	1
Ponera sp.			5	1
Ichneumonidae (ichneumon-flies)				
Undetermined			1	
Mesochorus sp.			1	
Lepidoptera (moths, butterflies and skippers)				
Frenate moths sp. undetermined	1		2	
Mallophaga (bird lice or biting lice)	2			
Odonata (dragon-flies and damsel-flies)				
Anisoptera (dragon-flies) naiads	15	2	2	1
Zygoptera (damsel-flies) naiads			9	
Orthoptera (grasshoppers, crickets, etc.)				
Tetrigidae				
Tettix sp., eggs		1	1	
Trichoptera (caddice-flies)				
Leptoceridae (?)			12	

Table 1. (continued)

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
ANIMAL FOOD				
Stomachs Examined	67	11	71	3
MOLLUSCA				
Gastropoda (snails)				
Pulmonata				
Undetermined (shells broken)	50		4	
Lymnaeidae				
Lymnaea obrussa Say	3			
Physidae				
Physa sp.	13	1		
Planorbidae				
Planorbis sp.	20			
P. deflectus Say	1			
CHORDATA				
Pisces (true fishes) remains			1	1
PLANT FOOD				
SPERMATOPHYTA				
Angiospermae				
Monocotyledoneae				
Undetermined			2	
Typhaceae (cat-tail family)				
Typha sp. (cat-tail)			6	
Sparganiaceae (bur-reed family)				
Sparganium eurycarpum Engelm. (giant bur-reed)	11			

Table 1. (continued)

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
	PLANT FOOD			
Stomachs Examined	67	11	71	3
Najadaceae (pondweed family)				
Potamogeton sp.	3	4	1	
P. richardsonii (A. Benn.) Rydb. (*P. perfoliatus* L.), (clasping leaved pondweed)	2			
Alismaceae (water plantain family)				
Alisma subcordatum Raf. (*A. plantago-aquatica* of Am.Auth.), (water plantain)	40			
Sagittaria sp.	13			
S. cuneata Sheldon (*S. arifolia* Nutt.), (arum-leaved arrowhead)	5			
S. latifolia Willd. (broad-leaved arrowhead)	3		1	
Gramineae (grass family)				
Undetermined	3	1	5	
Echinochloa crusgalli (L.) Beauv. (barnyard grass, duck millet or wild millet)	1			
Leersia oryzoides (L.) Schwartz (rice cutgrass)		1		
Panicum sp.				1
P. capillare L. (old witch grass)		1		
Setaria lutescens (Weigel) F. T. Hubb (*S. glauca* (L.) Beauv. (yellow foxtail)	2			1
S. viridis (L.) Beauv., (green foxtail)			1	

Table 1. (continued)

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
	PLANT FOOD			
Stomachs Examined	67	11	71	3
Cyperaceae (sedge family)				
Carex sp. (sedge)	46	1	1	
Cyperus sp.		1		
C. erythrorhizos Muhl., (red-rooted cyperus)		2	7	1
C. strigiosus (?)		1	2	
Eleocharis sp., (spike rush)	11	1		
Scirpus sp. (bulrush)	2	2	1	
S. acutus Muhl., (American great bulrush) (*S. occidentalis* (Wats.) Chase	21	4		
S. fluviatilis (Torr.) (gray river bulrush)	6	1		
S. heterochaetus (Wats.) Chase, (pale great bulrush)	1			
S. validus Vahl., (soft-stemmed bulrush)	14		1	
Scleria sp.[1]		1		

1. A single seed was found in the gizzard of a dowitcher which was collected at a mud-bottomed pond in Prichard's Pasture, just north of Dewey's Pasture, Clay County, Iowa, on May 5, 1935. The seed was identified, by Mr. A. C. Martin of the U.S. Fish & Wildlife Service, as *Scleria* sp. Hayden (1940) does not list this genus as occurring in Clay or Palo Alto Counties, Iowa. Gray's New Manual of Botany (1908) states, "(according to John Torrey) S. triglomerata Michx. occurs on low, usually sandy soil, eastern Mass. and Vt. to Ont., Iowa, and southward." The writer is inclined to believe that the bird, which was taken during the spring migration, probably picked up the seed at some locality farther south. There is again the possibility that *Scleria* may occur in northwestern Iowa.

Table 1. (continued)

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellowlegs	Greater Yellowlegs
	PLANT FOOD			
Stomachs Examined	67	11	71	3
Araceae (arum family)				
Acorus calamus L., (sweetflag)--	20	1		
Dicotyledoneae				
Polygonaceae (buckwheat family)				
Polygonum hydropiper L., (common smartweed or water pepper)----------	5	1		1
P. lapathifolium L., (Lapath's knotweed)-------		1		
P. natans A. Eaton, (blunt-leaved water smartweed) (P. fluitans Eaton) (P. amphibium var. hartwrightii (Gray) Bissel----------	30		1	
P. pennsylvanicum L., (Pennsylvania smartweed)--	2	2	1	
P. persicaria L., (lady's thumb)---	23	1		1
P. punctatum Ell., (dotted smartweed) (P. acre H.B.K.) (P. punctata (Ell.) Small-	3			
Rumex sp., (dock)----------		1		1
R. maritimus L., (golden dock)-		1	1	3
Amaranthaceae (amaranth family)				
Amaranthus sp.----------	2	1		
Ranunculaceae (crowfoot family)				
Ranunculus sp. (crowfoot)---	1			
Leguminose (bean family)				
Melilotus sp.----------	1			

Table 1. (continued)

Food Item	Wilson's Snipe	Dowitchers	Lesser Yellow-legs	Greater Yellow-legs
PLANT FOOD				
Stomachs Examined	67	11	71	3
M. officinalis (L.) Lam., (yellow sweet clover)	1			
M. alba Desr., (white sweet clover)		1		
Malvaceae (mallow family)				
Sphaeralcea sp.[1]		1		
Haloragidaceae (water milfoil family)				
Myriophyllum spicatum L. (?), (water milfoil)	1			
Verbenaceae (vervain family)				
Verbena sp.	2			
V. hastata L., (blue vervain)	1	1		
V. stricta Vent., (hoary vervain)	1			
Labiatae (mint family)				
Lycopus sp.			1	
Plantaginaceae (plantain family)				
Plantago major L., (greater plantain)		1		
Compositae (sunflower family)				
Undetermined	1			

1. A single seed was found in the gizzard of a dowitcher taken at Roland's Farm, Clay County, Iowa, on October 6, 1934. The seed was identified, by Mr. A. C. Martin, as belonging to the genus *Sphaeralcea*. Hayden (1940) does not list this genus as occurring in either Clay or Palo Alto Counties, Iowa. Gray's New Manual of Botany (1908) states that *S. remota* (Greene) Fernald, the only species listed under this genus, is known only from a gravelly island in the Kankakee River, Illinois. The seed may possibly belong to some other genus of the mallow family (Malvaceae) or it may constitute a possible new record, that is, for northwestern Iowa. The seed might also have been taken at some other locality since the bird was collected during a stop-over in migration.

V. DISCUSSION OF WILSON'S SNIPE

Capella delicata (Ord.)

The Wilson's snipe or jacksnipe, sometimes known only as "jack" or "snipe," is to be found, at present, over nearly all of North America and northern South America. It breeds from northwestern Alaska southward to northern California, Colorado, Iowa and Pennsylvania, although its nests have been found rather uncommonly in the southernmost part of this range.

It winters occasionally as far north as Minnesota, (Roberts, 1932), in the central United States and somewhat less frequently as far north as Montana, North Dakota, Ontario, Nova Scotia and Alaska, (Sperry, 1940). It extends southward in its winter range to southern Brazil.

During migration, the periods in which all the specimens considered in this study were collected, Wilson's snipe prefer wet meadows or semi-marsh (rather open marsh) conditions. Occasionally they are flushed, usually singly, from small grain and corn fields. The cover which they seek, except when frightened, is not of an exceptionally dense nature. When flushed, they rather frequently used somewhat more dense cover, but almost as often flew to cover from which easy escape was possible, a type of cover which would still be classed as rather open. The description of cover found on Whitford Slough gives a good example of what the author considers as ideal for jacksnipe, especially in areas similar to northwestern Iowa.

