In some cases flocks of two birds were observed to contain male and female ducks, but poor light conditions and the rapidity of activity made it possible to determine the sex composition of only a few flocks.

Flocks of only two birds became proportionately more common as the season advanced. The percentages of total flocks which were composed of only two ducks were: October (143 of 427 flocks) 34%, November (104 of 290 flocks) 36%, December (29 of 67 flocks) 43%, and January (14 of 30 flocks) 47%. It is possible that this increase in proportionate number of flocks of two birds may indicate pairing. By late February some of the ducks which breed locally had begun nesting.

LITERATURE CITED

Bent, Arthur Cleveland. 1923. Life Histories of North American Wild Fowl. Order *Anseres* (Part), U. S. Nat. Mus., Bull. 126.

Kortright, Francis H. 1942. The Ducks, Geese, and Swans of North America. The Stackpole Co. and Wildlife Management Institute, Washington, D. C. 476 pp.

Martin, Dale N. 1957. Wood duck autumn flight activity in relation to sunrise and sunset. (Paper presented at 19th Midwest Wildlife Conf., Milwaukee, Wisc.) Indiana Div. of Fish and Game, Indianapolis.

Martin, Elwood M. 1959. River float and roosting flight counts as indices to number of wood ducks. Unpubl. M.S. Thesis, Iowa State Univ. Library, Ames.

Martin, Elwood M. and Arnold O. Haugen. 1960. Seasonal changes in wood duck roosting flight habits. The Wilson Bulletin. 72(3):238-243, 1960.

Smith, Morton M. 1961. Louisiana wood duck studies. Final Report July 1950-June 1961. La. Wild Life and Fisheries Comm., New Orleans, 26 pp.

FOODS AVAILABLE TO WATERFOWL IN FALLOW RICEFIELDS OF SOUTHWEST LOUISIANA, 1960-1961

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According to Smith (1958-59), approximately four million ducks and geese winter in Louisiana each year. Most of these waterfowl utilize the southwest portion of the state. This wintering area covers approximately 2½ million acres and is composed of pastures, ricefields, fallow ricefields, and fresh, brackish, and salt marshes.

The quantity and kind of waterfowl food produced each year in marsh areas is known to be affected by many factors. Intrusion of salt water, drought or some other uncontrollable climatic factor, influences growth and production of food producing plants. A reduced food supply coupled with unfavorable water conditions causes some waterfowl to migrate further south and those that remain for the winter feed more heavily in ricefields. Studies have shown that even in years when marsh conditions are favorable, many ducks and geese feed at night in fields from which rice has been harvested and in fallow fields adjacent to the marsh. Feeding in these fields is more common when the waterfowl hunting season is closed.

Management of marshland by control of water levels is costly and often difficult. On the other hand, control of water levels in ricefields for waterfowl management has been simplified due to the presence of levees and drainage canals that are necessary during rice culture. Since the levee system is normally not destroyed until the land is prepared for the next rice crop, many levees are present in fallow fields.

Management of ricefields in Louisiana for waterfowl has been practiced on a very limited scale. Practically all management has been for the sole purpose of attracting waterfowl to hunt. However, a much greater waterfowl management potential is there, but practices and economics need developing so that land owners and tenants can realize a reasonable profit for their effort and investment.

The importance of rice in the diet of waterfowl has been demonstrated by Martin and Uhler (1939), Singleton (1953), Dillon (1957), Chamberlain (1957), Kimble and Ensminger (1959), and Wright (1959). The importance to waterfowl of weed seed associated with fallow ricefields had not previously been studied. However, Harmon, *et al.* (1960) and Rumsey, *et al.* (1961) studied the availability of waterfowl foods in rice fields of South Louisiana following the rice harvest.

Because of rotation practices employed in rice culture, and because of controls on rice acreage set by the Federal government, over half of the land available for waterfowl use in the rice belt is fallow rice land and not ricefields. Since there is such a large acreage of fallow rice land available for waterfowl use, a study of six one-year old fallow ricefields and three two-year old fallow ricefields was conducted to determine: (1) species of food available to waterfowl, (2) the amounts (dry weight) of each food present in pounds per acre, and (3) the seasonal availability of the foods.

Small amounts of tubers, green vegetation, and animal matter known to be utilized by waterfowl were also found during the study, but were not included with the results because of damage and consequent loss incurred during separation processes.

LOCATION AND DESCRIPTION OF AREA

The rice belt of Louisiana is roughly encompassed by U. S. Highway 190 on the north, the Texas boundary on the west, and the borders of Iberia and Vermillion Parishes on the east. The sampling areas were typical of land types of the rice area. Three fields were located near Lake Charles in Calcasieu Parish, three near Crowley in Acadia Parish, and three near Abbeville in Vermillion Parish. They ranged from 15 to 25 air miles from fresh water marshes.

