ASH CONTENT OF MACROPHYTES FROM CHAUTAUQUA LAKE[1, 2]

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Sixty-two ash content determinations were made on five predominant macrophytes from Chautauqua Lake, N.Y. Intraspecific seasonal variations (May/June-July-August), examined for *Myriophyllum sp.* only, were not statistically significant. However, many significant interspecific differences were noted; ash content in *Anacharis canadensis* and *Vallisneria americana* were significantly greater than in *Potamogeton Richardsonii* and *P. crispus*, while that of *Myriophyllum sp.* was intermediate. A review of determinations on similar taxa from other waters revealed that ash content tended to increase with alkalinity in the Potamogetonaceae and Halgoridaceae (*Myriophyllum sp.*), but not in the Hydrocharitaceae (*Anacharis sp.*, *Vallisneria sp.*).

Ash content of macrophytes is required to estimate organic production by harvest methods (Westlake, 1966) and is of interest for possible economic uses of macrophytes (Nelson and Palmer, 1939; Polisini and Boyd, 1972).

Previous reviews of ash content in macrophytes (Nelson and Palmer, 1939; Welch, 1948; Straskraba, 1966; Sculthorpe, 1967) indicate many interspecific differences. Other than differences between submerged and non-submerged species that reflect their differing carbon sources, there has been little discussion of interspecific variations.

Sculthorpe (1967) considered intraspecific differences to be minimal, but others (Westlake, 1963; Wetzel, 1966) have suggested that significant variations may occur under certain conditions. Wetzel (1960) reported that ash in *Potamogeton gramineus* varied signficantly with depth in shallow waters due to differential wave action. Other than abrupt increases during periods of rapid growth (Westlake, 1966), most studies have found no significant seasonal variation. Purposes of this study were to determine ash content ranges for major species in Chautauqua Lake, and to ascertain the extent of inter- and intraspecific variation.

STUDY AREA

Chautauqua Lake (Latitude 42° 10′ North, Longitude 79° 20′ West) is a large (57 km^2), eutrophic lake of natural origin in the southwest corner of New York, 13 km east of Lake Erie and 15 km north of the Pennsylvania border The lake basin is an elongate NW–ESE trough approximately 24 km x 1–3 km with sediments consisting of unconsolidated sands and silts. The predominance of shaly parent material in the surrounding drainage basin, its large size (450 km^2), and concentrated human ac-

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TABLE 1
Ash content[1] of macrophytes from Chautauqua Lake

Species	Time	Number of samples	Mean±1 S.D.
Potamogeton crispus	June	9	15.7±4.8
Potamogeton richardonsii	August	11	14.3±3.7
Myriophyllum sp.	May–June	6	16.8±2.5
Myriophyllum sp.	July	6	15.3±5.0
Myriophyllum sp.	August	6	23.5±2.5
Myriophyllum sp.	Total	18	18.6±6.6
Anacharis canadensis	July	12	21.9±5.1
Vallisneria americana	August	12	21.5±6.8

[1]% of dry weight.

tivity along the shoreline account for a moderately rich water composition of (~50 mg/l $CaCO_3$ alkalinity, 20–60 μg/l phosphate, and 0.1–6 mg/l nitrate (Hopke, *unpublished data*). These nutrient levels and extensive shallow water areas (about 6 km² less than 3 m deep) have resulted in luxuriant macrophyte beds for which the lake is noted. Of six important submerged macrophytes in the lake; *Potamogeton crispus*, *Myriophyllum sp.*, *Anacharis canadensis*, *Vallisneria americana*, *Potamogeton richardsonii*, and *Heteranthera dubia*, all except *H. dubia* were examined in this study for ash content. Fassett (1957) was used for species identification and nomenclature.

METHODS

Macrophyte material used for analyses consisted of harvest samples collected by Nicholson, Acciardi and De Shong (1973). Samples were collected randomly from several previous study sites, separated by species, oven dried for 24 hr at 100 C, and stored in dry paper bags. Ash contents were then determined by combusting representative weighed 3 g subsamples in covered crucibles for 24 hr at 450 C in a muffle furnace. This procedure resulted in thoroughly ashed samples but minimized loss of carbonates (Wilde and Voight, 1955).

