tions takes place in response to precisely the same factors as hem in the ranges of sedentary species.

The continual wide dissemination of so-called accidentals, has, then, provided the mechanism by which each species as a whole spreads, or by which it travels from place to place when this is necessitated by shifting barriers. They constitute sort of sensitive tentacles, by which the species keeps aware of the possibilities of areal expansion. In a world of changing conditions it is necessary that close touch be maintained between a species and its geographical limits, else it will be cut off directly from persistence, or a rival species, an associational analogue, will get there first, and the same fate overtake it through unsuccessful competition—supplantation.

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NOTES ON FOOD HABITS OF THE SHOVELLER OR SPOONBILL DUCK (SPATULA CLYPEATA).

BY W. L. MCATEE.

Reports have been made by the Biological Survey upon the food habits of all of the shoal-water ducks of the United States except the Shoveller. McAtee wrote the accounts[1] of the Mallard, Black Duck and Southern Black Duck, and Mabbott those[2] of the Gadwall, Baldpate, European Widgeon, Green-winged, Blue-winged and Cinnamon Teals, Pintail and Wood Duck. The Shoveller would have been included in the latter report had the author returned from war. However, design as well as fate had to do with the omission; truth is that the food habits of the Spoonbill duck are more difficult to study than those of any other anatine species yet investigated and the work, therefore, was postponed to the last. Even so the pioneer analyses by McAtee have not yet been supplemented and these are here reported upon so that some data on the food habits of the Shoveller will be available, and the

[1] U. S. Dept. Agr. Bull. 720, 35 pp., 1 Pl. Dec. 1918.
[2] U. S. Dept. Agr. Bul. 862, 67 pp., 7 pls. Dec. 1920.

dietetic reports upon a major group of our wild ducks made measurably complete.

Popularly the Spoonbill is reputed to feed upon mud and three of the local names of the bird emphasize this belief, namely, "mud duck," "mud lark," and "mud shoveller." With respect to mud, the pure thing itself, can scarcely be considered as nutritious, but the material referred to in common parlance as the pabulum of mud-eaters, is bottom ooze composed largely of more or less decayed vegetable debris often containing large numbers of minute plants and animals such as diatoms and ostracods. There is little doubt that these small organisms supply most of the nutriment in the so-called mud found in alimentary tracts of shovellers. The broadening of the bill of this bird, the multiplication of the straining lamellae and elongation of the intestine, all are specializations for nutritive utilization of minute organisms, and while the Spoonbill takes more of this kind of food than other ducks, it does not habitually profit by its specializations, as only about 15, certainly not to exceed 20 per cent of the birds examined had fed on bottom ooze.

For the present study of the food habits of the species, gizzards (some with crops) of 84 Shovellers have been examined. These were collected in 12 states with Texas most heavily represented by 25, but with 5 or more each from Colorado, California, Arkansas, Louisiana, South Carolina, and Florida. They were collected in all months from August to April inclusive, the largest numbers being taken in November and February. Fourteen of the total number of stomach contents analyzed were rejected, because of insufficiencies of various kinds, thus leaving 70 upon which the percentages of food items here cited are based.

Tabulating the food items of these 70 Spoonbills in the simplest way, (i. e. without attempting to eliminate errors due to inequalities in geographic and seasonal distribution of the specimens) we find that 65.76% of the total food is of vegetable and 34.24% of animal origin. This is a higher proportion of animal food than taken by any of the other shoal water ducks with the sole exception of the Southern Black Duck, a species living where animal food is plentifully available all the year.

The largest item of animal food is molluscs, practically all of them fresh-water univalves. They constituted 18.97% of the total or more than half of the animal food of the Shoveller. No fewer than 280 *Physa heterostropha* were counted in one stomach contents and 1100 *Amnicola floridana* in another. Unidentified snails were found in 29 of the 84 stomachs examined and the following identified kinds in the number stated in connection with each:

Amnicola floridana	2	Lymnaea sp.	1
Amnicola limosa	1	Planorbis exacuous	1
Amnicola porata	1	Planorbis parvus	4
Amnicola sp.	2	Planorbis trivolvis	1
Neritina reclivata	4	Physa heterostropha	2
		Physa sp.	2

Aquatic insects are next in importance in the regimen of the Spoonbill Duck, water-bugs contributing 3.64% to the diet and water-beetles, caddis larvae, dragon-fly nymphs, and all other insects together about one per cent each. The water bugs were chiefly water boatmen (Corixidae) found in 9 stomachs. These small creatures swarm over the bottom ooze and play an important part in transforming nutriment gathered there into meat much sought by higher forms. Other water-bugs captured by the Spoonbill include back-swimmers (Notonectidae among them *Notonecta undulata*), one of the medium-sized species of "giant water-bugs" (*Zaitha*) and a water scorpion (*Ranatra*).

