Summer Foods of Lesser Scaup in Subarctic Taiga

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ABSTRACT. Twenty-five adult and 38 juvenile lesser scaup (*Aythya affinis*) that were collected in taiga north of Great Slave Lake, Northwest Territories, had eaten almost entirely animal material (99 ± 1 per cent, $P < 0.05$). Juveniles collected in mid-summer had tended to feed on free-swimming organisms such as Chaoborinae and Conchostraca; whereas juveniles collected in late summer had tended to feed, as did adults in June, on bottom-associated organisms such as amphipods, odonates, and corixids. Sampling aquatic organisms concomitantly with collecting ducks revealed that seeds, copepods, and cladocerans were seldom or never eaten; most other organisms were consumed in proportions that were not significantly different ($P < 0.05$) from those in the collected samples.

RÉSUMÉ. *Alimentation estivale du petit milouin dans la taïga subarctique.* 25 petits milouins (*Aythya affinis*) adultes et 38 juvéniles, capturés dans la taïga au nord du Grand lac des Esclaves, dans les Territoires du Nord-Ouest, n'avaient consommé que de la nourriture d'origine animale (99 ± 1%, $P < 0.05$). Au milieu de l'été, les spécimens juvéniles semblaient plutôt se nourrir d'organismes nageurs comme les Chaoborinées et les Conchostraces, tandis que vers la fin de l'été, ces mêmes oiseaux, tout comme les adultes en juin, tendaient à se nourrir d'organismes du fond: amphipodes, odonates et corixidés. Un échantillonnage des organismes aquatiques effectué au moment de la capture des canards, a révélé que les graines, les copépodes et les cladocères n'étaient presque jamais mangés; la consommation de tous les autres organismes se fait dans des proportions qui ne sont pas significativement différentes ($P < 0.05$) de celles des échantillons capturés.

РЕЗЮМЕ. *Летняя диета американского нырка из районов приполярной тайги.* Диета 25 взрослых и 38 молодых особей американского нырка, пойманного в тайге на севере от Большого Невольничьего озера (Северо-Западные Территории), состояла почти исключительно из пищи животного происхождения (99 ± 1%; $P<0,05$). Молодняк, пойманный в середине лета, предпочитал в пищу такие свободно плавающие организмы, как Chaoborinae и Conchostraca. В свою очередь молодняк, пойманный в конце лета, употреблял в пищу донные организмы, например, амфиподные, т.е. организмы, поедаемые взрослыми особями в июне. После взятия проб водяных организмов одновременно с поимкой нырка было установлено, что семена, а также представители отряда Copepoda и т.д. поедаются чрезвычайно редко. Было также найдено, что большинство других организмов употреблялось в пищу в количествах, незначительно отличавшихся от обнаруженных во взятых пробах ($P<0,05$)

INTRODUCTION

Rogers and Korschgen (1966) presented information on the foods of 164 adult lesser scaup taken on breeding grounds, concentration areas, and wintering grounds. They concluded (pp. 262-63) from their study and review of recent

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investigations that, contrary to the earlier findings of Cottam (1939, pp. 53 and 134), lesser scaup feed predominantly upon animal material. Although much information is known about the foods of waterfowl during fall and winter, little is known about what is eaten during summer by adults and especially by juveniles. The limited information from previous studies on non-flying juvenile scaup is based upon 82 birds collected mostly in the prairie and aspen parkland regions of Canada (Cottam 1939, Munro 1941, Collias and Collias 1963, Bartonek and Hickey 1969).

This paper reports the food of 25 adult and 38 juvenile lesser scaup collected in subarctic taiga from June to September 1967. The food consumed by these scaup is compared with the relative availability and quantity of those organisms in the aquatic environment.

COLLECTING AREA

Scaup were collected along the Yellowknife Highway between Rae and Yellowknife, Northwest Territories. The collecting area is on the western edge of the Precambrian Shield 1 to 7 miles north of Great Slave Lake. The shield edge is an important, though limited, duck nesting area which Murdy (1966) described and compared to other regional environments. The topography is dominated by granitic outcrops which rise up to 50 feet and cover approximately a fourth of the surface. Between outcrops the land is low and flat with a heavy overburden of till, outplain, and lacustrine deposits. Except for a few restricted peat areas, the soil is mineral in nature. The surface layer thaws 1 to 4 feet depending on the site, and permafrost is continuous in this subarctic region. Taiga there is classified as the Northwestern Transition Section of the Boreal Forest. Jack pine (*Pinus banksiana*) forests occur on the outcrops and other xeric sites, white spruce (*Picea glauca*) on the mesic sites, and black spruce (*P. mariana*) on the hydric sites. Most of the area, though, has a brushy aspect from the willows (*Salix* spp.), small white birch (*Betula papyrifera*), aspens (*Populus* spp.) and coniferous reproduction which resulted from repeated and widespread fires in the late 1930's. The flora and vegetation of the area have been described by Thieret (1963, 1964).