RESULTS AND DISCUSSION

Ash content of important macrophytes from Chautauqua Lake are summarized in table 1. Seasonal samples were available only for *Myriophyllum sp.*, but variations were not great, and means for May/June, July and August did not differ statistically. Yet there could be a real tendency for ash content to increase in *Myriophyllum* during the season which was obscured by the small sample. Increases in ash content may be expected when macrophyte growth is accelerated due to rapid deposition of calcium carbonate (Westlake, 1966).

Ash contents of the Chautauqua Lake macrophytes are within the ranges others have reported for similar taxa elsewhere. Nelson and Palmer (1939) summarized five previous determinations for *A. canadensis* that ranged from 16.0%–27.9% (Mean = 20.5%) as compared with their own value, 26.8%, from a small stream. Sculthorpe (1967) gave 22.0%–30.7% as the ash content for *A. canadensis* based on previous studies. Our estimate, 21.9%±5.1%, fits better with the earlier results reviewed by Nelson and Palmer (1939), perhaps because data cited by Sculthorpe originated from harder waters.

The ash range Nelson and Palmer (1939) listed for *Vallisneria spiralis* (= *V. americana* in North America), 20.7%–28.6% (Mean = 24.8%), also overlaps closely with ours (21.5%±6.8%), but is slightly higher as are values given by Sculthorpe (1967) and Hannan and Dorris (1970). Hannan and Dorris found ash content in *V. americana* from the San Marcos River (Texas) to be 24.3%±2.5% (n = 3) and Sculthorpe listed a range of 25.2–28.6% for *V. spiralis*. Ash content in the two congeneric species we sampled, *P. richardsonii* and *P. crispus*, were similar as means were within 10%. *V. americana* and *A. canadensis*, two related taxa in the Hydrocharitaceae (Fassett, 1957), were even more similar in ash content as means were within 5%.

Ash content between the Potamogetonaceae and Hydrocharitaceae groups differed significantly. Mean ash percentages in *V. americana* (21.5% ± 6.8%) and *A. canadensis* (21.9% ± 5.1%) were significantly greater ($p < .05$) than those of *P. ricardsonii* (14.3% ± 3.7%) and *P. crispus* (15.7% ± 4.8%). Ash content in *Myriophyllum sp.* (18.6% ± 6.6%), intermediate to the two groups, was significantly greater than that of *P. richardsonii* ($p < .05$), but statistically indistinguishable from the other species.

Ash content reported for *Potamogeton sp.* vary considerably. Data given by Westlake (1966) and Sculthorpe (1967) for various species show a two-fold variation. Schuette and Hoffman (1921) reported a value of 11.4% for an unspecified *Potamogeton,* while ranges given by Westlake (14%–32%; 3 species) and Sculthorpe (13.0%–38.8%; 4 species) are even higher. At least some of the high values can be explained by difference in water quality. For example the high (38.8%) Sculthorpe reported was for *P. amplifolius* from calcareous waters. High percentages reported by Wetzel (1960) for 3 *Potamogeton* species (30%–40%) were caused by extensive calcium carbonate precipitation in the highly alkaline marl lakes he studied. Perhaps the high value Sculthorpe (1967) listed for *P. richardsonii* (30.2% vs. 14.3% ± 3.7% for Chautauqua Lake samples) has a similar explanation. Our value for *P. crispus* (15.7% ± 4.8%) is less but not significantly different from Hannan and Dorris' (1970) for this species from the Marcos River, Texas (19.3% ± 0.8%), which might be related to its high alkalinity (244–253 mg/l HCO_3).