The topography of the rice producing region is very flat with light to heavy clay and silty loam soils. The annual rainfall, which is usually high, ranges from 50 to 60 inches per year. Mild temperatures from 70° to 100°F. occur during the growing season. Constant irrigation and cultivation of the rice soils have increased their alkalinity, stickiness, and imperviousness to water (Reed and Sturgis, 1939).

TECHNIQUES

Sampling was restricted to two periods. The first samples were collected in November, 1960 while the second group of samples was collected three months later in February, 1961. A total of 450 ground samples were collected, with 25 being taken in each field during each sampling period. Transect lines in each field were paced, and where possible, they were directed perpendicular to ricefield levees to insure sampling of all water depths. Sampling points and transect lines were approximately 200 feet apart.

Equipment for collecting ground samples consisted of a three-inch section of six-inch diameter aluminum irrigation pipe sharpened at one end to facilitate penetration into the soil; a small putty trowel; and heavy Kraft paper bags. A wooden stopper was fastened in the sampling device to insure uniform sampling to a depth of ¼ to ½ inch. All plants encompassed within the sampling device were clipped at ground level and placed in the bag with the sample. Samples were labeled as to farm, sample number, date, and any unusual condition of the field that might affect the condition of the sample. All samples were taken to Louisiana State University and placed in cold storage at 35° F. to prevent seed deterioration and sprouting. Soil and debris was separated from the seed by washing the samples through a graduated series of four screens whose mesh sizes ranged from two to 32 meshes per square inch. The material retained by the screens was dried and run through a mechanical seed blower for further separation. This process removed the light chaff from the seed and heavier materials. Further separation was accomplished by screening. Final separation was completed with forceps under a three-inch, three-power, flourescent-lighted lens. The seeds were then identified, counted, weighed, and the pounds per acre determined.

Assistance in seed identification was given by Neil Hotchkiss, Patuxent Research Refuge, Laurel, Maryland.

RESULTS AND DISCUSSION

The production of weed seed in ricefields is known to be affected by a variety of conditions. This is also presumably true in fallow ricefields. The cultural practices that are used in rice production suppress the growth of weeds and grasses that produce good waterfowl foods. These restrictions are generally lifted during the fallow portion of the rice production cycle and an explosion of weed growth occurs. A large portion of these weeds produce good waterfowl foods.

Seeds were placed into two categories, those considered to be of major importance as food for waterfowl, and those of unknown or of little importance as waterfowl food. Seeds of major importance were judged on size, abundance, frequency of occurrence, and importance of each seed as shown in previous waterfowl food studies.

Seed of millets *(Echinochloa* spp.), brownseed paspalum *(Paspalum plicatulum)*, fall panicum *(Panicum dichotomiflorum)*, smartweeds *(Polygonum spp.)*, signalgrass *(Brachiaria extensa)*, and red rice *(Oryza sativa* var.), were considered to be of major importance in this study.

The amounts, frequency of occurrence, and percentage change between periods for major seeds is listed in Table I. Table II lists all seed found and identified in 450 ground samples.

The total quantity of all seed in the first sampling period ranged from 341.28 pounds per acre to 679.43 pounds per acre, and averaged 489.34 pounds. In the second period the amount of seed in the fields ranged from 254.42 to 499.97 pounds per acre and averaged 338.49 pounds per acre. This was a reduction from the first sampling period of 31 per cent.

Wild millets were the most abundant food found in the fields and averaged 124.58 pounds per acre during the first sampling period. In February millet averaged 70.65 pounds per acre; a reduction of 43.28 per cent. Neely (1956) found that 57 per cent of the wild millet seeds he submerged in water deteriorated in 90 days. Constant wetting and drying of millet seed is believed to be more detrimental than a prolonged period under water. No tests were made to verify this assumption. Greatest reduction of millet seed was noted in fields where the over-all vegetation was reduced by intense grazing of cattle. This permitted greater exposure of seed to birds and mammals as well as to more severe climatic conditions.

Brownseed paspalum constituted the second most abundant food and varied from 92.87 pounds per acre in November to 62.40 pounds per acre in February, a 32.81 per cent reduction. Seeds of this plant are low in protein (7%) and do not meet the 14-16 per cent protein requirement recommended for waterfowl. Although they are low in protein and fats, they may be high in other necessary elements.