Numerous ponds, pools and small streams are a major feature of this area. Some were altered through partial drainage and flooding resulting from ditches and borrow pits built by highway construction in 1957 to 1959. Almost half the water areas are pools less than an acre in size; about half are 1- to 40-acre ponds; and a few ponds encompass several hundred acres. The majority are bog ponds and bog pools characterized by floating mats of sedges (*Carex aquatilis, C. rostrata, C. limosa*), buckbean (*Menyanthes trifoliata*), cinquefoil (*Potentilla palustris*), and water arum (*Calla palustris*). Two other types of wetlands are the numerous shallow sedge pools and the infrequent large ponds with abrupt ericaceous shores. These ponds have bottoms of deep, loose muck; and most have extensive beds of yellow pondlilies (*Nuphar variegatum*). Submerged plants include pondweeds (*Potamogeton* spp.), watermilfoils (*Myriophyllum* spp.), bladderworts (*Utricularia* spp.), marestail (*Hippuris vulgaris*), and muskgrasses

(*Chara* spp.). Murdy (1965) described these waters as being generally "hard" with limited fertility. He found median values for composite surface samples taken in mid-July to be: specific conductivity, 125 μmhos at 25° C.; total alkalinity, 135 ppm; and pH, 7.4.

From 1962 to 1965, lesser scaup comprised approximately half of both the breeding ducks and the broods of this area (Murdy 1965).

METHODS

The Yellowknife Highway provided access into this area. Ducks were collected on both natural waters and waters that were altered by road construction. One pair collected in a roadside borrow pit is not included in the summaries of food habits, but is discussed separately.

An effort was made to collect only two birds from a flock or brood. Food materials taken from the esophagi were used in the analyses. Materials from the proventriculi and gizzards were not used because they bias data in favour of those items most resistant to digestion (Bartonek 1968). Food was removed from the esophagi and placed in a solution of 60 per cent ethanol and water within 5 to 15 minutes after collection.

Animals and seeds from plants that were potentially usable by waterfowl were assessed by sampling in the immediate vicinity of where the duck was feeding prior to being shot. Free-swimming organisms were collected with a long-handled dip net by making arcing sweeps that passed the net through water both at the surface and near the bottom. Bottom-associated organisms were collected by taking scoops of bottom material with the same net; unavoidably some of the free-swimming organisms were usually collected in the process. The net, a Turtox "Bottom Net", had an opening 18 x 8 inches and a bag 10 inches deep with a mesh of 20 openings per inch. This net and method tended to select the slower-moving and larger invertebrates which tended to be the main foods of scaup. Frequently small copepods and cladocerans passed through the net.

Esophageal contents from ducks and organisms collected in net samples were later identified, segregated, and measured volumetrically by water displacement. All items were wet when measured, but they were first drained on a blotter. Only invertebrates and seeds taken in net samples were included in the analyses of foods. Vegetative material and detritus were measured only when found in the ducks.

"Occurrence" and "average per cent of volume" are used to express data. Foods found within the ducks and their feeding site were compared by using *Indexes of Similarity* — an *I. S.* value of 0.00 would indicate that the two groups being compared had no food in common, and an *I. S.* value of 1.00 would indicate the food of the groups was identical and in the same proportions (cf. Curtis 1959, pp. 82 to 83; Ivlev 1961, pp. 42 to 45). The significance of differences ($P < 0.05$, $P < 0.01$) between the relative quantities of a specific food item in the scaup and those in the concomitant samples of bottom-associated and free-swimming organisms was determined by using Student's *t*-test for paired observations with data transformed to "$\sqrt{X+1}$".

TABLE 1. Occurrence and average percentage of volume (± SE) of foods in the esophagi of 23 adult lesser scaup collected near Yellowknife, Northwest Territories, during June 1967.