The water beetles eaten are chiefly small species, but include a few of the highly predaceous larvae known as water-tigers (Dytiscidae). A list of the water-beetles identified from Shoveller stomachs is:

Haliplus punctatus	1	Dytiscidae	3
Haliplus ruficollis	1	Berosus sp	3
Haliplus sp.	1	Tropisternus sp	2
Bidessus pullus	1	Water-beetles (further unidentified)	4
Bidessus sp.	1		
Hydroporus sp.	1		

Caddis larvae and their cases and dragon-fly nymphs are most numerous among the other insects preyed upon, but there is nothing of special note regarding them, nor were any of them identified. The remaining insects included larvae of midges,

soldier-flies, horse-flies, may-flies, a hymenopteron, and a bird louse, of a species (*Lipeurus squalidus*) known to infest the Shoveller. Not insects but more closely allied to them than to other orders are the water-mites (Hydrachnidae) which were identified from 5 stomachs.

Remains of small fishes composed nearly 3 per cent of the food of the Shovellers examined; in one case 6 small carp (*Cyprinus carpio*) had been taken by a single bird. Crustaceans make up the balance of the animal food and although 2 crawfishes were among them the great bulk was made up of those minute bivalved forms known as Ostracods together with a few of the naked Copepods. In one instance hundreds of Ostracods had been consumed as part of one meal. In the case of a Shoveller collected at South Island, S. C., March 31, 1905, a male specimen of a new species of *Ilyodromus* was identified by Dr. R. W. Sharpe of New York, who stated that the genus had not previously been reported from North America and that no male had ever before been found. The names of the Ostracods identified and the number of stomachs in which found are:

Candona sigmoides	1	Cypris pellucida	2
Candona simpsoni	2	Cypridopsis vidua	1
Candona sp	3	Cythere sp	1
Cypria dentifera	2	Ilyodromus sp	1
		Potamocypris smaragdina	1

Foraminifera were found in a single stomach from the Mississippi Delta, and oligochaete worms in two.

The approximate two-thirds of the diet of the Shoveller derived from the vegetable kingdom is drawn from numerous plant families none of which is of really preponderating importance. A fair share of the total course is composed of the macerated plant debris which is so important a constituent of the bottom ooze. Aside from this indeterminate material the leading items are: sedges, 16.02%; pondweeds, 11.25%; grasses, 8.28%; algae, 6.55%; waterlilies, 2.5%; duckweeds, 1.7%; and smartweeds, 1.1%. Chiefly the seeds of sedges are eaten, those most in favor being bulrush (*Scirpus*) and saw-grass (*Mariscus*). About 200 seeds of the latter plant were found in one stomach. The pondweeds consumed were mostly *Potamogeton* and widgeon grass (*Ruppia*)

of each of which more than 150 seeds were counted in single gizzards, but of another genus of this family, the horned pondweed (*Zannichellia*) more than 1600 seeds were taken by one bird at a meal. The grasses identified in the Shoveller's food were mostly switch-grasses (*Panicum*), and cultivated rice. However the seeds of the latter eaten were shattered grain gleaned in the fields in winter, and their consumption is a benefit since volunteer rice is very objectionable. About 300 seeds of a beach grass (*Monanthochlöe littoralis*) were found in one stomach. The algae determined were musk-grasses(*Chara*) but filamentous algae not identified are just as important a proportion of the food. Diatoms were detected in 2 stomachs. Seeds of water-lilies, largely those of water-shield (*Brasenia*) and stolons of the banana waterlily (*Castalia mexicana*) represent this family in the Shoveller's diet; duckweeds (*Lemnaceae*) are eaten entire, and seeds again of smartweeds are the portion sought. The only other item of plant food worthy of special note is the velvet duckweed (*Azolla caroliniana*), a fern ally growing on the water surface of southern swamps, specimens of which composed nearly half of the contents of one stomach; it seems to be rarely eaten by birds.

Items of vegetable food and number of stomachs in which found:

Diatoms	2	Foxtail grass (*Chaetochloa* sp.)	1
Musk-grass (*Chara* sp.)	3	Rice cut-grass (*Leersia oryzoides*)	1
Unidentified algae	7	Rice (*Oryza sativa*)	4
Velvet duckweed (*Azolla caroliniana*)	1	Beach grass (*Monanthochloe littoralis*)	2
Pepperwort (*Marsilea vestita*)	4	Unidentified grasses	5
Bur-reed (*Sparganium* sp.)	3	Nut-grass (*Cyperus* sp.)	3
Small pondweed (*Potamogeton pusillus*)	2	Spike-rush (*Eleocharis* sp.)	5
Sago pondweed (*Potamogeton pectinatus*)	2	Hair sedge (*Stenophyllus capillaris*)	1
Pondweeds (*Potamogeton* sp.)	13	*Fimbristylis* sp.	5
Bushy pondweed (*Naias flexilis*)	3	Bulrush (*Scirpus* sp.)	19
Horned pondweed (*Zannichellia palustris*)	1	Three-square (*Scirpus americanus*)	1
Widgeon grass (*Ruppia martima*)	12	River bulrush (*Scirpus fluviatilis*)	1
Wapato (*Sagittaria* sp.)	1	Bog-rush (*Mariscus mariscoides*)	1
Wild millet (*Echinochloa crus-galli*)	1	Saw-grass (*Mariscus jamaicensis*)	6
Switch grass (*Panicum* sp.)	6	*Carex* sp.	4
		Carex decomposita	1
		Unidentified sedges	11
		Small duckweed (*Lemna minor*)	1

