

MARINE ALGAE IN FOOD OF RHODE ISLAND WATERFOWL

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THE use of marine algae as food by Rhode Island waterfowl was first noted by the writer in the course of a study of the wintering habits of the Baldpate (*Mareca americana*) in Newport County. Shortly after the investigation was begun, the Greater Scaup (*Nyroca marila*) was observed to take certain species of the green marine algae as food. At that time it was thought that the ducks resorted to the algae as an emergency food. Later, it was found that Black Ducks (*Anas rubripes rubripes* and *A. r. tristis*) fed throughout the season on several species of algae in a brackish marsh in the town of Newport.

TECHNIQUE AND SCOPE OF STUDY

Observations were made in the towns of Newport, Middletown, Portsmouth, Tiverton, and Little Compton, in Newport County, Rhode Island. The greater part of the investigation was carried on from December 1934 to the first of April 1935. Supplementary studies of the Black Duck were made during the summer of 1935, and in January 1936 several trips were made to check previous findings on foods of the Baldpate.

The stomach contents of several Baldpates were examined to determine the identity of the algae taken by that species. These algae were so little reduced by bird digestion, however, that it proved feasible to analyze the droppings of the birds. The bulk of the data contained in this report was obtained in this manner. Percentage composition of the various feedings was arrived at by averaging estimates of the proportion of each species of algae in several low-power microscope-field counts per specimen. Because accurate and detailed measurements could not be made, and because other foods may have been more completely reduced by digestive fluids, the percentages herein given must be considered only suggestive of the relative proportion of foods consumed.

The nomenclature of the algae discussed in this paper follows Taylor's 'Marine Algae of the Northeastern Coast of North America' (5). The identifications of algal material were made at the Rhode Island College of Education, in Providence. Acknowledgment is made of the aid and invaluable suggestions given by Dr. Marion D. Weston, Professor of Botany at the College. A preliminary report on this study was presented in a paper for an extension course in Economic Ornithology, conducted by Dr. Charles Fish, at Brown University.

BALDPATE

Forbush (1) records the Baldpate as wintering sporadically in southern New England. Normally in this region wintering birds feed in the brackish

marshes of Tiverton and Little Compton, where the food plants *Ruppia maritima*, *Zannichellia palustris*, and *Potamogeton pectinatus* are available. The ducks feed at night during the hunting season, leave the feeding marshes at daybreak and spend the day on Easton's, Gardiner's, and St. Mary's Ponds, artificial reservoirs located respectively in the towns of Newport, Middletown, and Portsmouth. Little feeding appears to be done on these ponds, as at that time of year the beds of submerged aquatic vegetation are well beyond reach of surface-feeding ducks. The Baldpates indulge in some amount of pilfering from the American Coot, and glean fragments of *Naias flexilis*, *Potamogeton pusillus*, and *Ceratophyllum demersum* broken loose by diving Scaups and Redheads. Later in the spring the Baldpates show a preference for the new leaves of grasses and they are then found in flooded meadows.

This normal feeding schedule is disrupted by severe cold weather late in winter. The fresh ponds, and frequently the brackish marshes, are frozen over at such times. Probably a certain proportion of the Baldpate population is thus forced to migrate, but a considerable number of the birds move to salt water, usually associating with the Black Ducks, which normally are marine feeders late in winter.

Although during the winter of 1934-35 Baldpates frequented the feeding grounds of the salt-water Black Ducks, the food habits of the two species varied greatly. The Sakonnet River shores at Sachuest Point, Middletown, supported numbers of Black Ducks and Baldpates during that period. The former subsisted on mollusks and crustaceans, which abounded in the rock-weeds (*Fucus* and *Ascophyllum*) between the tide marks; the latter, on the other hand, seemed to prefer the green "sea-lettuce" (*Ulva lactuca*), which was plentiful in the tide pools along the shore. Baldpates were observed in small flocks in another locality—Easton's Point, in Middletown. Field observations indicated that the birds were gleaning drift plants of *Ulva lactuca* and *Enteromorpha intestinalis* from the floating sea wrack. A trickle of fresh water on the shores of this point was a favorite resort of the birds. Doubtless the presence of fresh water has much to do with the location of emergency feeding grounds of the Baldpate, as a third feeding ground was noted at Hazard's Beach, Newport, where tide pools that supported an abundance of marine algae adjoined a small flow of seepage fresh water.

Table 1 shows the species of marine algae found in the winter food of the marine-feeding Baldpate along the Rhode Island coast. In the column marked 'Number of occurrences' is given the number of specimens in which each species of algae was found to occur; the next column shows the number of specimens in which a species formed fifty per cent or more of the contents, and the last the number of specimens in which the entire contents were composed of one species.