Not once, during the period covered by these investigations, did the author observe snipe in a flock or "wisp." They were flushed singly in most cases, rarely in pairs or groups of three, and even in the latter cases the birds were separated by a distance of several feet. On the Whitford Slough area of northwestern Iowa, there was no indication of the gregariousness which has been recorded for snipe in the Louisiana marshes where "several hundred in flight in a compact mass" have been noted, (Pearson, 1940). Roberts (1932) states that "it may be seen singly or in considerable numbers."

The snipe has relatively short legs, tarsus 1.20 to 1.30 inches, which limits the physical possibilities in connection with wading. This limitation is perhaps offset by the long, sensitive bill which ranges from 2.37 to 2.75 inches in length. The bill is used in probing for food in shallow water, mud and muck.

Material Examined

In this study the stomachs of 67 jacksnipes were examined. This figure represents 32.8 per cent of the snipe observed. They were taken from different areas and upon dates as shown in table 2.

This table also gives somewhat of an indication of the relative numbers of snipe found on the various areas, especially of Pritchard's pasture, Roland's farm, Lost Island Lake, and Whitford Slough. Virgin Lake and Elk Lake were not checked as many times as were the other areas.

Table 2. Location and date of collection of Wilson's snipe examined:

Location	5/5	9/8	9/12	9/19	10/6	10/7	10/21	10/27	10/28	11/3	11/10	11/17	Location totals
Pritchard's Pasture	1	1											2
Roland's Farm			1	2	1							1	5
Virgin Lake							1						1
Elk Lake												1	1
Lost Island Lake						1							1
Whitford Slough			1				8	6	8	24	7	3	57
Date TOTALS	1	1	2	2	1	1	9	6	8	24	7	5	67

Totals by Months

May, 1935——1
Sept., 1934——5
Oct., 1934——25
Nov., 1934——36

Animal Food

Arthropoda. Of this phylum of animals, as well as of the total contents of the stomachs, insects formed by far the greatest percentage of the bulk of food. Insects were represented in 63 of the stomachs (93.65 percent). Fly larvae made up the largest percentage of insect food taken, occurring in 64.18 percent of the snipe. Midge larvae, (*Chironomus* sp.), commonly known as bloodworms, were taken in the largest numbers but by only 14.92 percent of the birds, and these mainly during September and early October. The larvae of long-legged flies (Dolichopodidae) were taken by 41.79 percent of the birds, mainly during the latter part of October and in November. The larvae of soldier-flies (Stratiomyiidae) occurred in 15 stomachs (22.38 percent) and Muscid larvae were found in 11 birds (16.41 percent). Six of the stomachs contained a total of eleven very minute fly puparia, about .3 mm. in length. The genera of flies taken were largely those which frequent low, wet meadows. They have been recorded as occurring at habitats which Hendrickson (1930, p. 54) characterizes as

> *Andropogon furcatus* consocies . . . level, mostly wet meadow . . . northern, central and western Iowa. . . . *Spartina* consocies . . . low, level, wet, frequently with some standing water in spring, but not in summer. . . . *Carex* socies . . . low, wet, often with standing water in the spring, but not in summer.

Beetles (Coleoptera) were the next most frequently occurring insects. They were represented mainly by larvae of water scavenger beetles

(Hydrophilidae) and rather frequently by only the mandibles of these. As mentioned before, the mandibles and heads of insects remain intact within the gizzard considerably longer than do softer parts of the insect bodies. The remains of predaceous diving beetles (Dytiscidae) or their larvae were found in five stomachs. In the case of one of these birds, the stomach contained one larva which was approximately 6 cm. long and alone almost filled the stomach although some other food material was present. This one larva made up at least 95 percent of this bird's meal.

Hemiptera (true bugs) were taken by snipe in only three instances. This is an interesting fact for comparison with the findings in the stomachs of lesser yellowlegs.

Hymenoptera (the head of an ant) and Lepidoptera (a caterpillar skin) each occurred in only one instance.

Bird lice were found in two stomachs. These were probably taken by the birds from their own bodies during preening of their feathers or possibly through intentional "self-delousing" activities.

The remains of naiads or nymphs of dragon-flies were found in 15 stomachs (22.38 percent). These were represented mainly by mandibles and the ends of abdominal segments, which seem to resist digestion somewhat longer than the rest of the larval body.

Arachnida were represented by beetle mites and spiders. Beetle mites belonging to the genus Eporibatula were found in 22 stomachs (32.83 percent). A total of 46 specimens were eaten. These mites are extremely small and from the standpoint of bulk of food taken, they represent a

negligible quantity. They are found among leaves and decaying vegetation in moist places and are considered to be rather unimportant economically, Essig (1934). The spiders mentioned above were represented chiefly by chelicerae, and these may have remained in the stomach from a meal several days past. They served merely to indicate that spiders were taken.

Crustacea were taken in quantitatively negligible amounts although ostracods (Cyclocypris sp.) were eaten by 14 birds (20.89 percent). A total of 22 specimens were taken. The ephippia, or winter eggs, of Cladocera (Moina macropa Straus, based upon descriptions and illustrations of ephippia) were taken by two birds.

Mollusca. Snail shells or pieces of shell were found in 50 stomachs, (74.62 percent of the snipe). This food, however, comprised only a small percentage of the total food, the average weight taken per bird for the fifty which contained snail shell being .0476 gram. One bird was taken in May; it contained no shell. Five birds were taken in September; three of them (60 percent) contained shell. Sixteen of the 25 birds collected in October (64 percent) contained shell. The remainder of the snipe, 36, were taken in November; 31 of them (86.11 percent) contained shell. This indicates a progressive increase in the percentage of snipe using snails as food during the fall months in northwestern Iowa.

Bryozoa. This phylum was represented by statoblasts or internal buds of Plumatella repens. Fifteen birds (22.38 percent) took a total of 38 statoblasts. Ward and Whipple (1918) list repens as a variety of P. polymorpha. Pratt (1935) does not list repens; however, P. polymorpha

is listed and its distribution is given as cosmopolitan. He states that the genus Plumatella is the "commonest of fresh-water bryozoans; in ponds and streams, usually not in the light." With the exception of one statoblast (which was taken by the Elk Lake snipe on November 17) these items of food were all found in birds taken at Whitford Slough, from October 21 to November 3. This would seem to indicate that Plumatella repens lives there under semi-marsh or marsh conditions, a type of habitat probably included by Pratt (1935) under the heading of "ponds."

Porifera. Sponges were represented in 16 stomachs by a total of 25 gemmules, all of which were further unidentifiable.

Plant Food

Cyperaceae. Sedges were eaten more frequently than any other one group of seeds taken by Wilson's snipe. The seeds of Carex were taken most frequently, 46 birds (68.65 percent) having taken a total of 434 seeds. Spike rush (Eleocharis) was eaten by 11 birds (16.41 percent), with a total of 67 seeds taken. Seeds of bulrushes (Scirpus) were taken by 35 birds (52.24 percent). American Great Bulrush was taken by 21 birds (31.34 percent) with 163 seeds taken. Soft-stemmed bulrush occurred in 14 birds with only 19 seeds taken.

Alismaceae. Water plantain (Alisma subcordatum) was found in 40 birds (59.70 percent), 233 seeds having been eaten. Arrowhead (Sagittaria)

was found in 21 birds, 54 seeds taken. Seeds of these two genera were taken from October 21 to the end of the collecting period, in November.

Polygonaceae. Blunt-leaved water smartweed (Polygonum natans) occurred more frequently than other smartweeds (in 30 birds, 44.77 percent), but only slightly more often than the seeds of lady's thumb (P. persicaria) which was found in 23 stomachs (34.32 percent). Other smartweeds were taken in almost negligible quantities. Smartweed seeds were taken chiefly after October 21.

Sparganiaceae. Giant bur-reed was found in eleven birds (16.41 percent) with a total of 17 seeds taken.

Other Seeds. Practically all other seeds were taken in almost negligible numbers from the standpoint of bulk of food taken.

In the cases of several of the snipe, the stomach contents consisted of a rather high percentage of unidentifiable rootlets.

Stones

Stones, found in all but four of the snipe stomachs, varied in number from one to an estimated 3000. Excluding the latter case because the stones were too small to be counted accurately, 3,579 stones were taken which weighed 4.3388 grams, an average weight per stone of .00121 gram. Without the excluded case, an average of 54.2 stones were taken per bird. Each of 56 birds took less than 50 stones, while 28

took less than 10 stones each. As stated above, four birds took no stones at all.

