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Interim Progress Report

(Preliminary - not for publication)

Title: The diets and energy requirements of some wild ducklings

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# THE DIET OF GADWALL DUCKLINGS

## A. Source of Material

The diet of flightless young Gadwalls in the Strathmore study area was determined from gullet (esophagus and proventriculus) contents in specimens collected over a five-year period, 1963-1967. From a total of 213 specimens, 167 or 78 per cent were usable. (A "usable" specimen contained at least 1 mg. dry weight of food). Sixty-five collections were made from 33 different sites. One collection was made from each of 18 sites, two from eight, three from one, four from three, five from two, and six from one site.

In 1963, 60 per cent of 91 specimens were usable. Thereafter, restricting collections to early morning or evening, and attempting to collect only ducks observed feeding, resulted in better specimens. Of 122 collected after 1963, 92 per cent were usable. Although a definite trend was not evident, older birds tended to have a higher proportion of usable specimens. Because larger ducks tend to have more food in their gullets, higher usability is to be expected.

For the purpose of analysing the data with respect to age of ducklings, specimens were assigned to eight age groups on the basis of weight as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Age (days) | 0-3 | 3-5 | 5-10 | 10-15 | 15-20 | 20-30 | 30-40 | 40+ |
| Weight (g) | to 33 | 33-45 | 45-100 | 100-165 | 165-280 | 280-510 | 510-650 | 650+ |

The age-weight relationships are based on growth rate data obtained from six Gadwalls raised from hatching to flying in an enclosure at the edge of a pond. The ducks were fed a commercial chick starter ration but had access to limited amounts of natural foods. They were brooded with an oil-burning brooder in a small shed. Data on weights of Class III* wild Gadwalls collected during the study were also used to construct the growth curve.

B. <u>Sources of Error</u>

Because of biases caused by differential breakdown and retention of food items in the gizzard, material from that organ was not used. J. Bartonek (Personal communication) had evidence that the use of material from the proventriculus could cause similar bias. Consequently, after 1963, contents from the esophagus and proventriculus were sorted, dried, and weighed separately. To check for bias, I considered those items which would be subject to the most distortion if differential digestion was occurring in the proventriculus.

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* Classification of Gollop and Marshall (1954)

Although statistical tests have not yet been made, the results, given in Table 1, are not as expected should differential digestion be present in the proventriculus. Relatively more seeds were present in that organ, and that would suggest that seeds were more resistent to digestion than other items. On the other hand, snails and adult beetles were no more prevalent in proventriculi than in esophagi. Moreover, dipterous larvae were relatively more plentiful in the proventriculi.

Table 1. Comparison of certain food items in esophagi and proventriculi of 117 Gadwalls

| Item | Esophagi | Proventriculi | Gullets* |
|---|---|---|---|
| total food weight (g) | 12.0581 | 10.1836 | 22.2417 |
| Per cent animal food | 20.0 | 16.4 | 18.4 |
| Per cent plant food | 80.0 | 83.6 | 81.6 |
| Per cent seeds in plant food | 3.8 | 9.3 | 6.4 |
| Per cent snails in animal food | 0.9 | 0.3 | 0.7 |
| Per cent beetles in animal food | 4.2 | 4.5 | 4.3 |
| Per cent dipterous larvae in animal food | 12.7 | 22.8 | 16.8 |

*esophagi and proventriculi combined

Were differential digestion occurring in the former, the larvae should be among the first items to disappear.

Bartonek and Hickey (in press?) compared proportions of various items in the esophagi and proventriculi of 178 diving ducks. They found significantly higher proportions (by per cent of volume) of vegetative material in esophagi but significantly lower proportions of seeds. Proportions of animal foods did not differ significantly. Unfortunately they did not compare esophagi contents with those of esophagi and proventriculi combined. In practice one would not have to make a choice between using esophagus material or proventriculus material, but rather, whether to use esophagus material alone or to combine the two. Because the contents of the Gadwall proventriculi contributed 46 per cent, differences in composition are minimized when the two are combined.

The evidence from my Gadwall data indicates that differences in the composition of esophagi and proventriculi contents are small and are not due to differential digestion. Although several digestive compounds are secreted in both the esophagus and proventriculus (Bolton, 1963), food probably does not remain long enough in either for significant breakdown to occur.