Ulva lactuca is seen to be the most important food item taken by the Baldpate in this emergency feeding. *Ulva* is commonly found drifting during the season in which the birds are feeding in salt water, and it is probable that this species is procured from drift rather than from attached growths of the plant. *Monostroma* superficially resembles *Ulva*, and probably is taken indiscriminately with the latter. *Enteromorpha intestinalis* may be obtained from places in which it grows attached to submerged rocks, although, like *Ulva lactuca*, it would be readily available to feeding birds in the drift weed wrack. The smaller algae, such as *Hormiscia*, doubtless were

TABLE 1

Species of Marine Algae eaten by the Baldpate

| Species | Number of occurrences | More than 50 per cent of contents | 100 per cent of contents |
|--|-----------------------|-----------------------------------|--------------------------|
| CHLOROPHYCEAE | | | |
| <i>Ulva lactuca</i> | 22 | 19 | 6 |
| <i>Enteromorpha intestinalis</i> | 18 | 2 | 0 |
| <i>Enteromorpha clathrata</i> | 8 | 0 | 0 |
| <i>Monostroma</i> , spp. | 3 | 0 | 0 |
| <i>Hormiscia penicilliformis</i> | 1 | 0 | 0 |
| RHODOPHYCEAE | | | |
| <i>Chondrus crispus</i> | 1 | 0 | 0 |

[Total number of specimens (stomach and droppings) analyzed 22]

taken incidentally while the ducks were feeding on the larger species; these filamentous forms commonly grow on the latter.

Marine algae may be classed as an emergency food of the Baldpate. It may be that this bird would normally feed on eelgrass (*Zostera marina*) when it is driven to salt water by cold weather. The effect of the extirpation of eelgrass (3, 4) on the food habits of the Baldpate is a matter for conjecture. It is possible that the ducks resort to algae in lieu of eelgrass, although this would be most difficult to prove because of the lack of comparative food-habits data on the Baldpate in times when *Zostera* was abundant.

GREATER SCAUP

Several thousand Greater Scaups were concentrated off the shores of Second Beach, in Middletown, during December 1934. The food of these birds appeared to consist principally of mollusks, particularly young of the sea clam (*Macra solidissima*). Only four specimens of the Greater Scaup were obtained in this area. Of these, the stomachs of two held small quantities of *Ulva lactuca*, and two droppings contained enough fragments of this plant to give a decided greenish color to the specimens.

It seems probable that in these instances *Ulva lactuca* was taken as a substitute for eelgrass, as the latter is known to have been an important food of the Scaup. Here again, however, it is impossible to give a definite evaluation of the feeding, because no data are available on the importance of *Ulva* in the food habits of the Scaup prior to the disappearance of the eelgrass.

BLACK DUCK

A brackish marsh in the town of Newport, locally known as Cotton's Creek, supports several thousand Black Ducks throughout each winter. Several pairs of 'native' Black Ducks (*Anas rubripes tristis*) nest there in spring. Feeding in winter is confined to night, while in the daytime the birds fly out to salt water.

A dam and tide-gate were placed across the outlet of this marsh at least forty years ago. The tide-gate, however, long ago ceased to function. The marsh remains slightly brackish as a consequence, and the general water level is held fairly stable at what would correspond with high-tide stage prior to the construction of the dam. The salinity of the water is too low for the growth of *Zostera*, except in the immediate vicinity of the broken tide-gate. *Ruppia maritima* occurs in fair growths in a few ponds, but is crowded out over the main body of the marsh by dense submerged mats of the marine algae, *Cladophora* and *Chaetomorpha*. These algae, together with *Enteromorpha intestinalis* and *E. clathrata*, dominate the extensive shallows over much of the marsh. These shallows represent former stands of *Spartina alterniflora* (saltmarsh cordgrass) that have been drowned out by the damming and subsequent rise in mean low-water level. Aside from the *Cladophora*, which normally are brackish-water forms, these algae attain a much greater size here than they would in water of sea strength. *Enteromorpha intestinalis*, for example, which in its typical tide-water environment produces fronds four to six inches long, here has fronds several feet long.

TABLE 2

Species of Algae eaten by the Black Duck

| Species | Number of occurrences | More than 50 per cent of contents | More than 85 per cent of contents |
|--|-----------------------|-----------------------------------|-----------------------------------|
| CHLOROPHYCEAE | | | |
| <i>Chaetomorpha linum</i> | 35 | 9 | 1 |
| <i>Cladophora expansa</i> | 34 | 4 | 1 |
| <i>Enteromorpha intestinalis</i> | 30 | 1 | 0 |
| <i>Enteromorpha clathrata</i> | 16 | 0 | 0 |

[Total number of specimens (droppings) analyzed 38]

Cladophora and *Chaetomorpha* are thus seen to compose the bulk of the vegetable food eaten by the Black Duck. *Enteromorpha intestinalis* averaged ten per cent of the entire feeding, and *E. clathrata* usually was present only as a trace. Several of the minute unicellular algae were taken, usually attached to the larger species. These formed such an insignificant part of the food that no attempt was made to identify and study them.