Duckweed (*Lemna* sp.)	2	Banana water-lily (*Castalia mexicana*)	2
False nettle (*Boehmeria cylindrica*)	1	Waterlily (*Castalia* sp.)	1
Water smartweed (*Persicaria amphibia*)	5	Senna (*Cassia sp.*)	2
Prickly smartweed (*Tracaulon sagittatum*)	2	Poison ivy (*Rhus toxicodendron*)	1
Unidentified smartweed (*Polygonum* sp.)	6	Grape (*Vitis* sp.)	2
Pigweed (*Amaranthus* sp.)	1	Malvaceae	1
Lambs'-quarters (*Chenopodium* sp.)	1	*Malva* sp	3
Glasswort (*Salicornia ambigua*)	1	*Hypericum* sp	1
Sea purslane (*Sesuvium martimum*)	1	Water milfoil (*Myriophyllum* sp.)	3
Coontail (*Ceratophyllum demersum*)	6	Mermaid weed (*Proserpinaca* sp.)	2
Water-shield (*Brasenia schreberi*)	3	Dodder (*Cuscuta* sp.)	2
		Heliotropium indicum	15
		Cleavers (*Galium sp.*)	1
		Buttonbush (*Cephalanthus occidentalis*)	2

Notes from other authors.—Audubon[1] reports leeches as part of the food of the Shoveller; Aughey[2] found Rocky Mountain locusts (*Caloptenus spretus*) in a stomach he examined; Baker[3] reports the mollusk (*Rissonia pulchra*); Fisher[4] notes that: "At . . . Owens Lake, Calif., Mr. Nelson found it feeding extensively on the larvae and pupae of a small fly (*Ephydra hias*) which abounds in the lake," Lantz and Piper[5] observed it feeding greedily on maggots as they floated downstream from a dead cow; and Samuels[6] adds tadpoles to its bill of fare.

Summary.—So far as known, the Shoveller damages no crop, nor does it feed upon any animals of pronounced value to man. On the other hand it does devour various fish predators as dragonfly nymphs, giant water-bugs, water scorpions, water-tigers, back-swimmers, and crawfishes. The latter creatures are destructive also to crops and leaves. The food preferences of the species are such that it probably is not attracted by pure clean stands of the valuable duck food plants so much as by sheer density of vegetation with an accompanying abundance of animal life.

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[1] Orn. Biogr. 4, 1838, p. 241.
[2] Rep. U. S. Ent. Comm. 1877, app. 2, p. 59.
[3] Proc. Ac. Sci. Phila., 1889, p. 267,
[4] N. A. Fauna 7, 1893, p. 17.
[5] Biol. Survey Field Notes.
[6] Orn. & Col. New England, 1868, p. 497.

The food habits of the species are of interest in that a larger number of minute organisms such as ostracods, copepods and diatoms, are taken, than by most ducks, a result, no doubt, of more thorough sifting of the bottom ooze.

U. S. Biological Survey, Washington, D. C.

THE SONG OF THE FIELD SPARROW.

BY ARETAS A. SAUNDERS.

THE song of the Field Sparrow (*Spizella pusilla*) is one which can be studied comparatively easily. The abundance of the species in most parts of its breeding range; the length of the song period; the freedom with which the species sings, the individual repeating its song at short intervals; the clearness of quality, which makes the pitch of the notes easily determined; and the shortness and general simplicity of the song, all are factors which help to bring this about.

The more one studies bird song, the more one attempts to make accurate records of songs, the more he becomes impressed with the fact that in almost all species there is great individual variation. Such variation is the rule, not the exception. Because of this it is difficult to make definite general statements concerning the character of the song of any species. Any such statement must be qualified by the fact that there are often individuals that sing a song entirely different in one or more respects from all others of that species.

The general characteristics of the song of the Field Sparrow, covering the five main factors of variation in bird song, are as follows.

1. Time. The Field Sparrow song is of short duration. The average length of the song, based on the one hundred and forty-nine records I now have, is 2.7 seconds. The longest song of all is 4.6 seconds, and the shortest 1.6 seconds. It is rare to find songs that are longer than 3.2 seconds or shorter than 2.4 seconds. One specific time character, that holds in practically all songs, is