Items such as seeds may pass down the esophagus into the proventriculus more rapidly than others and would thus occur in the latter in greater quantities. Such being the case, inclusion of proventriculus material would be necessary to avoid bias. In addition, one cannot overlook the possibility that the injection of formalin into the digestive tract helped to flush small items into the proventriculus. (Bartonek also used this technique to preserve gullet contents).

In my 1967-68 progress report (Sugden, 1968) I discussed the role of individual collections in contributing material to the total food mass analysed. At that time, I predicted that the addition of 1967 collections would reduce the contribution of any single collection to the total food to less than 35 per cent in most age classes. Such was not the case. Although maximum contributions were generally lowered, single collections are still contributing excessive amounts (Table 2).

The fact that 16 of the 60 collections were broken and divided between two age classes on the basis of weights may have reduced maximum contributions of single collections. In the 24 age class-food type situations, unbroken collections made maximum contributions in all but two cases.

If the food in the specimens from a collection that contributes an excessive amount to a certain age class is representative of that class, the results should not be biased by the addition of that particular collection. Two-thirds of the offending collections would be considered representative on the basis of all collections. One third contained items considerably in excess of the "average",

Other than adding more collections, it is doubtful if further attempts to refine the data will do anything but add confusion. Exceptional collections will be considered in the presentation and discussion of results.

C. Sample Size

The number of specimens used in most duck food studies has been dictated by practical considerations rather than sampling statistics. This study is no exception, although I have been fortunate enough to collect more material than has been available in previous studies.

Since one of the objectives of the study is to detect any changes in diet with age, sufficient specimens must be available for each age group considered. Indeed, if the diet composition does change with age, then any analysis involving the changing components should be based upon age groups rather than the entire sample to avoid bias. The reason

Table 2. Table showing numbers of usable specimens, collections, collecting sites; animal and plant food weights; and the largest percentage contribution of one collection to each age class - food type situation. The number of specimens in the particular collection is shown in parentheses.

| Age class (days) | | 0 - 5 | 6 - 10 | 11 - 15 | 16 - 20 | 21 - 30 | 31 - 40 | 41+ | All |
|---|---|---|---|---|---|---|---|---|---|
| Number of specimens | | 22 | 32 | 35 | 31 | 15 | 14 | 18 | 167 |
| Number of collections | | 11 | 16 | 14 | 12 | 8 | 8 | 9 | 60 |
| Number of different sites | | 8 | 14 | 10 | 10 | 8 | 8 | 9 | 32 |
| Total weight of animal food (g) | | .4451 | .8784 | 2.0102 | .9666 | .0503 | .3025 | .0656 | 4.7187 |
| Total weight of plant food (g) | | .0274 | .6307 | .8392 | 3.6517 | 2.2789 | 6.1309 | 7.3718 | 20.9306 |
| Largest contribution (%) of one collection: | Animal food | 27 (3) | 48 (4) | 78 (4) | 49 (3) | 49 (4) | 94 (3) | 43 (2) | 32 (4) |
| | Plant food | 36 (3) | 61 (2) | 35 (4) | 45 (7) | 57 (3) | 44 (3) | 21 (1) | 13 (2) |
| | Total food | 26 (3) | 28 (2) | 65 (4) | 36 (7) | 56 (3) | 56 (3) | 21 (1) | 12 (3) |

for this is that as the ducks grew, the amount of food found in the gullets increased at a greater rate than would their total food intake. Thus when material from all age classes is pooled, those food classes which change in proportion would distort the composition estimates for the sample as a whole. Even greater bias can result from unequal numbers of specimens in the different age classes when material from all classes is pooled.

The Gadwall material appears adequate for comparing ratios of broad classes of food in the diet. (e.g. Animal food vs. plant food; terrestrial or surface invertebrates vs. aquatic invertebrates; Insecta vs. Crustacea). The numbers of specimens in individual age classes are too few, however, to make precise statements regarding most lesser categories. Several tests were made using formulae for estimating sample size in food habits studies (Hanson and Graybill, 1956). Some examples will illustrate the reliability of the data in terms of proportions of specimens containing certain food items (Table 3). For example,