TABLE I.
AVERAGE POUNDS PER ACRE OF SEED OF MAJOR IMPORTANCE AS FOOD FOR WATERFOWL, PERCENT OF OCCURRENCE AND SEASONAL CHANGE IN NINE FALLOW RICEFIELDS IN SOUTHWEST LOUISIANA.

Species	*Average lbs./acre November*	*Average lbs./acre February*	*Per cent Occurrence (450 Samples)*	*Per cent Change Nov. to Feb.*
Millet	124.58	70.65	93.78	—43.28
Brownseed paspalum	92.87	62.40	52.67	—32.81
Fall Panicum	49.39	29.64	58.89	—39.99
Smartweed	44.34	30.67	40.00	—35.39
Signalgrass	13.26	6.74	14.44	—49.18
Red rice	3.55	3.89	9.11	+ 8.74
Total	327.99	203.99		

TABLE II.

SPECIES OF SEEDS CONTAINED IN 450 GROUND SAMPLES FROM NINE FALLOW RICEFIELDS IN SOUTHWEST LOUISIANA.

Scientific Name [1]	*Common Name* [1]
Alopecurus carolinianus	Foxtail
Alysicarpus tanginalis	Alyce Clover
Amaranthus sp.	Pigweed
Aster sp.	Aster
*Axonopus (compressus)**	Carpet grass
Brachiaria extensa	Signalgrass
Caperonia castaneaefolia [2]	Birdeye
Carex sp. †	Sedge
Centella erecta	**
Chamaesyce sp.	Purslane
Cladium jamaicense	Sawgrass
Commelina sp.	Dayflower
Coronopus didymus	Swine-cress
Croton capitatus	Doveweed
Cynodon dactylon	Bermuda grass
Cyperus albomarginatus	Umbrella-sedge
Cyperus compressus	Umbrella-sedge
Cyperus iria	Umbrella-sedge
Cyperus odoratus	Umbrella-sedge
Cyperus virens	Umbrella-sedge
Cyperus sp. †	Umbrella-sedge
Desmanthus illinoensis	Prairie-mimosa
Digitaria sanguinalis	Crabgrass
Digitaria (villosa) *	Crabgrass
Diodia teres	Buttonweed
Diodia virginiana	Buttonweed
Echinochloa spp.	Millet
Eclipta alba	Yerba-de-tago
Eleocharis acicularis	Spike-rush
Eleocharis flavescens	Spike-rush
Eleocharis obtusa	Spike-rush
Eleocharis palustris	Spike-rush
Eleusine indica	Goose-grass
Eriochloa sp.	Cup-grass
Fimbristylis dichotoma	Fimbristylis
Fimbristylis miliacea [2]	Fimbristylis
Fimbristylis sp. †	Fimbristylis
Gymnostyles anthemifilia [2]	**
Hydrocotyle sp.	Pennywort
Hypericum drummondii	St. John's-wort
Hypericum sp.	St. John's-wort
Ilex decidua	Deciduous holly
Ipomoea sp.	Morning-glory
Iva ciliata	Sumpweed
Lespedeza striata	Japanese clover
Lupinus sp.	Lupine
Melochia corchorifolia [2]	Teaweed
Myriophyllum pinnatum	Water-milfoil
Oryza sativa [2]	Rice
Oryza sativa var. [3]	Red Rice
Oxalis sp.	Wood Sorrel
Panicum dichotomiflorum	Panic-grass, Fall panicum
Panicum sp.	Panic-grass
Paspalum plicatulum [2]	Brownseed paspalum
Paspalum (distichum) *	Knot grass
Paspalum (urvillei) *	Vasey grass
Paspalum sp.	**
Passiflora sp.	Passion-flower
Phalaris sp.	Canary-grass
Plantago (virginica) *	Plantain
Poa sp.	Blue grass
Polygonum spp.	Smartweed

TABLE II. (continued)

Scientific Name [1]	*Common Name* [1]
Proserpinaca sp.	Mermaid-weed
Ptilimnium nuttallii	Mock Bishop's-weed
Ranunculus lindheimeri [3]	Buttercup
Rhynchospora corniculata	Beak-rush, Tadpole sedge
Sabal minor [2]	Dwarf-palmetto
Scleria sp.	Nut-rush
Serinia oppositifolia	**
Sesbania macrocarpa	Sesbania
Sonchus oleraceus	Common sow thistle
Sisyrinchium sp.	Blue-eyed grass
Strophostyles pauciflora	Wild bean
Thyella sp.	Tie-vine
Trifolium repens	White clover
Trifolium procumbens	Hop clover
Trifolium resupinatum	Reversed clover
Verbena sp.	Vervain
Vernonia sp.	Ironweed

[1] Based on Fernald (1950) unless otherwise noted.
[2] Based on Small (1933)
[3] Based on Dillon (1957).
* Parentheses denotes specific name uncertain.
** Denotes common name unknown.
† Denotes more than one species.

