Proceedings of the Iowa Academy of Science

Volume 91 | Number

Article 5

1984

The Aquatic Vascular Flora of Clear Lake, Cerro Gordo County, Iowa

Paul E. Niemeier
Iowa State University

Wayne A. Hubert
Iowa State University

Proc. Iowa Acad. Sci. 91(2): 57-66, 1984

The Aquatic Vascular Flora of Clear Lake, Cerro Gordo County, Iowa[1]

by PAUL E. NIEMEIER and WAYNE A. HUBERT[2]

Iowa Cooperative Fishery Research Unit[3], Iowa State University, Ames, Iowa 50011

A survey in July and August 1981 showed aquatic vascular plants in Clear Lake, Iowa, were concentrated in nine major vegetation beds covering a total of 22.6 hectares. Of 24 plant species identified, five were reported for the first time from this lake. The dominant taxa were softstem bulrush, *Scirpus validus*, and hybrid cattail, *Typha glauca*. Maps showing plant distributions and depth contours for the nine vegetation beds are presented. The 1981 community was characterized by emergent plants tolerant of high turbidity.
INDEX DESCRIPTORS: Clear Lake, flora, macrophytes, aquatic plants, species composition.

The aquatic vascular flora of Clear Lake was first described by Shimek (1897). His species list was the result of a 3-day collecting trip in July 1896. Bailey and Harrison (1945) briefly described the littoral vegetation in a report on Clear Lake fisheries. Since that time four other descriptions of the aquatic flora have been given as adjuncts to fishery research (Parsons 1950, Pearcy 1952, Ridenhour 1958, Mrachek 1966). All these studies were largely qualitative. The present study is the first attempt to quantitatively describe the distribution and abundance of each plant species, thus creating a data base for future research and management evaluation.

DESCRIPTION OF CLEAR LAKE

Clear Lake is a shallow, eutrophic lake in western Cerro Gordo County, north-central Iowa. It lies in the lateral moraine of the Mankato lobe of the Wisconsin glaciation (Bailey and Harrison 1945). It covers 1,474 hectares and is the third largest natural lake in Iowa. It has a watershed of only 3,548 hectares with mean and maximum depths of 2.9 and 6 m, respectively (Bachmann et al. 1980). Bailey and Harrison (1945) described several other characteristics: of the surface area, 13% is less than 1.5 m in depth, 22% is 1.5 to 3 m deep, 50% 3 to 4.5 m, and 15% exceeds 4.5 m; the lake is 7.7 km long and has a maximum width of 3.2 km. Subsurface inlets are presumed significant because, except in dry years, the water level remains at or near the outlet level.

In the early 1940's about 42% of the shoreline was occupied by private residences and cottages; 29% by woodland; 20% by resorts, cabins, and commercial establishments; 8% by roadsides, grassland, and miscellaneous; and 1% by marsh (Bailey and Harrison 1945). In 1981, the proportion occupied by residences was even greater. Most of the lake's margin is a narrow, sandy beach. The substrate in shallow water areas consists mainly of fine sand, which grades into soft organic bottom at about the 1.8-m contour (Bailey and Harrison 1945).

The lake does not thermally stratify during the summer because of the shallow depth and wind action (Pearcy 1952). The maximum water temperature is around 30°C in August.

Pearcy (1952) found that Secchi disc readings during the summer averaged about 1.5m. Sources of turbidity were mainly plankton and suspended soil particles. Bachmann et al. (1980) reported a Secchi depth of 0.7 m in the summer of 1979. In 1981 the turbidity appeared to be greater with Secchi disc readings of less than 0.3 m being common.

METHODS

Two surveys of aquatic vegetation were made during July and August 1981. Transects perpendicular from the shore to the outermost boundary of the vegetation zone were established at 20-m intervals in July and at 40-m intervals in August through each of the major vegetation beds. Vegetation was evaluated in 1-m^2 quadrats at 20-m intervals along each transect. Water depth, substrate type, and distance to shore were recorded, along with the taxa seen. When applicable, information was taken on the condition of the vegetation and habitat, particularly in areas where the activities of muskrats or man had damaged the vegetation beds.