Table 3. Estimates on sample size needed to estimate proportions of Gadwalls eating certain food items at allowable limits for deviation of five and ten per cent

| Item | Age group | Number in sample | Calculated deviation* | Sample needed for deviation* | |
|---|---|---|---|---|---|
| | | | | 5% | 10% |
| *Potamogeton pusillus* | 20+ | 47 | 13.4% | 336 | 84 |
| *Lemna* spp. | 20+ | 47 | 12.6% | 300 | 75 |
| Green algae | 20+ | 47 | 12.6% | 300 | 75 |
| Diptera larvae | to 20 | 120 | 9.0% | 390 | 97 |
| Diptera adults | to 20 | 120 | 8.9% | 375 | 94 |
| Hemiptera | to 20 | 120 | 8.0% | 324 | 81 |
| Coleoptera adults | to 20 | 120 | 8.0% | 324 | 81 |

* at 95% confidence

one would require about 336 specimens to be confident that the proportion of Gadwalls in the sample eating Potamogeton pusillus vegetation would be within 5 per cent of the true value 95 per cent of the time. In this case, one can state that 95 per cent of the time the proportion in similar samples of Gadwalls eating this plant will fall between 57 and 84 per cent. If one is satisfied with a lower limit of confidence, say 90 per cent, then the calculated deviation becomes less, or with the same given deviation, a smaller sample would suffice.

Although the diet data in terms of proportion of all ducks eating a certain food item are subject to considerable sampling error, they do approach a reasonable degree of reliability in many cases. But when tested on the basis of the average quantity of one item occurring in ducks that had eaten that item, the Gadwall samples are ridiculously low. On the basis of algae eaten by ten ducks from a sample of 47 over 20 days old, in excess of 11,000 specimens would be needed to assure 95 per cent confidence that the estimate of the mean weight of algae in the ten sample ducks was within 0.0100 g. of the mean for the population sampled. (The sample mean for algae was 0.3562 g.). Accepting an estimate within 0.0500 g. of the true mean reduces the requirement to 470 specimens, and with an allowable deviation of 0.1000 g., 116 specimens. These estimates include only those specimens containing algae. The problem lies with the high variance in the amount of algae in the gullets; viz. 0.0015 g. to 1.5058 g.; and the resulting high standard deviation of the mean. Thus percentages of the weights of various items found in Gadwall gullets are but an approximation of what the population may actually have eaten.

Amounts and composition of gullet contents are so variable that one would have to make serious inroads upon the Gadwall population of the study area in order to satisfy accepted statistical standards. It is doubtful if the population on the area could sustain the degree of collecting necessary to provide the desirable sample in a five year period. The only alternative would be to collect smaller numbers for many more seasons.

Gadwall Foods

Proportions of plant and animal foods in Gadwall gullets are given in Table 4 and illustrated in Fig. 1. When one collection[1] of four specimens which contained exceptionally large quantities of curculionid beetle larvae are eliminated from the 10-15-day age group, the results show a consistent trend from a predominately animal diet to a predominately plant diet as the birds grew.

Table 4. Average weight of 163 Gadwall gullet contents and proportions of surface invertebrates, aquatic invertebrates and plant foods in Gadwall gullets. ("T" indicates less than 0.5%)

| Age (days) | No. | Total food (grams) | Ave. wt. per gullet | Per cent composition | | |
|---|---|---|---|---|---|---|
| | | | | Surface invert. | Aquatic invert. | Plants |
| 0-3 | 6 | .2191 | .0365 | 74 | 26 | 0 |
| 3-5 | 16 | .2534 | .0158 | 41 | 48 | 11 |
| 5-10 | 32 | 1.5091 | .0472 | 24 | 34 | 42 |
| 10-15 | 31 | .9853 | .0318 | 5 | 40 | 55 |
| 15-20 | 31 | 4.6183 | .1490 | 2 | 19 | 79 |
| 20-30 | 15 | 2.3292 | .1553 | T | 2 | 98 |
| 30-40 | 14 | 6.4334 | .4595 | 3 | 2 | 95 |
| 40+ | 18 | 7.4374 | .4132 | T | 1 | 99 |

[1]The collection contributed 78% of all animal food for that age group.

During their first two to three days of life Gadwalls apparently ate little or no plant food. No ducks considered less than three days old contained plant material. The proportion of plant food in gullets increased rapidly with age of ducks, and by four weeks of age the ducks contained only negligible amounts of animal food. Chura (1961) reported a similar trend in the diet of young Mallards at Bear River Refuge, Utah, although the transition was not as rapid. The comparison is probably not valid because Chura used gizzard material and it has been demonstrated (Perret, 1962; Bartonek and Hickey, in press) that the inclusion of gizzard contents overrates plant proportions. The fact that most of the plant food in the Bear River Mallards comprised seeds, further indicates distortion.