Ash content of *Myriophyllum sp.*, particularly *M. spicatum,* has been determined in several studies. Nelson and Palmer (1939) reviewed five past determinations for *M. spicatum* that ranged from 17.1%–20.7% (Mean = 19.2% ± 1.9%), but found ash content to be only 13.8% in their Lake Owasso, Minn. sample. On the other hand, Westlake (1965) gave 25% as ash content of *M. alterniflorum* from Windermere, while Hannan and Dorris (1970) found only 8.9% ± 0.4% and 10.1% ± 1.2% for *M. heterophyllum* and *M. brasiliensex,* respectively, from the San Marcos River, Texas. Ash percentages we determined for our *Myriophyllum* material; 16.8% ± 2.5% (May/June), 15.3% ± 5.0% (July); 23.5% ± 8.5% (August); 18.6% ± 6.6% (overall mean); are close to previous determinations for *M. spicatum* cited in Nelson and Palmer (1939), but significantly higher than values reported for the two subtropical species in Texas.

Ash content of macrophytes varies significantly between species in the same as well as in unrelated habitats, but related species are more likely to overlap when they originate from similar waters. Although it is difficult to generalize on patterns of ash content in different macrophyte groups, suggestions can be offered regarding the wide variability exhibited by the Potamogetonaceae (*Potamogeton sp.*) and Haloragidaceae (*Myriophyllum sp.*) and conspicuous lack of it in the Hydrocharitaceae (*Anacharis sp.* and *Vallisneria sp.*). There are at least three possible reasons (assuming seasonal variation are accounted for): (1) species were represented by divergent life forms or surfaces which differ in their suitability for carbonate deposition, (2) samples originated from waters with widely varying alkalinities, or (3) species differ in their physiological abilities to regulate ash content. Reason (1) seems doubtful because ash content is similar in *A. canadensis* and *V. americana—V. spiralis,* two phylogenetically related but structurally divergent forms, while that of various *Potamogeton* species, all with basically similar life forms, ranges widely. Reason (2) holds true in extreme examples cited by Wetzel (1960) and Sculthorpe (1967), but existing information suggests only a general relationship between ash content and alkalinity, not a highly predictably one. Option (3) may have some merit based on the very close similarity within *M. spicatum, A. canadensis,* and *V. americana* samples from waters with alkalinities ranging from 45-55 mg/l $CaCO_3$ (Chautauqua Lake) or lower to very high values characteristic of marl lakes (200 mg/l).

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AN ALBINO *BLARINA BREVICAUDA* FROM SOUTHEASTERN OHIO.[1] Coat color mutations occur in all populations of mammals, and the color phase and frequency of occurrence appears to vary among the species. The insectivores (moles and shrews) are a widely distributed group with coat-color variants reported throughout its distribution. The true albino is represented in about 1 percent of mutant insectivores. Jackson (1928) concluded that ablinism was relatively rare in *Sorex* and *Microsorex* and found one albinistic *Sorex tundrensis* in a complete series of over 10,000 specimens. Albinism is reported in *Sorex cinereus* (Dexter, 1961) and *Blarina brevicauda* (Jackson, 1961) with many of these records being partial albinism. All records except one are from the New England states or Quebec.

We would like to report an albino short-tailed shrew (*Blarina brevicauda*) from Southeastern Ohio. The animal was captured within the city limits of Athens, Athens Co., Ohio, on 23 November 1973. The fur was an unblemished white and the eyes and feet were pink. There was absolutely no pigmentation in the skin, yet the teeth had a normal pigmentation pattern. The animal was probably a young of the year and was a male. External measurements were: total length 115 mm, tail length 21 mm, hind foot 18 mm, ear 4 mm, weight 9.5 g. No morphological differences other than coloration would distinguish it from normal colored individuals. The presence of normal dental pigmentation poses some interesting questions. If dental pigmentation is inherited as other pigmentation, why then did it occur in this individual? Is tooth pigmentation transmitted on a completely different set of genes with no relationship to coat color genes? If dental pigmentation is not inherited, how does it occur in such species specific patterns?

From the reported records of albinism in shrews, the incidence is about 1:20,000 to 1:50,000 in free-living populations, well below the expected rate of 1:10,000 based on allelic probabilities. This deviation may be due to strong selection pressures against coat-color variants which occur after young leave the nest (Kaufman and Wagner, 1973).—GERALD E. SVENDSEN AND MARK G. SVENDSEN, *Department of Zoology, Ohio University, Athens, Ohio 45701.*

[1]Note received February 25, 1974 (74–5).

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