Food items	Occurrence		Average % Volume	
Amphipoda (scuds)	16		34 ± 7	
Gastropoda (snails)	12		14 ± 6	
Valvatidae (round-mouthed snails)		*5*		*8 ± 5*
Planorbidae (orb snails)		*9*		*5 ± 2*
Physidae (pouch snails)		*1*		*tr.*
Pelecypoda (clams)	13		12 ± 4	
Sphaeriidae (fingernail clams)		*13*		*12 ± 4*
Cladocera (water fleas)	3		8 ± 5	
Trichoptera (caddis flies)	9		7 ± 4	
Coleoptera (water beetles)	8		7 ± 4	
Dytiscidae (predaceous diving beetles)		*8*		*7 ± 4*
Haliplidae (crawling water beetles)		*1*		*tr.*
Gyrinidae (whirligig beetles)		*1*		*tr.*
Diptera (midges)	7		7 ± 4	
Chironomidae (midges)		*6*		*6 ± 4*
Chaoborinae (phantom midges)		*1*		*tr.*
Odonata (dragonflies, damselflies)	8		4 ± 3	
Anisoptera (dragonflies)		*5*		*3 ± 3*
Zygoptera (damselflies)		*5*		*1 ± 1*
Hirudinea (leeches)	6		3 ± 2	
Anostraca (fairy shrimps)	1		2 ± 2	
Conchostraca (clam shrimps)	3		1 ± 1	
Ephemeroptera (mayflies)	2		1 ± 1	
Hemiptera (water bugs)	4		tr.	
Corixidae (water boatmen)		*4*		*tr.*
Parasitengona (water mites)	2		tr.	
TOTAL ANIMAL MATERIAL	*23*		*99 ± 1*	
Spermatophyta (seeds from misc. plants)	4		tr.	
TOTAL PLANT MATERIAL	*4*		*tr.*	
TOTAL FOOD MATERIAL	*23*		*100*	

RESULTS

Sixty-three scaup of 87 collected contained food in their esophagi and could, therefore, be used for analyses. Adults were collected during June while still paired. Because of other commitments during the last two-thirds of August, juveniles were collected only before and after this period.

Animal material averaged more than 99 ± 1 per cent ($P < 0.05$) of all esophageal contents for both the 25 adults and the 38 juveniles. In comparison, animal material from the proventriculi and gizzards averaged only 84 ± 7 per cent for adults and 90 ± 8 per cent for juveniles. The different proportions of animal food from these two segments of the digestive tract are explainable by the different rates of digestion for various types of food and the ability of gizzards to retain seeds longer than most other kinds. Plant material in the esophagi, which averaged less than 1 per cent, was found in only four adults and three juveniles. This consisted of mosses, nutlets of pondweeds, small burreed (*Sparganium minimum*), marestail, and watermilfoil, achenes of sedges, and seeds of other plants that occurred in smaller quantities.

Because of the similarity in their diets ($I. S. = 0.67$), the data on food from 11 male and 12 female adult lesser scaup have been combined and are summarized

in Table 1. Amphipods (scuds) averaged 34 per cent by volume of the food consumed; and they, along with cladocerans (water fleas), Anostroca (fairy shrimps), and Conchostraca (clam shrimps), made Crustacea (45 per cent) the most important class of invertebrates to these breeding scaup. Mollusks averaged 26 per cent of all foods and were comprised of gastropods (snails, 14 per cent) and Sphaeriidae (fingernail clams, 12 per cent). Insects also averaged 26 per cent and included mostly immature forms of aquatic species. Trichoptera (caddis fly) larvae, dytiscid (predaceous diving beetle) larvae, and chironomid (midges) larvae and pupae were the most important insects. Hirudinae (leeches, 3 per cent) and Parasitengona (water mites, trace) were eaten by a few birds.

A pair of adult scaup were not used in the summary in Table 1 because they

TABLE 2. Occurrence and average percentage of volume (± SE) of foods in the esophagi of juvenile lesser scaup collected near Yellowknife, Northwest Territories, during late July to early August (19 birds) and in early September 1967 (19 birds).