Although the proportion of animal food in the Gadwall's diet was decreasing as they grew, the actual intake of animal food would not start to decrease until about two weeks of age due to the rapidly increasing intake of total food. The relationship is depicted in Fig. 2. The curve for the total food intake was calculated from estimates based on food intake of captive Lesser Scaup ducklings and the scant information on other species. Scott and Holm (1964) concluded that basic food requirements were essentially the same for diving and dabbling ducks, so the use of Scaup data in this case seems justified. Although the plotted curve may deviate from the true curve for Gadwalls, the general relationship between animal and plant food intake should be realistic.

Assuming an average prefledging period of 50 days (Gollop and Marshall, 1954), it is possible to compare intake of animal and plant foods throughout the preflight life of Gadwalls. Estimates for ten day periods in Table 5 are derived from Fig. 1 by the cut and weigh method. The bulk of the preflight animal food intake occurs during the first 30 days with approximately one-half during the 10-20-day period. Intake of plant food increases until about three weeks of age when it becomes relatively constant. For the 50-day preflight period, the Gadwalls' diet was estimated to be made up of 12 per cent animal and 88 per cent plant food.

Table 5. Estimates of the relative rate of food intake by Gadwalls during their first 50 days of life

| Age period in days | Per cent of preflight intake | | |
|---|---|---|---|
| | Animal food | Plant food | Total food |
| 0 - 10 | 22 | <1 | 3 |
| 10 - 20 | 52 | 10 | 15 |
| 20 - 30 | 17 | 28 | 26 |
| 30 - 40 | 5 | 30 | 27 |
| 40 - 50 | 4 | 31 | 28 |

Animal foods

The composition of animal foods in the Gadwalls' diet changed from one high in surface or terrestrial invertebrates during their first few days, to one high in aquatic (limnetic and benthic) invertebrates in older birds (Table 3, Fig. 1). "Surface" invertebrates included adults of Diptera, Trichoptera, Zygoptera, Ephemeroptera, Hymenoptera, Homoptera, Thysanoptera, Carabidae; adults and young of Curculionidae, Arachnoida (other than Hydracarina), Gerridae, Saldidae and Lygaeidae. The small amount of unidentified animal material was arbitrarily divided equally between surface and aquatic invertebrates. The calculated proportions of surface invertebrates are probably lower than the actual proportions taken at the