Distribution maps were constructed from aerial photographs taken in 1980 and from data collected in 1981. Photographs were used to ascertain the shape and orientation of each bed. Since the shoreline adjacent to each bed was approximately straight, maps were drawn with a straight line to represent the shoreline. All measurements to features within plant beds were made perpendicular to the general curve of the shoreline. All plant and water-depth data were taken from the 1981 surveys, as were bed dimensions. Different species were indicated on maps by symbols and types of shading (Fig. 1). Total areas were determined for those species indicated by shading. Species designated by symbols usually consisted of solitary plants or represented very small numbers of species, and measurement from the maps therefore was not practical. Some taxa, such as *Scirpus* species, were lumped together in the mapping procedure due to difficulties in their identification. Depth contours were drawn for each vegetation bed. Only the map for the McIntosh East vegetation bed (Fig. 2) was incomplete; an outer bed of *Scirpus* (0.8 ha) was not measured.

RESULTS AND DISCUSSION

A total of 1,418 quadrats were sampled in 1981 in nine vegetation beds (Fig. 1). The total area of the vegetation in 1981 (as measured by planimetry) was 22.6 hectares (Table 1). The dominant plant taxon (*Scirpus*) covered a total of 18.6 hectares. Bulrushes and cattails were clumped in dense beds near the shoreline, primarily at the western end of Clear Lake. Plant distribution maps for all nine beds and their depth contours in centimeters are illustrated in Fig. 3-9.

A total of 24 species of aquatic vascular plants were found in 1981 (Table 2). The relative abundance of submersed, emergent, and floating-leaved macrophytes was determined. The Clear Lake flora was dominated by two species, softstem bulrush (*Scirpus validus*) and hybrid cattail (*Typha glauca*). All other species were much less abundant.

Submersed Vegetation

Potamogeton nodosus was the most common of three *Potamogeton* species found in 1981. As reported by Pearcy (1952), it was common-

[1]Journal Paper No. J-11028 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 2345. Financed by a grant from the U.S. Department of the Interior Office of Water Research and Technology through the Iowa State Water Resources Research Institute and Iowa State University.

[2]Present address: Wyoming Cooperative Fish and Wildlife Research Unit, Box 3166 University Station, Laramie, Wyoming 82071

[3]The Unit is jointly supported by Iowa State University, the Iowa Conservation Commission, and the U.S. Fish and Wildlife Service.

ly found on the shore side of bulrushes along the north shore of the lake. Scattered specimens were found in the west end of the Farmer's Beach area near shore and in sparse beds off Ventura Heights (Fig. 2) in the southwest end of the lake.

Potamogeton pectinatus was found primarily near shore along the north side of the lake. Pearcy (1952) reported this species to be very abundant in the west end of the lake, but it was represented only by scattered plants in the Ventura Heights area in 1981.

Potamogeton illinoensis was found on the east and west sides of the point extending south from McIntosh Woods State Park. It was reported to be widely distributed about the lake by Pearcy (1952).

Ceratophyllum demersum was found at one site on the south shore of the lake. A single strand was found entangled in a *Scirpus* stem on the east edge of the Farmer's Beach bed. Because a small marsh adjacent to the Farmer's Beach site contained *Ceratophyllum,* we assumed that the specimen washed out of the marsh area into the lake.

One plant species not previously reported was *Utricularia vulgaris.* It was found west of the point extending south from McIntosh Woods in an open area of the Black Rushes, in water about 1-m deep.

Floating-leaved Vegetation

Nymphaea tuberosa and *Nuphar advena* were commonly found in water 1-m deep in the McIntosh East and West vegetation beds and in the Black Rushes. Overall, *Nymphaea tuberosa* was more abundant than *Nuphar advena.*

Lemna minor and *Wolffia columbiana* were found in sheltered areas on the north and west sides of the lake.