Food items	Occurrence		Average % volume	
	July-August	September	July-August	September
Amphipoda (scuds)	3	16	1 ± 1	57 ± 9
Diptera (midges)	18	3	54 ± 8	1 ± 1
Chaoborinae (phantom midges)	*17*		*54 ± 8*	
Chironomidae (midges)	*1*	*3*	*tr.*	*1 ± 1*
Conchostraca (clam shrimps)	10	3	30 ± 8	2 ± 2
Odonata (dragon- & damselflies)	1	5	tr.	17 ± 8
Anisoptera (dragonflies)		*4*		*15 ± 8*
Zygoptera (damselflies)	*1*	*2*	*tr.*	*2 ± 2*
Hemiptera (water bugs)	4	7	4 ± 3	11 ± 7
Corixidae (water boatmen)	*3*	*7*	*1 ± 1*	*11 ± 7*
Gerridae (water striders)	*1*		*3 ± 3*	
Parasitengona (water mites)	3		8 ± 3	
Trichoptera (caddis flies)	2	4	tr.	6 ± 5
Coleoptera (water beetles)	5	6	1 ± 1	4 ± 3
Chrysomelidae (leaf beetles)	*2*	*2*	*tr.*	*3 ± 3*
Dytiscidae (predaceous diving beetles)	*2*	*4*	*tr.*	*1 ± 1*
Haliplidae (crawling water beetles)	*1*		*tr.*	
Gastropoda (snails)	1	5	1 ± 1	1 ± 1
Physidae (pouch snails)	*1*	*1*	*1 ± 1*	*tr.*
Planorbidae (orb snails)		*2*		*tr.*
Valvatidae (round-mouthed snails)		*2*		*tr.*
Lymnaeidae (pond snails)		*1*		*tr.*
Ephemeroptera (mayflies)	2	1	2 ± 1	tr.
Pelecypoda (clams)		3		tr.
Sphaeriidae (fingernail clams)		*3*		*tr.*
Cladocera (water fleas)	2		tr.	
TOTAL ANIMAL MATERIAL	*19*	*19*	*100*	*99 ± 1*
Bryophyta (mosses)		3		tr.
Spermophyta (seeds from misc. plants)		1		tr.
TOTAL PLANT MATERIAL		*3*		tr.
TOTAL FOOD MATERIAL	*19*	*19*	*100*	*100*