To summarize briefly:

1. The stomachs of 67 Wilson's snipe were examined. These were taken mainly from Whitford's Slough, during the latter part of October and the first half of November, 1934.

2. The remains of snails were found in 74.62 percent of the stomachs. This constituted a small percentage of the total bulk of food.

3. Insects and insect larvae formed by far the largest percentage of total food taken, being represented in 93.65 percent of the stomachs. The larvae of flies were the most important item, followed by the remains of larvae of water beetles.

4. Other animal foods represented were: true bugs, ants, a moth, bird lice, dragon-fly naiads, spiders, beetle mites, ostracods, water fleas, moss-animals, and fresh-water sponges.

5. Stones were found in all but 4 of the 67 stomachs.

6. Seeds of sedges, bulrush, and spike rush were eaten more frequently than any other one group of seeds.

7. Seeds of the water plantain, smartweed and bur-reed families were taken in respectively smaller numbers. Other seeds were represented but in quantitatively negligible amounts.

8. Some of the stomachs contained a rather high percentage of unidentifiable rootlets.

Suggestions for Management of Wilson's Snipe in Northwestern Iowa

Protection from Hunters. The permanently closed season on snipe (the hunting season of 1941 was the first closed season) should be continued.

Cover. For agencies interested in the preservation of Wilson's snipe it is suggested that areas be acquired which are similar to that described for Whitford Slough (a low, wet meadow or semi-marsh with not too rank-growing vegetation of a type which will partially "go down" in the fall). These areas need not necessarily be kept free of pasturing stock, inasmuch as snipe occur here largely in migration. Northern Iowa, however, is within the southern boundary of the breeding range. Hunting might better be prohibited on acquired areas.

Food. An area of the above nature will provide ample animal food. Sedges, water-plantain, arrowhead, and smartweeds should be encouraged. Bulrushes should not be too thick. Patches of them are good, but a heavy stand over considerable area is to be avoided. Other plants are apparently not quite so important. With encouragement of those mentioned, other species of plants will come into the area sufficiently to make excellent snipe cover. The writer has seen this happen on a federal migratory waterfowl refuge.

Table 3. Systematic List of Food Items Found in Stomachs of 67 Wilson's Snipe Collected in Clay and Palo Alto Counties, Iowa.[1]

CLASSIFICATION	Number of Stomachs[2]	Total Number Specimens[3]	Percentage of Occurrences[4]
ANIMAL FOOD			
Phylum Porifera			
Unidentified gemmules------	16	25	23.88
Phylum Bryozoa			
Plumatellidae			
Plumatella repens			
Statoblasts----------	15	38	22.38
Phylum Arthropoda			
Crustacea			
Branchiopoda			
Cladocera			
Daphnidae			
Moina macropa Straus			
ephippia--------	2	2	2.98
Ostracoda			
Cyprididae			
Cyclocypris sp.---------	14	22	20.89
Arachnida			
Araneae			
(represented mainly by			
chelicerae)----------	9	12	13.43

1. The animal foods are listed systematically by Phylum and Class according to Pratt (1935). Orders, families and genera are arranged alphabetically. Plant foods are arranged according to Hayden (1940).

2. The number of stomachs in which each item occurred.

3. The total number of specimens of each species represented.

4. The percentage of the 67 birds in which each food item occurred.

Table 3. (continued)

ANIMAL FOOD

CLASSIFICATION	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Acarina			
Galumnidae			
Eporibatula sp.	22	46	32.83
Hexapoda (Insects)			
Unidentified	4	15	5.97
Coleoptera			
Unidentified (Including mere parts)	6	6	8.95
Carabidae	5	11	7.46
Chrysomelidae	1	1	1.49
Dytiscidae	5	6	7.46
Hydrophilidae	22	100	32.83
Unidentified	2	5	
Tropisternus sp.	19	94	
T. glaber Herbst.	1	1	
Staphylinidae			
Philonthus sp.	1	1	1.49
Diptera			
Unidentified	3	7	4.47
Fly (?) puparia (very minute)	6	11	8.95
Ceratopogonidae	2	2	2.98
Unidentified	1	1	
Probezzia sp.	1	1	
Chironomidae			
Chironomus sp.	10	1,083	14.92
Clusiidae	1	1	1.49
Dolichopodidae	28	475	41.79

Table 3. (continued)

ANIMAL FOOD

CLASSIFICATION	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Unidentified	27	474	
Sarcionus sp.	1	1	
Muscidae			
Limnophora sp.	11	71	16.41
Stratiomyiidae	15	54	22.38
Unidentified	2	3	
Odontomyia sp.	13	51	
Hemiptera			
Unidentified	1	1	1.49
Miridae	1	1	1.49
Nabidae	1	1	1.49
Hymenoptera			
Formicidae	1	1	1.49
Lepidoptera	1	1	1.49
Mallophaga	2	2	2.98
Odonata			
Anisoptera	15	28	22.38
Phylum Mollusca			
Gastropoda			
Pulmonata	50	shells broken; numbers unknown	74.62
Lymnaeidae			
Lymnea obrussa Say	3	3	4.47
Physidae			
Physa sp.	13	43	19.40
Planorbidae			
Planorbis sp.	20	36	29.85

Table 3. (continued)

PLANT FOOD

CLASSIFICATION	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
PLANT FOOD			
Division Spermatophyta			
Subdivision Angiospermae			
Class Monocotyledoneae			
Sparganiaceae			
Sparganium eurycarpum Engelm.	11	17	16.41
Najadaceae	5	15	7.46
Potamogeton sp.	3	5	
P. richardsonii (A. Benn.) Rydb.	2	10	
Alismaceae			
Alisma subcordatum Raf.	40	233	59.70
Sagittaria	21	54	31.34
S. sp.	13	32	
S. cuneata Sheldon (arifolia)	5	15	
S. latifolia Willd.	3	7	
Gramineae			
Unidentified	3	3	4.47
Echinochloa crusgalli (L.) Beauv.	1	1	1.49
Setaria lutescens (Weigel) F. T. Hubb.	2	2	2.98
Cyperaceae			
Carex sp.	46	434	68.65
Eleocharis sp.	11	67	16.41
Scirpus sp.	2	2	2.98
S. acutus Muhl.	21	163	31.34
S. fluviatilis (Torr.)	6	6	8.95
S. heterochaetus (Wats.) Chase	1	2	1.49
S. validus Vahl.	14	19	20.89
Araceae			
Acorus calamus L.	20	57	29.85

Table 3. (continued)

CLASSIFICATION	PLANT FOOD Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Class Dicotyledoneae			
Polygonaceae			
Polygonum hydropiper L.	5	12	7.46
P. natans A. Eaton (P. amphibium L.)	30	65	44.77
P. pennsylvanicum L.	2	3	2.98
P. persicaria L.	23	170	34.32
P. punctatum Ell.	3	4	4.47
Amaranthaceae			
Amaranthus sp.	2	3	2.98
Ranunculaceae			
Ranunculus sp.	1	1	1.49
Leguminosae			
Melilotus sp.	1	2	1.49
M. officinalis (L.) Lam.	1	1	1.49
Haloragidaceae			
Myriophyllum sp.	1	3	1.49
Verbenaceae			
Verbena sp.	2	4	2.98
V. hastata L.	1	1	1.49
V. stricta Vent.	1	1	1.49
Compositae			
Undetermined	2	2	2.98

VI. DISCUSSION OF DOWITCHERS

Limnodromus griseus

Dowitchers, although not as numerous as several other species of shore birds, are found in Iowa as fairly rare migrants, DuMont (1934). Thirty-three birds were observed during the fall of 1934; of this number, seven were collected by the author (table 4) in August to November, inclusive.

Two subspecies are recognized, both of which occur in Iowa during migration. The long-billed dowitcher, Limnodromus griseus scolopaceus (Say), is supposedly more numerous than the eastern or short-billed form, L.g. griseus (Gmelin), however, in the fall of 1934 the author observed twice as many of the eastern form as were seen of the long-billed subspecies.