Polygonum coccineum was not found in 1981, but in a brief survey in late July 1982 it was common in water less than 0.5 m deep in the Ventura Heights area at the southwest end of the lake. *Polygonum amphibium* was found in one quadrat located in the western portion of the Black Rushes.

Emergent Vegetation

Three species of cattail were found in Clear Lake. *Typha latifolia,* the common cattail, was found in muck substrates at water depths of less than 0.5 m in the Kaster's Kove vegetation bed on the west side of McIntosh Woods and on the west side of the point extending south from McIntosh Woods. A few scattered plants were noted in the shallows of the Ventura Condominium bed in the northwestern part of the lake. *Typha angustifolia,* the narrow-leafed cattail, was found scattered in deeper water in the Kaster's Kove, McIntosh West, McIntosh East, Baptist Camp, Black Rushes, North Shore, and South Bay beds. The most abundant cattail was *Typha glauca* Godr., a hybrid between *Typha latifolia* and *T. angustifolia.* It was found in every vegetation bed surveyed except for the Farmer's Beach site. *Typha glauca* had not been reported in Clear Lake before 1981. The spread of *Typha* in Clear Lake seems to have occurred rapidly. A plant distribution map drawn by Pearcy (1952) showed only a few stands of *Typha latifolia* along the north shore of the lake, primarily in the Black Rushes and McIntosh East. Mrachek's 1966 distribution map showed *Typha* restricted to the Ventura Condominium bed and a small area of the North Shore bed; it was lacking in the Black Rushes. In 1981, *Typha* covered more than 5.9 hectares.

Carex comosa was found growing in shallow water on the shore side of the rushes along the north shore of the lake and along the west shore of McIntosh Woods State Park. *Carex* was found as solitary plants growing in deep muck substrates.

Salix interior, the sandbar willow, was found in scattered locations along the shore of the lake. *Salix* suckers were not found in waters deeper than 0.3m.

Phragmites communis was reported from two locations, McIntosh West and North Shore vegetation beds. The substrate at both sites was primarily sand.

Bidens cernua was noted in September 1981, flowering on floating vegetation mats in the shallow waters off the east side of McIntosh Woods and the Black Rushes.

Other marginal emergent plants found growing in Kaster's Kove, McIntosh West, and McIntosh East vegetation beds were *Sagittaria latifolia, Cyperus* sp., and *Eleocharis palustris.* Muskrat feeding evidently eliminated most of the *Sagittaria* early in the growing season, and only a few mature plants were noted in the fall.