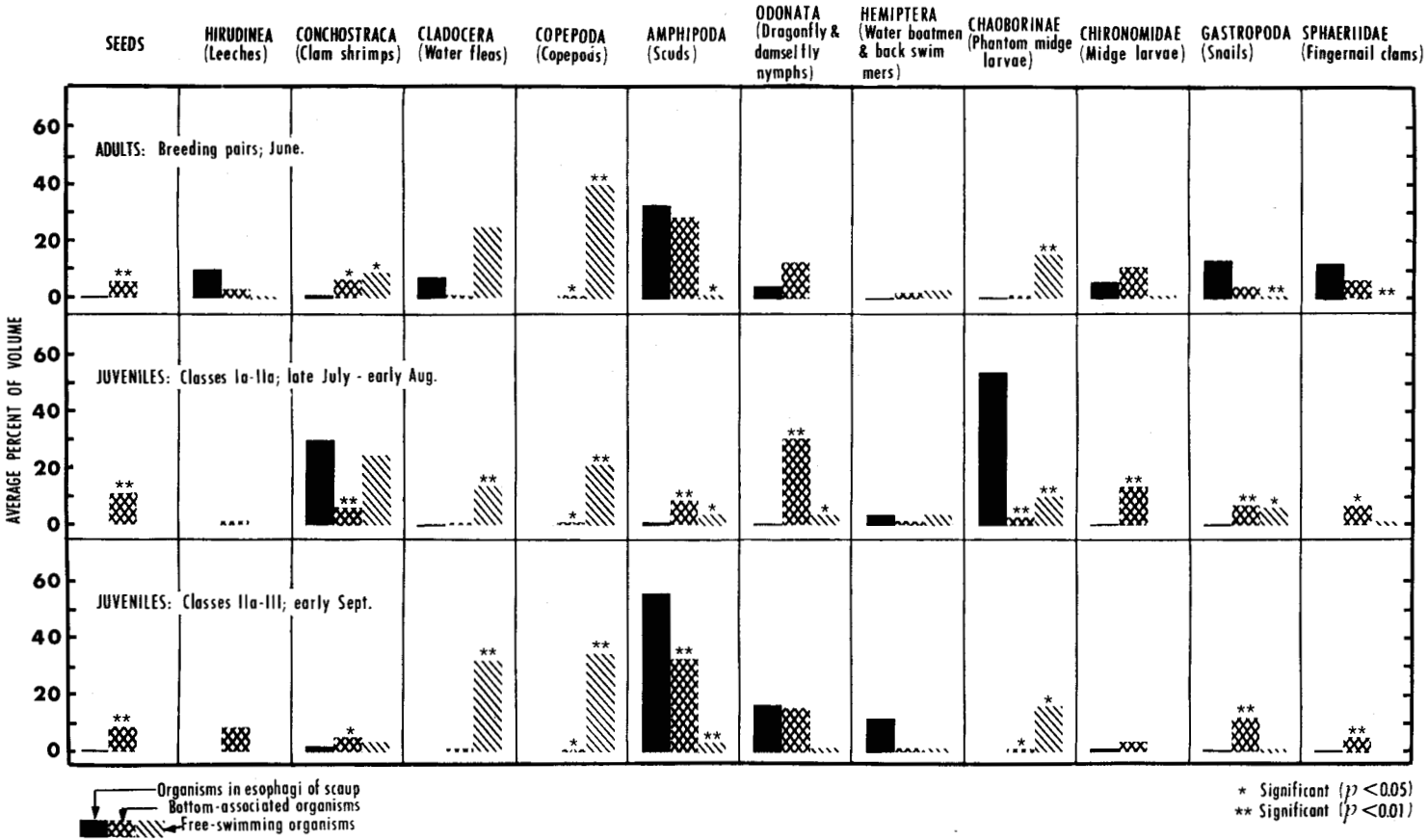

FIG. 1. Average percent of volume of the more important foods found in the esophagi of lesser scaup and in concomitant samples of bottom-associated and free-swimming organisms.

were collected in a roadside ditch. Their esophageal contents consisted principally of chironomid larvae — 96 per cent for the male and 89 per cent for the female. Larvae of dytiscids and Chaoborus (phantom midges), adult corixids (water boatmen), and nymphs of Ephemeroptera (mayflies) and Zygoptera (damselflies) made up most of the remainder.

Food items eaten by 38 juvenile lesser scaup are summarized in Table 2 and separated into 2 periods of collection, i.e. late July to early August, and early September. Although these periods were not selected by design but rather from necessity, they showed remarkable differences in the food consumed. The juveniles collected earliest had fed mainly on free-swimming organisms such as Chaoborus larvae and pupae (54 per cent), Conchostraca (30 per cent), and Gerridae (water striders, 3 per cent); whereas the juveniles collected in September had fed primarily on bottom-associated organisms such as amphipods (57 per cent), Anisoptera (dragonflies) nymphs (15 per cent), corixids (11 per cent), and Trichoptera larvae (6 per cent). The two groups had few foods in common; the *I. S.* value obtained by comparing specific food items in their diets was only 0.05.

Average percentages of some of the most important foods collected in samples of organisms taken concomitantly with the scaup are shown in Fig. 1. Among bottom-associated organisms, amphipods, Odonata (dragonflies and damselflies) nymphs, chironomid larvae, gastropods, Sphaeriidae, and seeds of various plants formed the bulk of foods. Copepods, cladocerans, Conchostraca, and Chaoborus larvae and pupae contributed the largest percentages among free-swimming organisms.

The food items eaten by the adults collected in June and the juveniles collected in September were similar to samples of bottom-associated organisms rather than to those of free-swimming organisms. The opposite was the case for the juveniles collected in late July and early August. The *I. S.* values obtained by comparing animals and plant seeds found within the esophagi of the scaup with those collected in samples are listed in Table 3.

In most cases, the mean percentage of a particular food item eaten by the adult scaup did not differ significantly ($P < 0.05$) from the corresponding

TABLE 3. Mean values for *Indexes of Similarity** obtained by comparing the food items found in the esophagi of scaup with those collected concomitantly in samples of bottom-associated and free-swimming organisms.

Age group	Period of collection	Number of birds	Esophageal contents vs. samples of bottom-associated organisms	Esophageal contents vs. samples of free-swimming organisms
Adults:	June	23	0.34 (0.22-0.45)	0.03 (0.00-0.06)
Juveniles:				
	late July — early August	19	0.06 (0.02-0.10)	0.18 (0.11-0.24)
	early September	19	0.41 (0.29-0.54)	0.03 (0.00-0.06)

*Confidence interval in parentheses, $P < 0.05$.

percentages obtained in samples taken from the environment (Fig. 1). Some items, such as seeds and Conchostraca of the bottom-associated organisms and copepods and Chaoborus larvae and pupae of the free-swimming organisms, were found in significantly greater percentages in the environment than in the esophagi of the adult scaup.