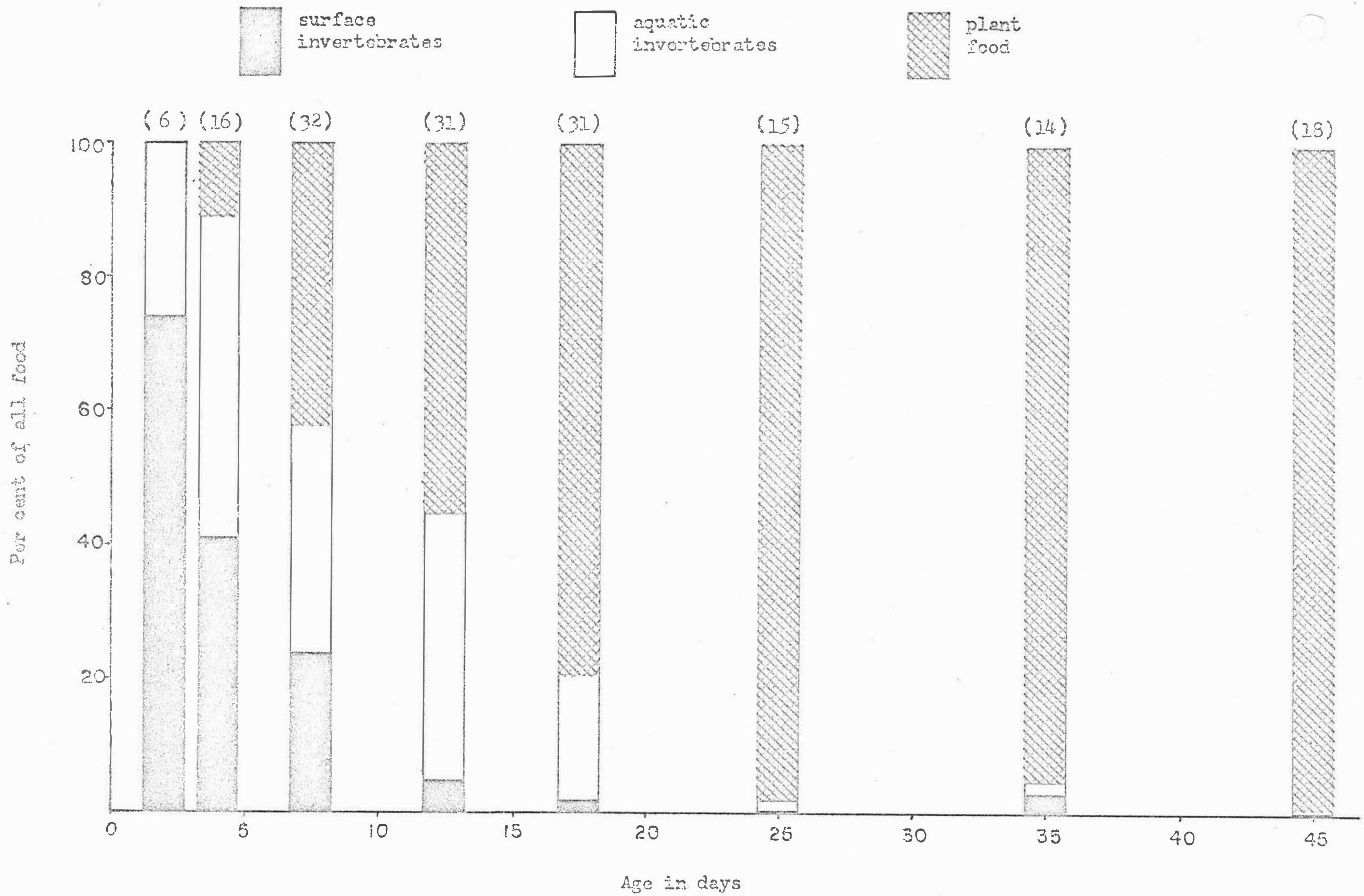


Figure 1. Graph illustrating changes in the diet of Gadwalls as they grow. (Number of specimens shown in parentheses).