Fall panicum and smartweed were next in abundance, each averaging approximately 45 pounds per acre in November and decreasing to approximately 30 pounds per acre in February. Signalgrass and red rice occurred in smaller amounts.

Preference of plant communities for certain growing sites was common in fallow ricefields. This was evident by the consistent abundance and prolific growth of plants in some areas and their scarcity in others. Although several species were wide-spread and were growing under various conditions, some were very selective as to site, in relation to moisture, whether moist or dry. Brownseed paspalum and signalgrass indicated a preference, as shown by occurrence in samples, for dryer sites near ricefield levees. Smartweeds, millets, and spikerushes showed positive correlation with moist sites.

Although no tests were made to determine reasons for losses in seed from one sampling period to the next, the following factors are believed to be contributors:

(1) Constant wetting and drying of seed resulting in germination and/or decay.
(2) Consumption of seed and vegetation by small mammals such as mice, rice rats, and other rodents.
(3) Overgrazing and trampling of plants and seed by cattle.
(4) Utilization of seed by ants.
(5) Utilization of seed by waterfowl.
(6) Utilization of seed by bronzed grackles *(Quiscalus quiscala)*, red-winged blackbirds *(Angelaius phoeniceus)*, ricebirds *(Dolichonyx orysivorus)*, cowbirds *(Molothrus ater)*, and English sparrows *(Passer domesticus)*.

Dillon (1957) has stated that rice soils are generally deficient in suitable material as grit for waterfowl. An analysis of samples from five of the nine fields revealed evidence to support this assumption. Although small quantities of quartz grit were noted in most samples, calculations based on volumetric measurements indicated that there was less than 10 pounds per acre. Management of this type of land for waterfowl should probably include addition of suitable materials for grit. Some fields contained small, rather soft, iron concretions. Although seldom eaten by ducks, they are consumed sparingly by geese. They are not a suitable substitute for hard grit.

Results of this study show that there is considerable waterfowl food in unmanaged fallow ricefields. Under proper management these fields could not only be made to produce much more food, but they also could be made much more attractive to waterfowl.

Since a levee system exists in the fields, they could be flooded after minor repair from damage caused during rice harvesting. Seeds of several "moist-site" waterfowl food producing plants are present in nearly all fields. Periodic spring and summer flooding would permit maximum seed production. When flooded during the winter, these fields would be very attractive to waterfowl. Since there is practically no cover in the fields, gunning pressure must be light in order to have continuous waterfowl use. The addition of cover along fence rows and canals would shield waterfowl from many disturbances. Grazing by domestic animals should be controlled.

Most plants that produce waterfowl foods are pests in ricefields. Many farmers spray with herbicides to control weeds. They sow germinated rice on moist fields to accelerate establishment of rice stands in order to suppress weed growth. Some graze fallow fields heavily; some clip them for pasture improvement. The use of insecticides undoubtedly reduces the supply of animal foods such as snails, insects and crayfish. It is evident that management for maximum production of waterfowl foods conflicts with rice production. Few rice farmers can be induced to voluntarily manage their land for wintering waterfowl; therefore, some arrangement must be worked out whereby landowners and tenants are compensated for their efforts and investments.

Fallow ricefields have a high potential for waterfowl management. During the next few years marsh destruction will exceed marsh restoration. Management of ricefields and fallow fields could more than make up for this loss of wintering habitat.

SUMMARY

A total of 450 ground samples which were collected between November 1, 1960 and February 28, 1961 from nine fallow ricefields in southwest Louisiana were analyzed to determine: (1) the species of seeds available to waterfowl in six one-year old fallow ricefields and three two-year old fallow ricefields, (2) the amounts (dry weight) of each food present in pounds per acre, and (3) the seasonal availability of the foods. Foods were classified into two categories, those of major importance as waterfowl food and those of unknown or of little importance as waterfowl food. Seed of millet, brownseed paspalum, fall panicum, smartweed, signalgrass, and red rice were classified as major waterfowl foods. One-year-old fallow ricefields exhibited more species and larger amounts of seed than did two-year fallow fields. Millet ranked first in abundance, with brownseed paspalum, fall panicum, smartweed, signalgrass, and red rice occurring in descending order of abundance. In general seed amounts decreased approximately 40 per cent between sampling periods. Small birds, waterfowl, small rodents, seed sprouting, cattle grazing, ants, and seed deterioration are suspected as being responsible for seed reduction between periods.