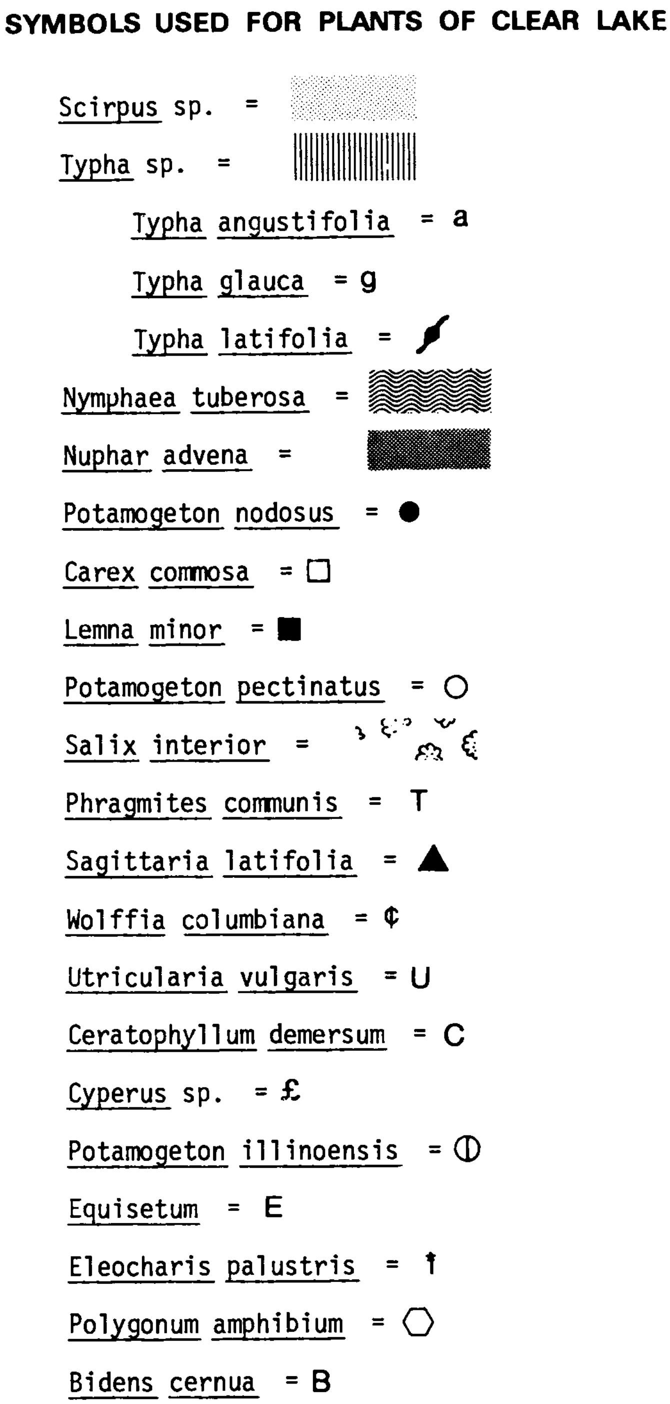


Fig. 1. Symbols and shading used to identify various plant taxa in Figures 3-13. Contours shown in Figures 3-13 are in centimeters.