According to Sperry (1940) when collected in the same area and from mixed flocks, there is little chance that there would be any appreciable difference in the food habits of the two forms. The two subspecies were therefore considered as one in the food habits study.

The length of the legs, tarsus 1.30 to 1.50 inches, is approximately the same for dowitchers as for Wilson's snipe. The bills, which are about equally sensitive in both species, are of approximately the same length, with a possibility of a one-fourth inch longer bill in the case of the dowitchers. The bills of dowitchers collected ranged from 2.25 to 3.12 inches in length. These facts should make the wading and probing possibilities of the two species approximately equal. This is discussed under

the "Comparisons of Food Habits of Wilson's Snipes and Dowitchers."

Dowitchers prefer rather open, flat, muddy or sandy beaches and were observed feeding in soft mud, sand, and in water up to one and a half or two inches deep.

While probing for food in soft mud and sand the bill was inserted to about three-fourths or slightly more, of the full length. When the birds fed in water, they often partly or wholly immersed their heads in an effort to obtain their meal.

Roberts (1932) mentions "single individuals, feeding along the waters edge . . ."; however, the author observed this species only in small groups of from three to eleven individuals per flock. Even in the feeding activities of the flock of 11, the birds confined themselves to a radius of approximately ten feet.

Material Examined

Eleven dowitchers were collected and their stomachs examined. They were collected from different areas and upon different dates as shown in table 4, below.

Table 4. Location and date of collection of dowitchers examined.

Location	1934 7/11	7/29	8/13	8/17	8/30	9/6	9/29	10/6	10/20	1935 5/5	5/15	Location Totals
Lost Island Lake			1	1	1	1	1		1			6
Pritchard's Pasture										1		1
Roland's Farm								1				1
Round Lake											1	1
Ruthven, Ia. (no other information available)	1											1
Louisa Co., Ia. (no other information available)		1										1

Totals by Months

July	2
August	3
September	2
October	2
May 1935	2

Animal Food

Arthropoda--In the dowitchers examined, this phylum made up about 99 percent of the bulk of animal food taken, and of this bulk, insects, mostly in immature stages, comprised by far the largest part (approximately 90 percent.)

Midges (larval and pupal stages of Chironomus sp.) were taken by seven birds (63.63 percent). From these seven birds the recognizable remains of 1641 midges were counted; seven of these were pupae and 1634 were larvae. Two of the birds, collected while feeding actively, contained midge larvae (one 63, the other 27) in the food tube anterior to the proventriculus. These birds were probing in mud covered by about an inch and a half of water.

Other insects represented were: water beetles; the larvae of biting midges, muscid and soldier-flies; hymenoptera, by pupal cases; odonata, by naiads; and orthoptera, by a grasshopper egg.

Crustacea made up the remainder of the arthropods found in dowitchers.

Amphipods were found in only one bird, however, in volume they comprised nearly the entire meal of this individual.

The winter eggs (ephippia) of Cladocera (water fleas) were found in 5 stomachs (45.45 percent) but in volume of food were negligible.

Ostracods, found in two stomachs, were also negligible from the standpoint of total food volume.

Porifera--Seven gemmules of a fresh-water sponge were found in one stomach, unimportant with respect to food volume.

Bryozoa--One bird contained three microscopic statoblasts of Plumatella repens.

Mollusca--Only one dowitcher contained snail shells; one specimen of Physa sp. was entire and the remains of one or more others were present.

Plant Food

Seeds were taken in small numbers by most of the dowitchers. In only one bird were seeds found comprising most of the meal. Only two birds contained totals of more than five seeds, while two contained no seeds at all. In six of the individuals seeds made up an almost negligible quantity of food. It is apparent that seeds form a relatively unimportant part of the diet of dowitchers in northwestern Iowa.

Stones

Many more stones and a greater average weight of stones per bird were found in dowitchers than in any other species examined. The average number of stones per bird was a fraction less than 443; the average weight per stone was .00101 gram, making the average weight of stones per bird approximately .44 gram.

This need not mean that grit is more essential in the diet of dowitchers than in that of Wilson's snipe, greater or lesser yellowlegs. Possibly the different situations under which the birds fed would have considerable bearing upon the grit content of the gizzards. Most of the dowitchers were taken from areas of sandy or gravelly bottoms, although

three of them were taken from mud-bottomed pasture ponds. These three contained 13, 40 and 107 stones while the others contained from 135 to 1518. In contrast to this practically all the snipe were taken from a mud-bottomed, grass and sedge grown slough where very little gravel was available.

Conversely, the greater percentage of stones in dowitchers could perhaps indicate somewhat different grit requirements which may or may not be due to a difference in requirements among these species for certain mineral elements.

To summarize briefly:

1. The stomachs of eleven dowitchers were examined. No consideration was given as to whether the birds were the eastern (short-billed) or the long-billed form.

2. Stones were found in every stomach. There were more stones per bird and they constituted a greater percentage of gizzard contents by weight than in other species examined.

3. Insects, mostly immature forms, constituted approximately 85 to 90 percent of the food exclusive of grit. Midge larvae, commonly called blood-worms, were the most important item. Other insects, both adult and immature forms, were represented.

4. Other animals included in the diet were: Amphipods, Cladocera (ephippia), Porifera (gemmules), Bryozoa (statoblasts) and Mollusca (remains of snail shells).

5. Seeds (usually in very small numbers) were found in nine of the

eleven stomachs. They apparently form an almost negligible part of the diet of dowitchers in northwestern Iowa. Seeds are perhaps more important in the diet during the spring than in the fall. The seeds of no particular species of plant were taken in sufficient quantities by a large enough number of birds to warrant any conclusions being drawn as to preference for one species of seed over another.

Suggestions for Management of Dowitchers in Northwestern Iowa

Protection from Hunters: This species of bird is now on the permanently protected list and there is no indication that the U. S. Fish and Wildlife Service has any intention of removing it. This protection should by all means be continued.

Food and Cover: Acquisition of breeding grounds need not be considered inasmuch as dowitchers do not breed in the United States. They seem to seek out no one type of cover. Instead they seem to prefer the flat, open beaches which are characterized more by a lack of cover. They occur in northwestern Iowa only during migration. There are ordinarily a sufficient number of ponds of the character preferred by the birds to meet all demands by the numbers migrating through the state. The nature of food taken (chiefly insects) indicates that no effort need be expended by mankind to assure these birds a plentiful supply of food. In fact, it might be said that they do mankind a favor, no matter how small, with practically every meal they take.

In the light of the above statements, it would seem that protection and the unmolested use of the shores of our lakes and ponds is about all that we can give to the dowitchers.

Table 5. Systematic List of Food Items Found in Stomachs of 11 Dowitchers Collected Mainly in Clay and Palo Alto Counties, Iowa.[1]

CLASSIFICATION	Number of Stomachs[2]	Total Number Specimens[3]	Percentage of Occurrences[4]
ANIMAL FOOD			
Phylum Porifera			
Unidentified gemmules------	1	7	9.09
Phylum Bryozoa			
Plumatellidae			
Plumatella repens, statoblasts---------	1	3	9.09
Phylum Arthropoda			
Crustacea			
Cladocera			
Daphnidae			
Moina macropa Straus (ephippia)---------	5	11	45.45
Ostracoda			
Cyprididae			
Cyclocypris sp. (possibly sharpei)---	2	2	18.18
Amphipoda			
Talitridae			
Hyalella azteca (Saussure)-	1	24	9.09

1. The animal foods are listed systematically by Phylum and Class according to Pratt (1935). Orders, families and genera are arranged alphabetically. Plant foods are arranged according to Hayden (1940).
2. The number of stomachs in which each item occurred.
3. The total number of specimens of each species represented.
4. The percentage of the 11 birds in which each food item occurred.