Animal organisms made up a large part of the food in many specimens, but it was impossible to estimate the proportion of animal to vegetable matter in fecal analysis. Crustaceans appear to be the principal items sought, particularly *Gammarus* spp., which abound in the algal mat.

It is well known that eelgrass was formerly an important food of the Black Duck. Conditions in this particular marsh, however, lead one to believe that this feeding on marine algae is a normal occurrence. First of all, for many years the water here has probably been too fresh for eelgrass to grow. Furthermore, large numbers of Black Ducks fed in this marsh prior to the disappearance of eelgrass from the Atlantic coast. There are unfortunately no data available on the abundance of waterfowl on the marsh at that time for comparison with the present population. The possibility exists, therefore, that the present feeding on *Cladophora* and *Chaetomorpha* and other algae on this marsh may be the result of the shortage of eelgrass on former feeding grounds.

In the spring and early summer of 1935, droppings of both the adult and the young 'native' Black Ducks of this locality contained *Chaetomorpha* and *Cladophora*. This tends to support the contention that marine algae are normal foods for the waterfowl of this marsh. Evidence from other points on the Atlantic coast indicates, on the other hand, that the Black Duck will resort to marine algae as a substitute for eelgrass. The stomachs of Black Ducks taken on Long Island, New York, in December 1936, contained considerable quantities of *Ulva lactuca*.

VALUE OF MARINE ALGAE AS EMERGENCY FOOD FOR WATERFOWL

It appears from this study that ducks cannot digest efficiently marine algae of the membranaceous type, including such species as *Ulva*, *Enteromorpha*, and *Monostroma*. The fact that algal material from droppings was so little reduced by digestion as to permit of specific identification is evidence in point. The degree of digestion of algae varies with the individual bird, but in no case did the reduction of tissue in digested membranaceous algal material seem comparable with that normally found in tissues of other plants eaten by birds. Several instances were noted in which birds had passed scraps of *Ulva* fronds 5 millimeters in diameter, and almost invariably in droppings that represented feedings on this alga, plant fragments could be recognized with the unaided eye.

It must be borne in mind, however, that fecal analysis does not show the actual percentage of algal material digested. Intensive quantitative study is needed before a definite statement can be made in this regard. At the same time, superficial observation indicates that marine algae may not be so susceptible of digestion as other plant materials, and for this reason the value of algae as an emergency food is questioned.

Despite the apparent indigestibility of marine algae, the ducks under observation remained in comparatively good condition after several weeks of feeding on these plants. No evidence was found that the Baldpate took any food other than marine algae during this period, although it is recognized that there are many foods that cannot be detected in fecal analysis. Thus it would seem that marine algae of the species discussed form an adequate emergency food for the Baldpate during protracted cold weather. Furthermore, these algae are important in supplementing the animal diets of the Greater Scaup and the Black Duck.

SUMMARY

During the winter of 1934-35, certain waterfowl were found to feed on marine algae in Newport County, Rhode Island. The Baldpate, when driven to salt water by the freezing over of the fresh-water marshes, fed extensively on *Ulva lactuca* and *Enteromorpha intestinalis*; Scaups took small quantities of *Ulva lactuca*; and a local concentration of Black Ducks subsisted to a large extent on the brackish-water algae *Chaetomorpha linum* and *Cladophora expansa*.

The occurrence of marine algae in the food of these ducks may have a particular significance in view of the present dearth of eelgrass on the Atlantic coast. Possibly the Baldpate normally would feed on eelgrass when driven to salt water, and has resorted to algae as a substitute. This seems even more probable in the case of the Scaup. The feeding of the Black Duck on brackish-marsh algae seems more likely to be a normal occurrence in this particular instance. In all cases, however, lack of comparative food-habits data during times of eelgrass abundance makes it possible only to speculate on the extent to which algae are important as a substitute food.

Marine algae appear generally to be partially indigestible. The filamentous forms such as *Cladophora* and *Chaetomorpha* seem to lend themselves more readily to avian digestion than do the membranaceous forms, such as *Ulva*. Nevertheless, these algae were found to constitute an adequate emergency winter food for the Baldpate. Moreover, they dominated the vegetable portion of the feedings of the Scaups and the Black Ducks studied, and formed an important addition to the animal-food items taken by these birds.

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