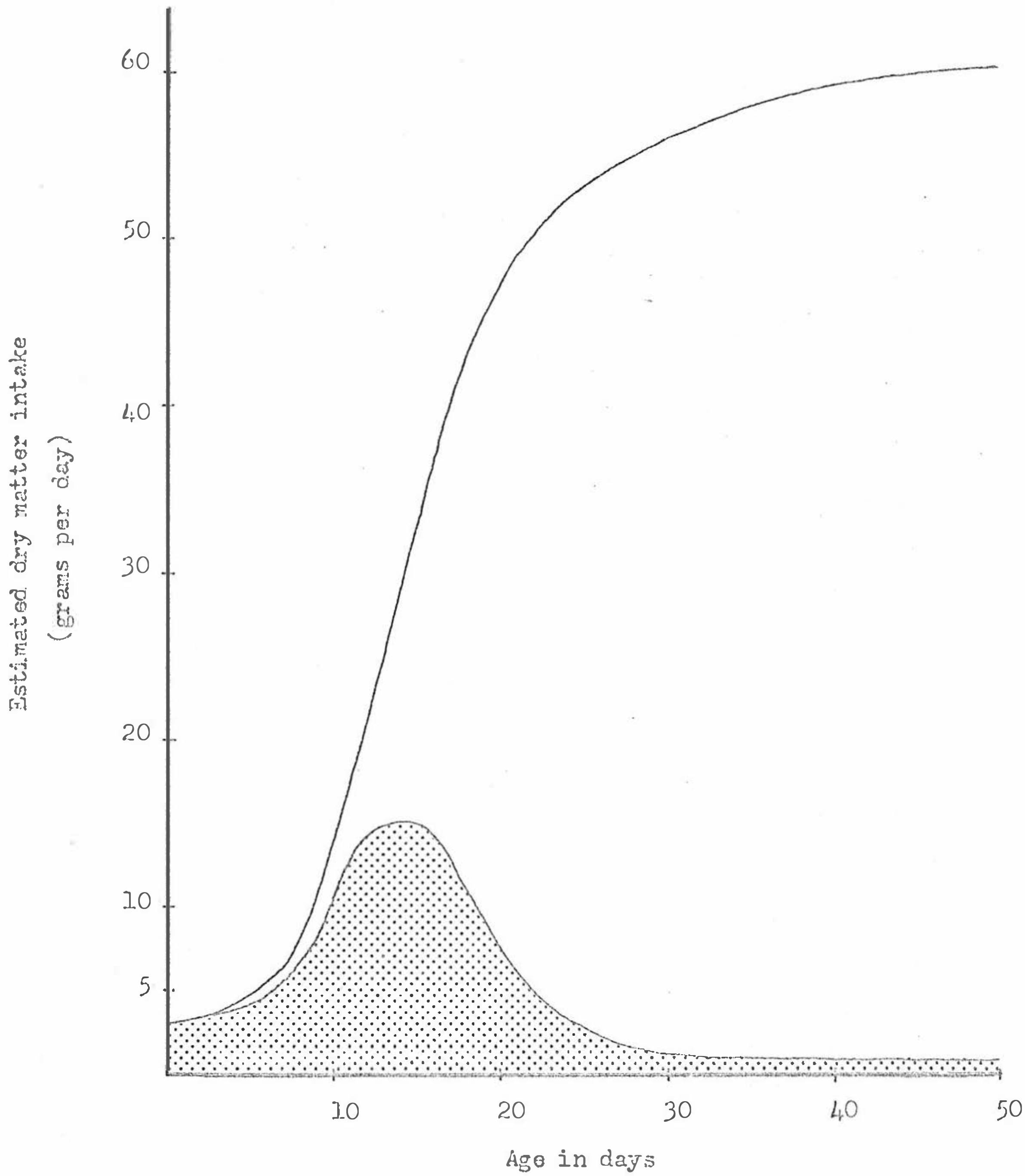


Figure 2

Graph showing relationship of plant food and animal food (shaded) intake with changing age of young Gadwalls.

surface because many aquatic forms such as Corixidae, Culicidae larvae, Dytiscidae, Ceratopogonidae pupae, and Gastropoda are undoubtedly captured at the surface. Feeding observations indicate that Class I Gadwalls secure a large portion of their food by surface-pecking or bill-dipping (Sugden, 1968). Veselovsky (1953) stated that during their first few days of life, ducklings catch only those food items which they can see. This would also indicate the importance of surface invertebrates at that time.

A trend from high use of terrestrial fauna to high use of aquatic fauna as the ducks grew was also reported for Mallards by Chura (1961). Because only animal food is involved this comparison is probably valid. As with the Mallards, the change in Gadwall diet was associated with changing feeding methods.

The relative amounts and occurrence of different taxonomic groups of invertebrates found in Gadwall gullets are shown in Table 6. The original percentage by weight data have been adjusted in two ways. The first involved elimination of six exceptional specimens. Two of the specimens contained unusually large amounts of Cladocera. In the 167 original specimens the two in question contributed 77 per cent of total Cladoceran weight. Four specimens containing excessive amounts of Curculionidae beetle larvae were also eliminated. These four ducks originally contributed 94 per cent of the total beetle larvae weight in 167 specimens. Elimination of the six specimens tends to increase percentages of items other than Cladocera and Coleoptera larvae and, I believe, provides a more realistic estimate of the animal food composition.

Table 6. Estimated composition of Gadwall animal foods during the preflight period by percentage dry weight and occurrence: (Results are based on 161 specimens for weight and 167 specimens for occurrence. "T" indicates less than 0.5 per cent).

| Item | Percentages | | |
|---|---|---|---|
| | Dry Weight | | Occurrence |
| Class Hirudinea | | (T) | 1 |
| Class Crustacea | | | |
| Cladocera | 9 | | 36 |
| Podocopa | T | | 5 |
| Eucopepoda | T | | 2 |
| Amphipoda | T | | 2 |
| (Crustacea total) | | (9) | 42 |
| Class Insecta | | | |
| Collembola | 1 | | 9 |
| Ephemeroptera a. | 1 | | 2 |
| Ephemeroptera n. | T | | 1 |
| Zygoptera a. | T | | 2 |
| Zygoptera n. | 1 | | 5 |
| Coleoptera a. | 7 | | 28 |
| Coleoptera l. | 4 | | 22 |
| Trichoptera a. | 3 | | 4 |
| Diptera a. | 16 | | 44 |
| Diptera l., p. | 37 | | 59 |
| Hymenoptera a. | T | | 7 |
| Thysanoptera a. | T | | 1 |
| Homoptera a. | T | | 2 |
| Hemiptera | 11 | | 34 |
| Unident Insecta | 2 | | - |
| (Insecta total) | | (84) | 85 |
| Class Arachnoidea | | | |
| Araneida | T | | 1 |
| Hydracarina | T | | 7 |
| (Arachnoidea total) | | (T) | 7 |
| Class Gastropoda | | (2) | 4 |
| Unident animal food | | (4) | - |