Table 5. (continued)

CLASSIFICATION	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
ANIMAL FOOD			
Hexapoda (Insecta)			
Coleoptera			
Dytiscidae	1	1	9.09
Hydrophilidae	1	1	9.09
Diptera			
Ceratopogonidae	3	4	27.27
Unidentifiable	2	2	18.18
Palpomyia sp.	1	2	9.09
Chironomidae			
Chironomus sp.	7	1641	63.63
Muscidae			
Limnophora sp.	1	1	9.09
Stratiomyiidae			
Odontomyia sp.	1	1	9.09
Hymenoptera			
Braconidae			
Meteorus sp., pupal cases	1	19	9.09
Odonata			
Anisoptera, naiads	2	2	18.18
Orthoptera			
Tetrigidae			
Tettix sp., (possibly), egg	1	1	9.09
Phylum Mollusca			
Gastropoda			
Pulmonata			
Physidae			
Physa sp.	1	1	9.09

Table 5. (continued)

CLASSIFICATION	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
PLANT FOOD			
Division Spermatophyta			
Subdivision Angiospermae			
Class Monocotyledoneae			
Najadaceae			
Potamogeton sp.	4	5	36.36
Gramineae			
Unidentified	1	2	9.09
Leersia oryzoides (L.) Schwartz	1	1	9.09
Panicum capillare L.	1	5	9.09
Cyperaceae			
Carex sp.	1	5	9.09
Cyperus sp.	1	1	9.09
C. erythrorhizos Muhl.	2	111	18.18
C. strigiosus (?)	1	9	9.09
Eleocharis sp.	1	9	9.09
Scirpus sp.	2	4	18.18
S. acutus Muhl.	4	5	36.36
S. fluviatilis (Torr.)	1	1	9.09
Scleria sp.	1	1	9.09
Araceae			
Acorus calamus L.	1	1	9.09
Class Dicotyledoneae			
Polygonaceae			
Polygonum hydropiper L.	1	2	9.09
P. lapathifolium L.	1	1	9.09
P. pennsylvanicum L.	2	3	18.18
P. persicaria L.	1	1	9.09
Rumex sp.	1	1	9.09
R. maritimus L.			
Seeds	1	1	9.09
tubercles of calyx	1	17	9.09

Table 5. (continued)

CLASSIFICATION	Number of Stomachs	Total number Specimens	Percentage of Occurrences
PLANT FOOD			
Amaranthaceae			
Amaranthus sp.----------	1	1	9.09
Leguminosae			
Melilotus alba Desr.-----	1	1	9.09
Malvaceae			
Sphaeralcea sp.---------	1	1	9.09
Verbenaceae			
Verbena hastata L.-------	1	2	9.09
Plantaginaceae			
Plantago major L.-------	1	2	9.09

Also under plant food taken were five small objects thought to be galls.

VII. COMPARISONS OF FOOD HABITS OF WILSON'S SNIPE AND DOWITCHERS

As stated before, the writer wished to compare or contrast the food habits of dowitchers and Wilson's snipe, two species of shorebirds which are morphologically very similar, although showing preferences for somewhat different types of habitat. There are both similarities and dissimilarities in the food habits of the two species. These will be discussed under sub-headings as used for each of the two birds.

Animal Food

Arthropoda—In each of these two species of birds Arthropods comprised the greatest percentage of the entire bulk of food, and insects far outnumbered all other arthropoda in numbers of specimens and bulk taken. The larvae of flies made up the largest part of the insect material, occurring in 64.18 percent of the snipe and in 72.73 percent of the dowitchers. The larvae of midges (Chironomus sp.) were taken in the largest numbers but by only 14.92 percent of the snipe as against 63.63 percent of the dowitchers. Conversely, the larvae of long-legged flies (Dolichopodidae) were taken by 41.97 percent of the snipe, while not an occurrence of this larva was found in dowitchers. The larvae of soldier-flies (Stratiomyiidae) and muscids (Muscidae) also occurred in higher percentages in Wilson's snipe than in dowitchers. The figures on occurrences of these families of flies are in accord with the findings of Sperry (1940) in snipe and dowitchers. Sperry found flies and their larvae occurring in 66.6 percent of the long-billed dowitchers examined by him as compared with occurrences

in 72.73 percent of the dowitchers examined by the author. Sperry (1940) states that "Adults [flies] were captured occasionally, but larvae mainly, and counts of from 200 to 300 in a stomach were common," indicating apparently that some of the birds took larger numbers. The author found in four birds totals of 202, 530, 357, and 361 remains of Chironomus sp. larvae alone.

In entomological literature there are numerous statements to the effect that the larvae of Chironomus, and certain Dolichopodidae, Stratiomyiidae and Muscidae are aquatic in nature, however, the author has been unable to find definite statements regarding the exact types of pond bottoms or conditions of shallow water areas in which the larvae of these forms are most abundant. As stated before, dowitchers show a preference for open, muddy or sandy flats and shallow-water areas while snipe more frequently choose low meadows or semi-marsh areas as their feeding grounds. Both species will take as food the larvae of the above mentioned flies, that is, any of the larvae are acceptable as food. This would seem to indicate that rather than showing a decided preference for larvae of one kind, the birds will take those which are available or most easily obtainable. If this be true, then these findings, supported by the findings of Sperry (1940) would seem to shed additional light upon the habitat of the larvae of these group of flies. "Bloodworms" (Chironomus sp.) would seem to be much more abundant in water areas which have a muddy or sandy bottom rather than a bottom with an excess of decaying vegetation bordering on the formation of peat. In support of this statement the following observation is of interest: ten snipe were found to

contain remains of Chironomus larvae. Five of the birds, taken from Whitford Slough, took a total of 56 "bloodworms"; five birds taken from mud and sand bottomed areas where there was a lack of excess decaying vegetation contained a total of 1,027 of these larvae.

The aquatic larvae of Dolichopodidae, Stratiomyiidae and Muscidae seem to be more abundant in low-meadows and semi-marsh areas with a peat-formation type of bottom.

Insects other than those mentioned above were taken by both dowitchers and snipe but in comparatively small numbers.

Beetle mites (Eporibatula sp.) were found in 32.83 percent of the snipe stomachs; none was found in dowitchers. These mites are more readily available to snipe. Essig (1934) states that the mites occur ". .on ground among decaying vegetation and wet leaves and moss on decaying logs," a type of habitat seldom found on open, muddy or sandy beaches. It would seem evident that they also occur in or at least adjacent to semi-marsh conditions.

Spiders (Araneae)were not taken by dowitchers but were found in 13.43 percent of the snipe.

Ostracods were taken in about the same percentages by the two species.

The ephippia of Cladocera occurred in 45.45 percent of the dowitchers but in only 2.98 percent of the snipe.

Porifera and Bryozoa--Sponge gemmules and statoblasts of bryozoa were taken respectively by 23.88 percent and 22.38 percent of the snipe, while each of these occurred in 9.09 percent of the dowitchers.

Mollusca--Only one dowitcher (9.09 percent) contained snail shell as against its occurrence in fifty snipe, (74.62 percent). Three genera of snails were found but with little if any preference for any one genus shown by the birds. Here again the author believes that abundance and availability was the determining factor in relative numbers taken.

Plant Food

Plant food formed a very small percentage of the total bulk of food in each of the two species of birds. Wilson's snipe took a larger variety of seeds and with much higher percentages of occurrences than did dowitchers, and seeds are apparently much more important in the diet of snipe. It is to be remembered in this connection that the variety and quantity of seeds is greater in a marshy situation than on open, flat beaches; this is possibly again a question of availability of seeds to the birds.

Stones

Stones were taken by 100 percent of the dowitchers and by 94 percent of the snipe. The variation in size of stones taken was greatest in dowitchers, however, the average size per stone (by weight) was about the same: for snipe .00121 gram per stone; for dowitchers .00101 gram per stone. Snipe took an average of 54.2 stones per bird as against 443 per dowitcher. Stones then furnished a much larger percentage of the stomach contents in the case of dowitchers.

Summary of these comparisons

1. Insects, principally immature forms, comprise the chief item of diet in both dowitchers and snipe.

2. Snipe taken from situations which are more characteristic of areas frequented by dowitchers displayed a much greater similarity to the food habits of dowitchers than did snipe taken from a typical snipe area, such as Whitford Slough.

3. Availability and relative abundance of the various kinds of animal food found in the type of habitat chosen by each of these two species of birds determines the variety and amounts of such foods taken. Dissimilarities in food habits then are probably due to differences in the habitat requirements of animal forms used as food. It is the author's belief, based upon these investigations, that food preferences which might be indicated by the birds are of secondary importance.

4. Local distribution of these two species during migration is influenced more by cover type preference than by food preference.