An analysis for grit revealed an average of less than 10 pounds of quartz grit per acre in five of the fields sampled.

LITERATURE CITED

Chamberlain, J. L. 1959. Gulf coast marsh vegetation as food of wintering waterfowl. J. Wildl. Mgmt., 23: 97-102.

Dillon, O. W., Jr. 1957. Food habits of wild ducks in the rice-marsh transition area of Louisiana. Proc. Eleventh Ann. Conf. SE. Assoc. Game and Fish Comm., 11: 114-119.

Fernald, M. L. 1950. Gray's manual of botany. Eighth Edition. American Book Co., New York. 1632 pp.

Harmon, B. G., C. H. Thomas and L. L. Glasgow. 1960. Waterfowl foods in Louisiana ricefields. Trans. of the Twenty-fifth N. A. Wildl. Conf., 25: 153-161.

Kimble, Robert and Allen Ensminger. 1959. Duck food habits in southwestern Louisiana marshes following a hurricane. J. Wildl. Mgmt., 23: 453-455.

Martin, A. C. and F. M. Uhler. 1939. Food of game ducks in the United States and Canada. U. S. Dept. of Agric., Tech. Bul. 634. 156 pp.

Neely, W. W. 1956. How long do duck foods last underwater? Trans. Twenty-first N. A. Wildl. Conf., 21: 191-198.

Reed, J. F. and M. B. Sturgis. 1939. Chemical characteristics of the soils of the rice area of Louisiana. La. Agric. Exp. Sta. Bul. 307. 31 pp.
Rumsey, R. L., C. H. Thomas and L. L. Glasgow. 1961. Waterfowl foods in ricefields of Southwest Louisiana. Unpublished MS, 8 pp., Louisiana State University, School of Forestry, Baton Rouge, La.
Singleton, J. R. 1951. Production and utilization of waterfowl food plants on the East Texas Gulf Coast. J. Wildl. Mgmt., 15(1): 46-56.
Small, J. K. 1933. Manual of the southeastern flora. John Kunkel Small, New York. 1554 pp.
Smith, M. M. 1958-59. Waterfowl investigations. La. Wildl. and Fish Comm., Eighth Biennial Rep. 188 pp.
Wright, T. W. 1959. Winter foods of mallards in Arkansas. Proc. Thirteenth Ann. Conf. SE. Assoc. Game and Fish Comm., 13: 291-296.

OUR WATERFOWL'S FUTURE

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During a year that finds our nation's waterfowl situation the gloomiest it has been in the past few decades, we are gathered in hopes of brightening our prospective concerning our waterfowl population of the future. Will future game management call for artificially supplying ducks for the future waterfowl hunters of America, or can wise and efficient conservation practices save our wildfowl resources? Can our progeny share the art of waterfowling as near as we have known it in our own generation?

True, our present dilemma seems to be situated in the northern breeding areas where drainage and drought have drastically reduced the natural breeding places of a good portion of our nation's waterfowl population. This does not mean that our southern wintering areas are not of immediate or equal concern to be disregarded until the northern situation is rectified. On the contrary, drainage and loss of good wetlands in the southeastern United States easily approaches equality, or excels, in magnitude and importance the drainage prevailing in the prairie pot-hole regions. Our job in the Southeast is not only to provide recreational opportunity for the public, but to aid in sustaining a population of well-fed, well-wintered waterfowl for a healthy return to their northern breeding grounds.

Today's management plan, more so than ever before, stresses the multiple-use purpose of our lands and resources. Through inter-agency aid and cooperation, wetlands on almost every public area or any State or Federal development projects might be made into highly suitable resting and feeding areas for waterfowl. Flood control and water retention agencies as well as mosquito control agencies can be our most promising benefactors in aiding restoration of waterfowl habitats. Cities and communities developing water retention units can aid by providing portions of their development for fish and wildlife benefits. County and statewide sportsmen's associations and clubs can be propagandized into developing waterfowl habitats of a high caliber. On all public and civic enterprises incorporating an aqueous possibility, waterfowl development potentials should be highly scrutinized and technical advice be made readily available.

Present day inclination toward large and already suitable wetlands as a prerequisite for waterfowl habitat development is fastly becoming unrealistic due mainly to the high cost of acquisition of primary wetlands. State and Federal agencies can well benefit from the hoards of private individuals developing small acreage wetlands for waterfowl. State and Federal personnel should encourage their respective agencies toward the small area development if large acreage development seems economically unsuitable. Thousands of small areas can be developed or restored as excellent waterfowl habitats. A scattering of these areas could better distribute the waterfowl population as well as the hunting pressure. The contribution from a large aggregate of these small wet-