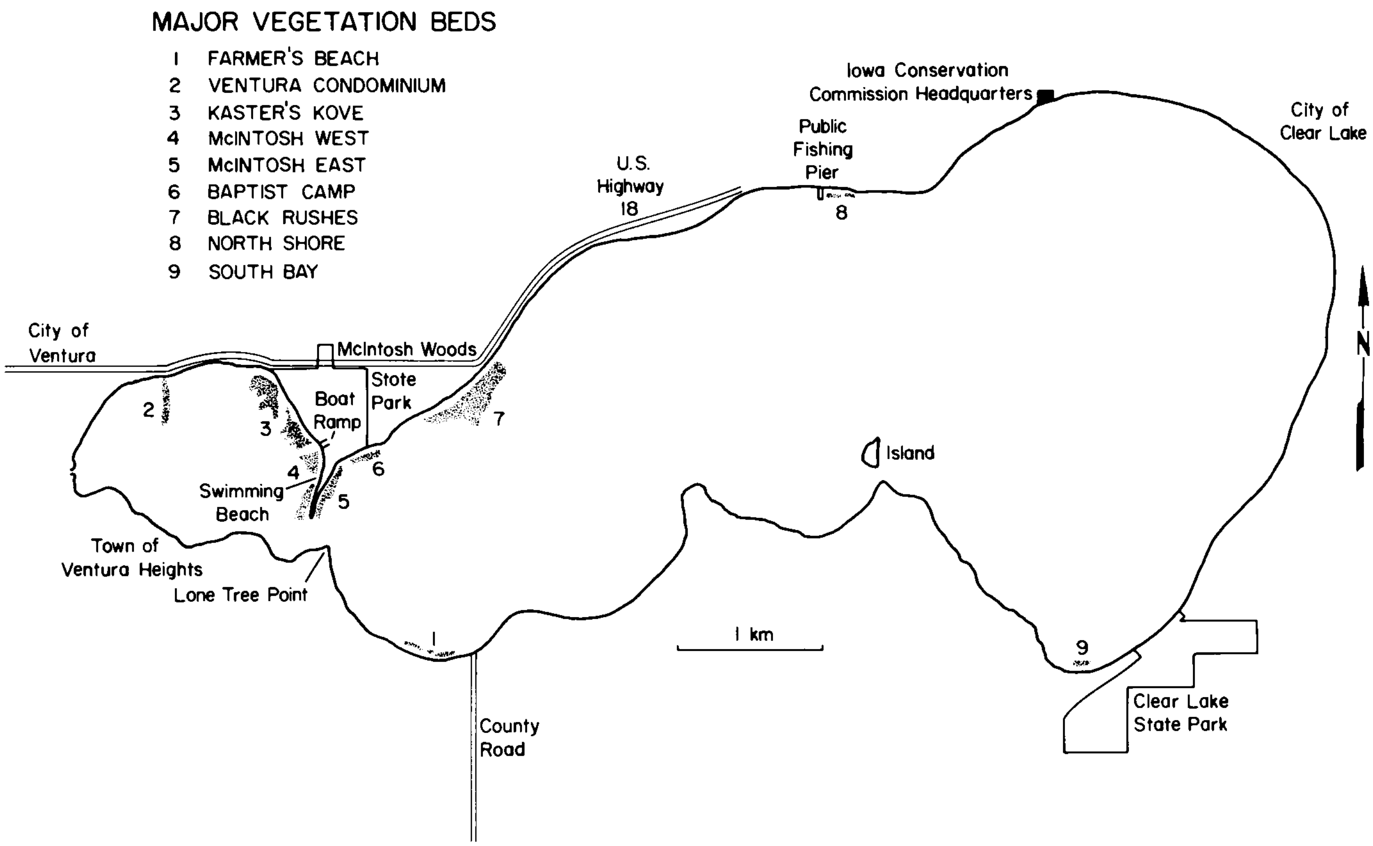


Fig. 2. Clear Lake, Iowa, showing the location of the nine major vegetation beds surveyed in 1981.

Equisetum sp. was found in one location in 1981. A small stand was located off the west side of the McIntosh Point in shallow water.

Scirpus was the most abundant genus found in Clear Lake during the survey. Two species, *Scirpus validus*, the softstem bulrush, and *S. acutus*, the hardstem bulrush, were distributed lakewide. The two species are difficult to identify in the field, and there is some question as to whether they are separable (Koyama 1958; Boivin 1967; Miller and Beal 1972). Dabbs (1971) found that many of the criteria used to identify the two species in the field, such as hardness of the culm, stem color, and even inflorescence form, were sound diagnostic characteristics. Problems of identification were compounded when it was discovered that the two species hybridize (Dabbs 1971). The hybrid plants display a number of intermediate characteristics between the parent species. Dabbs (1971) and Fernald (1950) advocated using floral scale lengths and relative lengths of floral scales to differentiate the two species.

The history of *Scirpus* in Clear Lake is confusing. Bailey and Harrison (1945) reported *S. acutus* as being very abundant, but did not mention *S. validus*. Just 5 years later, Parsons (1950) found only *S. validus*, but no *S. acutus* present. Since 1950, only *S. validus* has been reported from Clear Lake, although clear examples of both species were collected in 1981.

Scirpus validus tends to grow in shallower water than does *S. acutus* (Dabbs 1971). Dabbs found that the mean depth for *S. validus* was 43 cm, whereas *S. acutus* grew a mean depth of 109 cm in the Saskatchewan River Delta. He stated that *S. acutus* frequently was

Table 1. Total area (hectares) and areas covered by the dominant plant forms in each of the nine major vegetation beds surveyed in Clear Lake, Iowa, 1981.