VIII. DISCUSSION OF LESSER YELLOWLEGS

Totanus flavipes (Gmelin)

Lesser yellowlegs were more numerous than snipe, dowitchers and greater yellowlegs combined. Observations totalling 1,283 of this species were recorded from June 25 to October 20, 1934. By far the majority of these birds were seen around the sandy beaches of Lost Island Lake, on both the Clay and the Palo Alto County shores. They were seen most frequently feeding in water from "tarsus-deep" to "breast-deep." Some were seen around mud-bottomed ponds.

The legs of the lesser yellowlegs are typical of the wading type. The tarsus is from 2.40 to 2.50 inches long and the tibia is bare for about 1.25 inches. The wading possibilities are greatly increased over those of dowitchers and snipe.

Compared with these latter two species, the bill of the lesser yellowlegs is considerably shorter, 1.40 to 1.50 inches, and less sensitive at the tip. During feeding activities, it is used very little for actual probing in the sand and mud. The use of the bill more closely resembles that of the "spearing type" although in structure it is of the true "probing type."

Yellowlegs prefer the open, mud flats and sandy lake shores, and are only occasionally seen feeding on upland areas. They frequently feed alone, yet they commonly gather together in flocks. The "flock", as a unit, gradually breaks down when the birds alight and begin to feed. This observation agrees with statements made by Bent (1927). He states that the lesser

yellowlegs "is more apt [than the greater yellowlegs] to be seen in large flocks, though the flocks are seldom compact and are usually much scattered, especially when feeding."

Material Examined

The study of the food habits of lesser yellowlegs in northwestern Iowa is based on the examination of 71 stomachs. These specimens were taken mainly between late July and late October. The number of birds taken represented 5.53 percent of those observed. Table 6 gives the collection data for the specimens.

Animal Food

Arthropoda. Reference to table 7 shows insects to be the main item of diet for lesser yellowlegs, although in this case the pressure is exerted on a group of insects somewhat different from that of dowitchers and snipe. Hemiptera (true bugs) were taken most frequently. Water boatmen (Corixidae) were represented in 50 stomachs (70.42 percent of the total number of lesser yellowlegs taken). This group would very likely be taken only by wading and spearing on the part of the yellowlegs. Lygaeidae (the chinch bug family) occurred in 29.58 percent of the stomachs (see table 1., for species). Nabidae were found in 23.94 percent of the birds, and Coreidae in 21.13 percent. Other bugs were present in smaller percentages.

Hymenoptera were represented chiefly by ants (Formicidae) which

Table 6. Location and Date of Collection of Lesser Yellowlegs Examined[1]

LOCATIONS	DATES																	Location Totals
	Apr. 1933	May 1935	July 1934	August 1934				September 1934					October 1934					
	28	4	23-27	28--1	12-16	17-21	30--3	7-11	12-16	17-21	27--1	2-6	7-11	17-21				
Conesville, Louisa Co.	1																	1
Ruthven, Ia.								1 (1933)										1
Elk Lake		2																2
Pritchard's Pasture		1																1
Mud Lake Bridge Pond								1										1
Roland's Farm Pond										3								3

1. The collection dates are grouped into five-day periods according to the observational date groupings listed by the author in his 1934 fall shore bird migration studies (Spawn 1935, p. 621.)

Table 6. (continued)

LOCATIONS	DATES																
	Apr. 1933	May 1935	July 1934	August 1934				September 1934				October 1934					Location Totals
	28	4	23-27	28--1	12-16	17-21	30--3	7-11	12-16	17-21	27--1	2-6	7-11	17-21			
Virgin Lake														2			2
Electric Park Lost Island Lake													2				2
Lost Island Lake, Palo Alto Co.			2	1	1	2	4	10		1	9	1	1				32
Lost Island Lake, Clay Co.					2	4	2	3	2	2	7	1		3			26
Date Totals	1	3	2	1	3	6	6	15	2	6	16	2	3	5			71

Totals by Months

April	1
May	3
July	3
August	15
September	39
October	10

occurred in 42.25 percent of the stomachs. Remains of "mining bees" (Halictus sp.) were present in 9.86 percent of the birds. It is unlikely that wading had anything to do with the taking of this order of insects. To the author, it seems quite apparent that the birds fed not only by wading but also at some distance back from the shore line as well.

Homoptera (Cicadellidae) were eaten by 26 birds, (36.62 percent), and lantern flies (Fulgoridae) by 14.08 percent. One adult plant louse (Aphididae) was taken; four birds ate a total of 578 aphid eggs (identified as such by Dr. Muesebeck of the U. S. National Museum).

Bloodworms, the larvae of midges (Chironomus sp.) were eaten by 19 lesser yellowlegs (26.76 percent). Other diptera were taken less frequently. This fact might be taken as fair evidence of at least a certain amount of actual probing, though not necessarily so.

The larvae and larval remains of water scavenger beetles (Hydrophilidae) occurred in 18.31 percent of the stomachs. The remains of undetermined ground beetles (Carabidae) were found in 10 stomachs (14.08 percent). Other beetles and their larvae indicate feeding activities both in the water and upon dry land.

The remains of naiads of dragon-flies and damsel-flies (Odonata) occurred in 11 birds (15.49 percent).

Caddice-fly larvae and remains of stone-covered larval cases were obtained from 12 stomachs (16.90 percent.).

The winter eggs (ephippia) of water fleas were taken by 30 birds (42.25 percent) but quite obviously, due to their size, contributed a

practically negligible quantity to the total bulk of food in any one stomach.

Ostracods, amphipods, spiders and beetle mites comprised the remainder of the arthropods used as food.

Porifera. Fresh-water sponge gemmules were found in two birds, one of which contained four gemmules of Carterius tubisperma Mills. Pratt (1935) gives the distribution of this sponge as in the eastern and central states.

Nemathelminthes. One undetermined nematode was found.

Bryozoa. Two birds contained a total of 14 statoblasts of Plumatella repens.

Annelida. Earthworms (Lumbricus sp.) occurred in only one instance and only one worm was eaten by the bird.

Mollusca. Snails (Gastropoda) were found in only four lesser yellowlegs, (5.63 percent), whereas in the case of Wilson's snipe, there were 50 occurrences, (74.62 percent) recorded. Snails were found much more abundantly in the Whitford Slough area than around the shores of Lost Island Lake. The taking of snails as food, by lesser yellowlegs, apparently becomes a problem of availability of snails in the habitat chosen by the birds.

Chordata. One bird contained a few very small fish bones in its stomach.

Plant Food

Seeds and other parts of plants form an almost insignificant part of the diet of lesser yellowlegs in northwestern Iowa. The 71 stomachs examined contained a total of 52 seeds, less than one seed per bird. The species of seeds and the numbers of each species taken are shown in table 7.

Stones

Stones were contained in 56 stomachs (78.45 percent). An average of 716 stones per bird was found and the average weight per stone was found to be 0.0001 gram. These figures, however, require some explanation. Fifteen birds took no stones at all. Seventeen of those containing stones took less than 100 each, while 19 others took less than 500 stones each. Eight birds took between 500 and 1000 stones; 4 took between 1000 and 2500; 6 took between 2500 and 5000; and 2 took over 5000 stones (one of these contained 7,579).

These stones are not taken as single units by the birds. The following fact is of interest. Eight birds took over 1000 stones each. In six of these, the remains of cases of caddice-fly larvae were found, some with the stones still attached. It is the author's belief that the large numbers of small stones found are taken incidental to regular feeding activities in perhaps the large majority of instances.

Summary:

1. The stomachs of 71 lesser yellowlegs were examined. These were collected mainly over the period extending from late July to late October, 1934.

2. Insects comprised the principal items of food. Hemiptera (true bugs) were taken by the largest number of birds. Hymenoptera (ants, in this case) were found in 42.25 percent of the stomachs. Leaf-hoppers, lantern-flies, aphids (eggs), blood-worms, larvae of water beetles, dragon-fly and damsel-fly naiads, and caddice-fly larvae also were represented. The type of food taken indicates both feeding in water and upon adjacent land areas.

3. Phyla of animals taken in much smaller quantities are as follows: Porifera, Nemathelminthes, Bryozoa, Annelida, Mollusca, and Chordata.

4. Plant food formed an almost insignificant percentage of the volume of food taken by lesser yellowlegs.

5. Stones were taken by 78.45 percent of the birds; the average number of stones taken per bird was 716; the average weight per stone proved to be 0.0001 gram.