a = adult     n = naiad     l = larva     p = pupa

In the second adjustment, data are weighted according to the estimated intake of each ten-day age period (Table 5). For example, the percentages for the 0-10-day group were scaled down to total 22; those of the 10-20-day group were scaled down to total 52; and so on. The sum of the scaled percentages equals 100. Percentages were weighted to give adequate emphasis to those groups in which animal food intake is greatest.

The adjustments result in better agreement between percentage by weight and percentage by occurrence. A comparison between weight and occurrence percentages of the eight highest (by weight) items gives a correlation coefficient value of $r = 0.81$ before adjustment and $r = 0.92$ after adjustment.

Three insect orders, Diptera, Coleoptera, and Hemiptera, made up the bulk of animal food found in Gadwall gullets. Larvae and pupae of Diptera were the most important single items. A further breakdown of identified material is given in Table 8, Appendix . One family, the Chironomidae, was singularly dominant and the adults, larvae and pupae collectively accounted for an estimated 46 per cent of animal food eaten by young Gadwalls. That family was also a major item in the diets of young Mallards in Utah (Chura, 1961) and Manitoba (Perret, 1962).

Three families, Dytiscidae, Curculionidae, and Haliplidae contributed the bulk of beetle material eaten by Gadwalls (Table 8, Appendix ). Four specimens contained unusually large quantities of Curculionid larvae as well as considerable adults. The larvae had infested immature spikes of *Myriophyllum* and *Potamogeton* which were also eaten.

Corixidae comprised most of the Hemiptera taken by Gadwalls. Although Notonectids were sometimes abundant, it seems they were too difficult to capture. The relationship between diet composition and factors such as food abundance and availability will be discussed in a completion report.

The relatively high incidence of Cladocera in the Gadwall gullets resulted from the occurrence of trace amounts in many. The ingestion of such minor quantities - often a single ephippium - probably occurred incidental to swallowing other foods. When sufficiently abundant however, Cladocerans will evidently be taken in large quantities. One bird had gorged itself on ephippia that had been concentrated along a lake shore by wind action. Another's gullet was full of immature Cladocerans about 0.3 mm in diameter. It contained an estimated 25,000 individuals.

Plant foods

The increasing importance of plant food as Gadwalls grow has been discussed. Foods in Gadwall gullets are listed in Table 7 by percentages of dry weight and occurrence. Because the composition of the plant food did not differ significantly among age groups the data have not been weighted as with animal foods. Percentage of dry weight is for the pooled weight from all groups.

Pondweed (*Potamogeton* spp.) vegetation was the most important item in the diet and of that, small pondweed (*P. pusillus*) contributed the greatest bulk. Aquatic vegetation was also important in the autumn diet of Gadwalls in Utah (Gates, 1957). In that case, vegetation of *P. pectinatus*, *Ruppia maritima* and *Zannichellia palustris* was eaten.

The next most important plant eaten by Strathmore Gadwalls was green algae (Chlorophyceae), followed by duckweeds (*Lemna* spp.). Items which occurred in considerable quantity in but one collection were:

Table 7. Plant foods found in 167 Gadwall gullets
"T" indicates less than 0.5 per cent;
"t" represents one specimen