Juvenile scaup that were collected between late July and early August had consumed more Chaoborus larvae and pupae and fewer cladocerans and copepods than found in the samples of free-swimming organisms (Fig. 1). They also consumed smaller percentages of seeds, Conchostraca, amphipods, odonates, chironomid larvae, gastropods and Sphaeriidae than those found in corresponding samples of bottom-associated organisms.

Juvenile scaup that were collected in early September consumed more ($P < 0.05$) amphipods and fewer seeds, Conchostraca, gastropods, and Sphaeriidae than were found in samples of bottom-associated organisms (Fig. 1). They also consumed fewer cladocerans, copepods, and Chaoborus larvae and pupae than were found among samples of free-swimming organisms.

None of the 87 scaup, 34 adults and 53 juveniles, contained lead shot in their gizzards. Because hunting pressure in the collection sites is light and restricted largely to those areas visible from the road, the likelihood of ducks ingesting shot on these breeding grounds is small.

DISCUSSION

The food habits of the two age groups of juvenile scaup appear to be different (*I. S.* =0.05). Although other food was available and all scaup had fed by diving, the juveniles collected in late July and early August had fed mainly upon free-swimming organisms, whereas, the September-collected juveniles, like the adults that were collected in June, had fed mainly upon bottom-associated organisms (Fig. 1, Table 3). Although there may have been important differences in the biomass of food available during these two periods, the relative proportion of food items at the sample site was not very different. *I. S.* values of 0.60 and 0.51 were obtained for bottom-associated organisms and free-swimming organisms, respectively, when the percentages of each food item for both periods were compared. The average depths of water in which birds from the two groups were feeding did not differ significantly; they averaged 4.0 ± 0.4 feet for the early group and 3.5 ± 0.2 feet for the late group. Because the early group was younger (range, Class Ia to IIa; median, Class Ib — 7 to 13 days) than those collected in September (range, Class IIa to III; median, Class IIc — 34 to 42 days), they simply may not have been diving and feeding at as great a depth as the older ducks.

A change in foods from one type of animal to another type of animal as ducklings become older has not been previously described; however, Bartonek and Hickey (1969) in Manitoba concluded that juvenile canvasbacks (*Aythya valisineria*) and redheads (*A. americana*), but not lesser scaup, ate proportionately less animal material and more plant material as they became older. Other studies on the food of diving ducks report similar changes from animal

to plant foods among the juveniles (Mendall 1958, p. 187, Beard 1953, p. 434).

Scuds, or amphipods, appear to be a principal food of the lesser scaup throughout much of its breeding range. In this study, they averaged 54 ± 6 per cent by volume in the 35 scaup that had eaten them. *Hyalella azteca* and *Gammarus lacustris*, respectively, were eaten by 26 and 14 birds; one species did not appear to be selected over the other. Rogers and Korschgen (1966, pp. 259 to 261) and Bartonek and Hickey (1969) in Manitoba, Dirschl (1969, pp. 82 and 83) in Saskatchewan, and Munro (1941, pp. 134 to 137) in British Columbia show scuds to be one of the most important groups of foods eaten by adult and juvenile scaup during the summer.

Amphipods are also reported to be an important food to scaup migrating through Minnesota. R. L. Jessen of the Minnesota Department of Conservation (personal communication) said that in 1961 the standing crop of invertebrates available to broods on Warren Lake in Mahnomen County, Minnesota, was nearly 300 pounds per acre (wet weight) of amphipods, with little other food. Although this lake has a history of early scaup use and scaup did eat amphipods, Jessen did not want to over-emphasize their importance. He said there was indirect evidence that Sphaeriidae and large chironomid larvae were also taken in the fall, and Anostroca and Ephemeroptera nymphs in the spring. N. J. Ordal of the Minnesota Department of Conservation (personal communication) said that old-time hunters near Fergus Falls commonly associated good scaup hunting with the presence of "blue-bill bugs" or "freshwater shrimps" (local names for amphipods). Some hunters even tested the suitability of the hunting area by tying string to a freshly killed bird, throwing the bird into the water, and then retrieving it after it had time to "cool"; if the carcass was covered with "blue-bill bugs" then the lake would be a good place to hunt scaup.

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