6. The occurrences of large numbers of stones in the stomachs were found in several instances to be closely associated with the taking of caddice-fly larvae within the larval cases, the stones being taken incidental to the eating of these larvae.

Suggestions for Management of Lesser Yellowlegs in Northwest Iowa

Protection from hunters: The permanent protection now afforded yellowlegs, by Federal law, should be continued.

Cover: Yellowlegs prefer open, muddy or sandy flats and shorelines of ponds and lakes. Bare, rocky or sandy points, jutting out into the water areas are especially attractive to the birds. The birds breed far to the North, in Canada and Alaska; hence, nesting areas are automatically removed from consideration in northwestern Iowa and similar areas.

Food: Seeds form a rather unimportant part of the diet of yellowlegs. This and the fact that they prefer open shores and flats make it unnessary to encourage land plants. Aquatic plants, such as pondweeds (Potamogeton sp.), etc., might well be encouraged because of the effect they have upon the presence and production of aquatic life which is taken as food.

Table 7. Systematic List of Food Items Found in Stomachs of 71 Lesser Yellowlegs Collected Mainly in Clay and Palo Alto Counties, Iowa.[1]

ANIMAL FOOD	Number of Stomachs[2]	Total Number Specimens[3]	Percentage of Occurrences[4]
Phylum Porifera			
gemmules	2	5	2.82
Undetermined	1	1	
Haploscleridae			
Carterius tubisperma Mills	1	4	
Phylum Nemathelminthes			
Nematoda	1	1	1.41
Phylum Bryozoa			
Plumatellidae			
Plumatella repens, statoblasts	2	14	2.82
Phylum Annelida			
Lumbricidae			
Lumbricus sp.	1	2	1.41

1. The animal foods are listed systematically by Phylum and Class according to Pratt (1935). Orders, families and genera are arranged alphabetically. Plant foods are arranged according to Hayden (1940).

2. The number of stomachs in which each item occurred.

3. The total number of specimens of each species represented

4. The percentage of the 71 birds in which each food item occurred.

Table 7. (continued)

ANIMAL FOOD	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Phylum Arthropoda			
Crustacea			
Cladocera			
Daphnidae			
Moina macropa Straus, (ephippia)-----	30	406	42.25
Ostracoda			
Cyprididae			
Cyclocypris sp. (possibly *sharpei*)---	4	23	5.63
Amphipoda			
Talitridae			
Hyalella azteca (Saussure)-	1	19	1.41
Arachnida			
Araneae----------	6		8.45
egg masses----------	2	2	
remains of spiders------	4	4	
Acarina			
Galumnidae			
Eporibatula sp.--------	2	2	2.82
Hexapoda (Insecta)			
Undetermined (mandibles)---	2	4	2.82
Coleoptera			
Undetermined----------	8	16	11.27
Anthicidae			
Anthicus sp.----------	1	1	1.41
Carabidae			
Undetermined----------	10	38	14.08
Cratacanthus dubius (?) (Beauv.)-------	2	20	

Table 7. (continued)

ANIMAL FOOD	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Chrysomelidae	3	4	4.23
Undetermined	2	2	
Glyptina sp.	1	1	
Orthaltica melina (?) Horn	1	1	
Cicindelidae	2	2	2.82
Coccinellidae	1	2	1.41
Curculionidae	6	7	8.45
Dytiscidae	6	9	8.45
larvae	4	5	
adults	3	4	
Elateridae	3	6	4.23
Unidentified	2	4	
Drasterius sp.	1	2	
Heteroceridae			
Heterocerus undatus Melsh.	1	4	1.41
Hydrophilidae	13	82	18.31
Tropisternus sp., (larvae & remains)	10	79	
T. nimbatus Say	3	3	
Nitidulidae			
Carpophilus niger Say	1	1	1.41
Phalacidae			
Phalacrus politus Melsh.	2	5	2.82
Scarabaeidae			
Aphodius distinctus (Mull)	7	12	9.86

Table 7. (continued)

ANIMAL FOOD	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Staphylinidae			
Philonthus sp., (or near)-	3	4	4.23
Tenebrionidae----------	1	1	1.41
Diptera			
Undetermined----------	4	15	5.63
Undetermined, minute puparia-	2	23	2.82
Asilidae----------	1	1	1.41
Borboridae----------	2	2	2.82
Chironomidae			
Chironomus sp.----------	19	130	26.76
remains larvae----------		97	
remains pupae----------		14	
remains adults----------		19	
Chloropidae			
Meromyza americana Fitch--	1	2	1.41
Dolichopodidae----------	3	13	4.23
remains larvae----------		12	
remains adults----------		1	
Metopiidae----------	5	18	7.04
Lucilia sp.----------		2	
Muscidae----------	4	5	5.63
remains larvae----------		3	
remains adults----------		2	
Stratiomyiidae			
Odontomyia sp.----------	1	1	1.41
Syrphidae----------	4	26	5.63
Tabanidae, (larva)----------	1	1	1.41
Tachinidae----------	1	2	1.41

Table 7. (continued)

ANIMAL FOOD	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Tipulidae, (pupae)----------	4	74	5.63
Hemiptera			
Undetermined----------	6	30	8.45
remains heads----------		1	
eggs----------		29	
Coreidae----------	15	56	21.13
remains heads----------		51	
remains entire bugs----		5	
Corixidae----------	50	495	70.42
eggs (not counted as individual specimens)-		1280	
remains heads----------		389	
remains entire bugs----		106	
Gerridae			
Gerris sp. (heads)-------	1	4	1.41
Lygaeidae----------	21	324	29.58
remains heads----------		310	
remains entire bugs----		14	
Mesoveliidae			
Mesovelia bisignata (?) Uhler, (head)--------	1	1	1.41
Miridae, (heads)----------	5	6	7.04
Nabidae, (heads)----------	17	56	23.94
Pentatomidae----------	5	8	7.04
remains heads----------		7	
remains entire bugs----		1	
Saldidae			
Saldula sp.----------	1	1	1.41

Table 7. (continued)

ANIMAL FOOD	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Tingidae			
Piesma cinerea Say	2	2	2.82
Homoptera			
Cicadellidae	26	1099	36.62
remains heads		918	
remains entire specimens		181	
Fulgoridae	10	74	14.08
Aphididae, (adults)	1	1	1.41
(eggs)	4	578	5.63
Hymenoptera			
Unidentified	9	16	12.68
Andrenidae			
Halictus sp.	7	33	9.86
Formicidae	30	204	42.25
Undetermined		144	
Formica sp.		2	
Monomorium sp.		1	
Myrmica sp.		47	
Ponera sp.		10	
Ichneumonidae	2	7	2.82
Undetermined		1	
Mesochorus sp.		6	
Lepidoptera	2	6	2.82
Odonata, (remains naiads)	11	36	15.49
Anisoptera		3	
Zygoptera		33	
Orthoptera			
Tetrigidae, (eggs)	1	2	1.41

Table 7. (continued)

ANIMAL FOOD	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Trichoptera	12		16.90
remains larvae		5	
remains larval cases		25	
remains heads of adults		2	
Phylum Mollusca			
Gastropoda			
Pulmonata	4	shell broken; numbers unknown	5.63
Phylum Chordata			
Pisces			
remains bones small fish	1	5	1.41
In addition to the above listed materials were found pieces of an hyaline, tubular material less than a millimeter in diameter and up to 1.5 centimeters in length. It was necessarily included as unidentifiable.	3	4	4.23
PLANT FOOD			
Division Spermatophyta			
Subdivision Angiospermae			
Class Monocotyledoneae			
Typhaceae			
Typha sp.	6	16	8.45
Najadaceae			
Potamogeton sp.	1	1	1.41
Alismaceae			
Sagittaria latifolia Willd.	1	1	1.41

Table 7. (continued)

PLANT FOOD	Number of Stomachs	Total Number Specimens	Percentage of Occurrences
Gramineae			
Undetermined	5	5	7.04
Setaria viridis (L.) Beauv.	1	1	1.41
Cyperaceae			
Carex sp.	1	1	1.41
Cyperus erythrorhizos Muhl.	7	10	9.86
C. strigiosus (?)	2	8	2.82
Scirpus sp.	1	1	1.41
S. validus Vahl.	1	1	1.41
Class Dicotyledoneae			
Polygonaceae			
Polygonum natans A. Eaton	1	1	1.41
P. pennsylvanicum L.	1	1	1.41
Rumex maritimus L.	1	1	1.41
Labiatae			
Lycopus sp.	1	2	1.41
Undetermined seeds	2	2	2.82
Pieces of undetermined plant material	2	4	2.82

IX. GREATER YELLOWLEGS

Totanus melanoleucus (Gmelin)

Fourteen of these birds were observed in the Ruthven, Iowa, area during the fall of 1934, but only one was collected. Two stomachs, from birds collected in 1933 and at the time in the Iowa State College collection, were also examined.