| Item | Percentage Dry Wt. | Percentage Occurrence |
|---|---|---|
| CHLOROPHYCEAE | 26 | 23 |
| CHARACEAE *Chara* sp. veg. | 3 | 2 |
| CYANOPHYCEAE | T | t |
| MUSCI veg. | T | t |
| NAJADACEAE | | |
| *Potamogeton pectinatus* veg. | 1 | 3 |
| *Potamogeton petinatus* spike | 1 | 4 |
| *Potamogeton pectinatus* tuber | T | t |
| *Potamogeton richardsonii* veg. | T | 1 |
| *Potamogeton pusillus* veg. | 42 | 31 |
| *Potamogeton pusillus* spike | 2 | 5 |
| *Potamogeton* sp. veg. | T | 5 |
| *Potamogeton* sp. seeds | T | 5 |
| *Zannichellia* palustris veg., seeds | 2 | 11 |
| GRAMINEAE sp. veg. | T | t |
| *Puccinellia aeroides* seeds | T | t |
| *Hordeum jubatum* seeds | T | 1 |
| *Alopecurus aequalis* seeds | T | 1 |
| *Beckmannia syzigachne* seeds | 5 | 2 |
| CYPERACEAE | | |
| *Eleocharis* sp. seeds | T | 3 |
| *Scirpus* spp. seeds | 1 | 10 |
| *Carex* spp. seeds | T | 2 |
| LEMNACEAE | | |
| *Lemna minor* | 9 | 13 |
| *Lemna trisulea* | T | 5 |
| POLYGONACEAE | | |
| *Rumex maritimus* seeds | T | 1 |
| *Polygonum* sp. seeds | T | 1 |
| CERATOPHYLLACEAE | | |
| *Ceratophyllum demersum* veg. | 3 | 2 |

(cont'd)

Table 7. Plant foods found in 167 Gadwall gullets
"T" indicates less than 0.5 per cent;
"t" represents one specimen

| Item | Percentage Dry Wt. | Percentage Occurrence |
|---|---|---|
| CHENOPODIACEAE | | |
| *Chenopodium* sp. seeds | T | 2 |
| RANUNCULACEAE | | |
| *Ranunculus circinatus* veg. | 1 | 2 |
| HALORAGIDACEAE | | |
| *Myriophyllum exalbescens* veg. | T | 7 |
| *Myriophyllum exalbescens* spikes | T | 2 |
| *Myriophyllum* sp. seeds | T | t |
| COMPOSITAE | | |
| *Sonchus* sp. seed | T | t |
| *Taraxacum* sp. seed | T | t |
| Unident. veg. material | 1 | - |
| Unident. seeds | T | - |

leaves of *Chara*, *Ceratophyllum*, and *Ranunculaceae*; immature spikes of *Myriophyllum* (taken with Curculionid larvae); and current seeds of *Puccinellia*, *Alopecurus*, and *Beckmannia*. It appeared that the grass seeds were stripped from the plants, although some of the *Beckmannia* seeds may have been taken from the water surface.

Eventually I wish to express Gadwall energy needs in terms of metabolizable energy and to expand that to actual food eaten. Whether or not it will provide a better estimate than that given in Fig. 1 remains to be seen.

Lawson G. Sugden

Edmonton, Alberta. April 8, 1968.

Information contained in this report is preliminary and not for publication.

## APPENDIX

Table 8. Percentages of identified invertebrate items in Gadwall gullets (Total weight of identified material shown in parentheses. "T" indicates less than 0.5 per cent).

### COLEOPTERA

| Family | Adults (0.1890) | Adults (0.1030)* | Larvae (1.4673) | Larvae (0.0735)* |
|---|---|---|---|---|
| Dytiscidae | 12 | 22 | 2 | 33 |
| Curculionidae | 67 | 39 | 95 | 5 |
| Hydrophilidae | 5 | 10 | T | 5 |
| Haliplidae | 3 | 6 | 3 | 57 |
| Carabidae | 6 | 11 | | |
| Melyridae | 5 | 10 | | |
| Scarabaeidae | 1 | 1 | | |
| Staphylinidae | 1 | 1 | | |

*four exceptional gullets eliminated

### DIPTERA

| Family | Adults (0.5631) | Larvae (0.8962) | Pupae |
|---|---|---|---|
| Chironomidae | 88 | 73 | 14 |
| Culicidae | T | T | 2 |
| Ceratopogonidae | T | T | 8 |
| Ephydridae | 1 | 2 | |
| Anthomyiidae | 4 | T | |
| Tipulidae | T | | |
| Tabanidae | 5 | | |
| Dolichopodidae | T | | |
| Mycetophilidae | T | | |
| Otitidae | T | | |
| Chloropidae | T | | |

(continued)

Table 8. (continued)

HEMIPTERA

| Family | (0.2546) |
|---|---|
| Corixidae | 96 |
| Notonectidae | T |
| Gerridae | T |
| Lygaeidae | 3 |
| Saldidae | T |

HYMENOPTERA

| Family | (0.0103) |
|---|---|
| Formicidae | 88 |
| Braconidae | 12 |

GASTROPODA

| Family | (0.0273) |
|---|---|
| Physidae | 82 |
| Planorbidae | 18 |

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