Vegetation beds	Total Area	Plant species			
		Scirpus	*Typha*	*Nymphaea tuberosa*	*Nuphar advena*
Farmer's Beach	1.67	1.67	—	—	—
Ventura Condominium	2.33	0.62	1.75	—	—
Kaster's Kove	5.48	3.29	2.37	0.25	0.13
McIntosh West	2.32	2.32	0.24	0.01	0.01
McIntosh East	2.88	2.89	0.31	0.13	—
Baptist Camp	0.47	0.47	0.09	—	—
Black Rushes	5.09	5.09	0.69	0.93	0.56
North Shore	1.75	1.74	0.02	—	—
South Bay	0.63	0.55	0.45	—	—
TOTAL	22.60	18.64	6.92	1.32	0.69

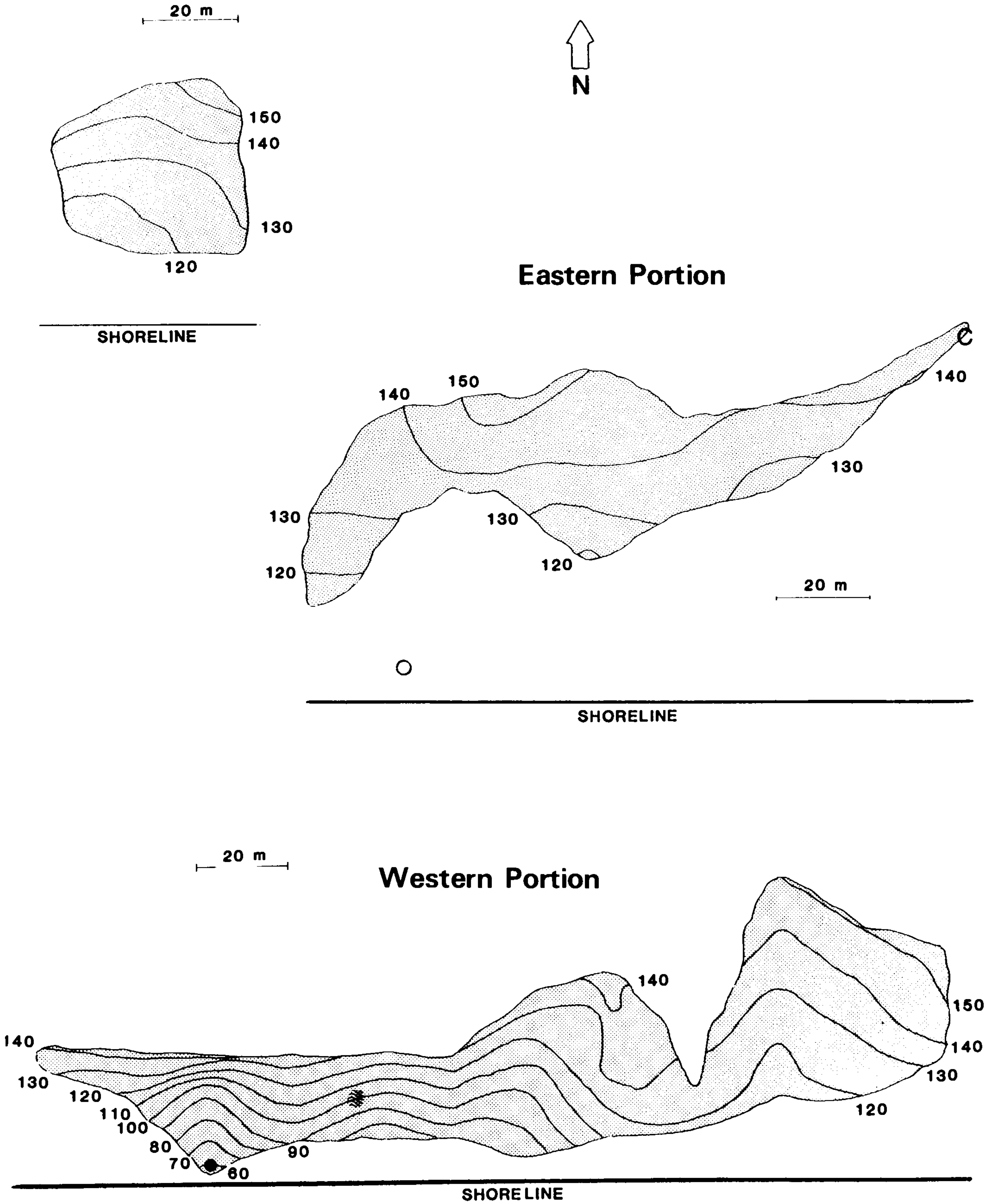


Fig. 3. Farmer's Beach vegetation bed, summer 1981. Depth contours in centimeters.

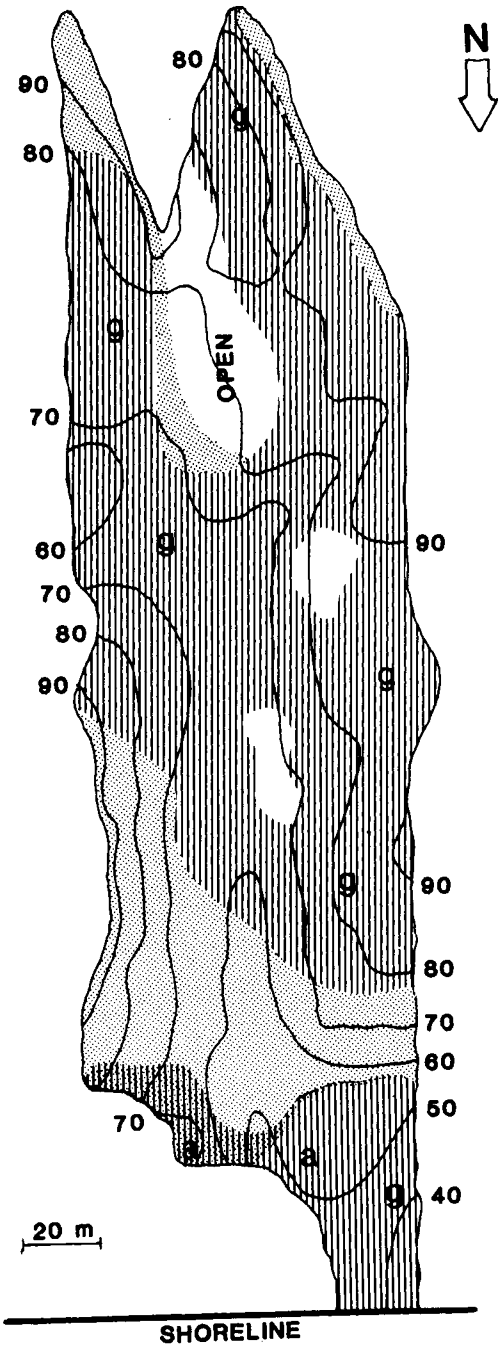


Fig. 4 Ventura Condominium vegetation bed, summer 1981. Depth contours in centimeters.

found in depths up to 150 cm. Dabbs reported that the two species overlap in water depths of 60 to 65 cm. Fassett (1975) reported that *S. validus* preferred water depths of "several feet." *Scirpus* in Clear Lake grew to a depth of 1.6 m. From this information, one would tend to believe that the plants we found growing at this depth were *S. acutus* rather than *S. validus*, the name they have carried for the past 37 years. Possibly the species has long been misidentified. A number of the characteristics of these deep-water plants seem to be intermediate between the two species, raising the possibility that they are hybrid plants. The shift from *Scirpus acutus* in 1945 to *S. validus* in 1949 is a possibility. Dabbs (1971) reported such a shift of *Scirpus* in reverse order in Big Lake, Saskatchewan.