The writer realizes that the examination of three birds of any particular species is not sufficient material upon which to base any conclusions regarding food habits. For reasons set forth in the introduction to this dissertation the results of the analyses of these three birds are included. The table showing a systematic list of food items found has not been prepared in this case because the percentages of occurrences of various items could not be considered to be accurate, due to the small number of greater yellowlegs taken.

The individual analysis of each of these three birds follows:

1. Taken (not by the writer) at Graettinger, Palo Alto County, Iowa, September 7, 1933.

Animal food.

1 mandible of naiad of dragon fly, Anisoptera.

Plant food.

1 seed grass, Panicum sp.

1 seed yellow foxtail, Setaria lutescens F.T. Hubb

1 seed red-rooted cyperus, Cyperus erythrorhizos Muhl.

1 seed dock, Rumex sp.

3 seeds golden dock, R. maritimus L.

.2 cc. macerated plant and animal material and mud, unidentifiable.

2 stones = .0024 gram.

2. Taken (not by writer) at a roadside puddle near Ruthven, Palo Alto County, Iowa, September 10, 1933.

Animal food.

No entire specimens.

Plant food.

1 seed common smartweed, Polygonum hydropiper L.

1 seed lady's thumb, Polygonum persicaria L.

.2 cc. macerated animal and plant material (remains earthworm, beetle, and small stems.)

32 stones = .0977 gram.

3. Taken at Lost Island Lake, Palo Alto County, Iowa, September 1, 1934.

Animal food.

1 remains of ground beetle, Carabidae.

1 leaf beetle, Coptocycla bicolor Fabr.

2 elytra of flea-beetle, Systena elongata Fabr.

1 head of water beetle, Hydrophilidae

8 ants, Myrmica sp.

1 ant, Ponera sp.

201 heads of ants, of above genera.

2 small pieces of fish bone, Pisces.

No Plant food.

.8 cc. macerated insects, about 95 percent ants.

No stones.

X. SUMMARY

The study of the food habits of shorebirds (Charadriiformes) in northwestern Iowa was conducted mainly during the summer and fall of 1934. The specimens examined were collected, with the exception of two birds, in Clay and Palo Alto Counties, (the Ruthven area).

In this investigation 152 shorebird stomachs were examined. This number represents four species: (1) Wilson's snipe, Capella delicata (Ord.); (2) dowitchers, Limnodromus griseus subspecies griseus (Gmelin) and scolopaceus (Say); (3) lesser yellowlegs, Totanus flavipes (Gmelin); and, (4) greater yellowlegs, Totanus melanoleucus (Gmelin).

The taxonomic specimen-enumeration method was used in the analyses of the stomachs. Results are presented in tables 1, 3, 5, and 7, pp. 20, 43, 56, and 74, respectively.

Insects, chiefly larval forms, comprised by far the greatest percentage of the total bulk of food in each species of bird.

The stomachs of 67 snipe were examined. Insects were represented in 93.65 percent of these. Fly larvae were found in 64.18 percent of the snipe (Chironomus sp., in largest numbers but by only 14.92 percent; Dolichopodidae in 41.79 percent; Stratiomyiidae, 22.38 percent; Muscidae, 16.41 percent). The larvae of water scavenger beetles (Hydrophilidae) were present in 32.83 percent of the snipe. Other animal foods represented included: other flies and beetles, true bugs, ants, a moth, bird lice, dragon-fly naiads, spiders, beetle mites, ostracods, ephippia of water fleas,

statoblasts of moss animals, and gemmules of fresh-water sponges. Snails were eaten by 74.62 percent of the snipe but comprised a small percentage of the total bulk of food. Seeds of sedges, water plantain, smartweed, and bur-reed were the most important plant foods taken but formed a very small part of the total volume of food. Certain individual stomachs contained a rather high percentage of unidentifiable rootlets. Stones were found in all but four of the stomachs.

The stomachs of 11 dowitchers were analyzed. Insects constituted 85 to 90 percent of the food exclusive of grit. Midge larvae were most important, being taken by 63.63 percent. The larvae of biting midges (Ceratopogonidae) occurred in 27.27 percent; and dragon-fly naiads were found in 18.18 percent. Other animals represented were: beach fleas, ephippia of water fleas, gemmules of fresh-water sponges, and statoblasts of moss-animals. Remains of snails were found in 9.09 percent of the dowitchers. Seeds were found in nine of the eleven birds, but they formed an almost negligible part of the diet. Stones were found in every stomach. There were more stones per bird and they constituted a greater percentage of the gizzard contents by weight than in any other species examined.

The comparison of food habits of dowitchers and snipe show that when collected from the same type of habitat there are relatively few differences between these species as to food taken. When collected from their more typical habitats there are certain rather distinct differences in the food habits. Availability and relative abundance of the kinds of animal food found in the type of habitat chosen in each case is the principal factor in determining the variety and amounts of such food taken; food

preferences which might be indicated by the birds are believed to be of secondary importance.

The lesser yellowlegs food habits study was based upon the analyses of 71 stomachs. Insects were again the principal item of diet, but the forms taken differ somewhat from those of dowitchers and snipe. This is probably due to the differences in methods of feeding, which in turn are likely the result of the different morphological characters of the bills and legs of the birds. The true bugs (Hemiptera) were taken most frequently. Water boatmen (Corixidae) were found in 70.42 percent of the yellowlegs; the chinch bug group (Lygaeidae) in 29.58 percent; Nabidae, 23.94 percent; and, Coreidae in 21.13 percent. Other bugs were found in smaller percentages. Ants occurred in 42.25 percent; leaf hoppers in 36.62 percent; lantern flies in 14.08 percent; and larvae of midges in 26.76 percent. Other insects represented were: larvae of water scavenger beetles, ground beetles, dragon-fly and damsel-fly naiads, and caddice-fly larvae (some in their stone-covered cases). Winter eggs of water fleas were found in 42.25 percent of the birds, but were quantitatively negligible. Ostracods, amphipods, spiders, beetle mites, gemmules of fresh-water sponge, statoblasts of moss-animals, one nematode, and one earthworm were also taken. Snails were taken by only 5.63 percent of the yellowlegs. Seeds formed an almost insignificant part of the diet, there being a total of only 52 seeds taken from the 71 stomachs. Stones were contained in 78.45 percent of the stomachs. The occurrences of large numbers of stones were found in several instances to be closely

associated with the taking of caddice-fly larvae within their stone-covered larval cases, the stones being taken incidental to the eating of these larvae.

The stomachs of the three greater yellowlegs were available in the Iowa State college collection and were included merely for whatever value the analyses might have. No conclusions were based upon their examination.

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VITA

Full Name of Father, Charles Earl Spawn.

Maiden Name of Mother, Josephine Natrass.

Date and Place of Birth —
December 6, 1907, at Chester, South Dakota.

Elementary and Secondary Schools Attended —
Chester Consolidated, Grade and High School, Chester, So. Dak.

Colleges Attended — Degrees Earned —
South Dakota State College, Brookings, B. S., 1931
South Dakota State College, Brookings, M. S., 1933
Iowa State College, Ames

Fields of Specialization —
Undergraduate Major — Entomology; Minor — Zoology.
M. S. Major — Entomology; Minor — Zoology-Botany.
Ph. D. Major — Zoology (Specialization in Wildlife).
First Minor — Entomology.
Second Minor — Botany.

Professor in Charge of Major Work ——— Dr. George O. Hendrickson

I also wish to state, with fond remembrance, that until the time of his death, in 1934, Professor J. E. Guthrie was in charge of my major work.

Signed: Gerald B. Spawn
Gerald B. Spawn