Twenty-four species of aquatic macrophytes were found in Clear Lake in 1981. Of 52 taxa identified in previous studies (Shimek 1897, Bailey and Harrison 1945, Parsons 1950, Pearcy 1952, Ridenhour 1958, Mrachek 1966), only 19 were found in 1981. Five taxa were found in Clear Lake for the first time: *Equisetum* sp., *Carex comosa*, *Eleocharis palustris*, *Utricularia vulgaris*, and *Bidens cernua*. The diversity of aquatic flora observed in 1981 was not as great as has been previously reported.

In general, the plant community has shifted from one dominated by submersed macrophytes to one dominated by emergent forms (Shimek 1897, Bailey and Harrison 1945). Parsons (1950) stated that submersed vegetation was so abundant in 1945 and 1946 that boating was nearly impossible in the west end of the lake. In 1981, fewer than 23 hectares of emergent macrophytes with very few submergent plants were present at the west end of the lake.

Changes in the aquatic macrophyte community of Clear Lake over the past 85 years can be related to two factors, increased levels of phytoplankton turbidity and water level fluctuation. Reduced light penetration probably has led to a reduction in community diversity especially due to impacts on turbidity intolerant submersed species. No vegetation was found growing at depths greater than 1.6 m in 1981. Pearcy (1952) found vegetation growing at depths down to 4.5 m. The average Secchi disc reading in 1981 was 0.4 m compared to 1.5 m in 1952. Turbidity-tolerant species have become dominant in Clear Lake, while turbidity intolerant species have been reduced in abundance or disappeared.

While Clear Lake is not a marsh, the phenomenon of "marsh habitat cycles" explains some vegetational changes in the lake (Van der Valk and Davis 1978; Weller 1981). Because much of the vegetated portion of Clear Lake is shallow (13% less than 1.5 m) and the lake exhibits a 20-year cycle in water level fluctuation, an explanation for the distribution of Clear Lake's vegetation can be provided in terms of marsh cycles. Clear Lake periodically experiences drought during which water level is reduced and the germination phase can be triggered.

ACKNOWLEDGMENTS

We thank R. R. Mack and D. L. Stang for assistance in the field; M. A. L. Niemeier for photography, field assistance, and critical reading of the manuscript; Kay Klier of the Iowa State University Herbarium for assistance with plant identification; and to the Iowa Conservation Commission for providing facilities and equipment; and the Clear Lake Camp for providing lodging, dock facilities, and a research base during the 1980 and 1981 field seasons.

Table 2. Aquatic macrophytes found in Clear Lake, Iowa, summer 1981, and their percent frequency of occurrence in 1418 quadrats.

Taxa	Occurrence (Percent of total quadrats)
Equisetaceae	
Equisetum	0.07
Typhaceae	
Typha angustifolia L.	1.48
Typha glauca Godr.	19.00
Typha latifolia L.	1.27
Najadaceae	
Potamogeton illinoensis Morong	0.07
Potamogeton nodosus Poir.	0.85
Potamogeton pectinatus L.	0.35
Alismaceae	
Sagittaria latifolia Willd.	0.14
Graminae	
Phragmites communis Trin.	0.21
Cyperaceae	
Carex comosa Boott	0.78
Cyperus sp.	0.07
Eleocharis palustris L.	*
Scirpus acutus Muhl.	0.42
Scirpus validus Vahl.	77.50
Lemnaceae	
Lemna minor L.	0.56
Wolffia columbiana Karst.	0.14
Salicaceae	
Salix interior Rowlee	0.35
Polygonaceae	
Polygonum amphibium L.	*
Polygonum coccineum Muhl.	*
Ceratophyllaceae	
Ceratophyllum demersum L.	0.07
Nymphaeaceae	
Nuphar advena (Ait.)	1.97
Nymphaea tuberosa Paine	2.19
Lentibulariaceae	
Utricularia vulgaris L.	0.07
Compositae	
Bidens cernua L.	*

* Observed in 1981, but not within sampled quadrats.

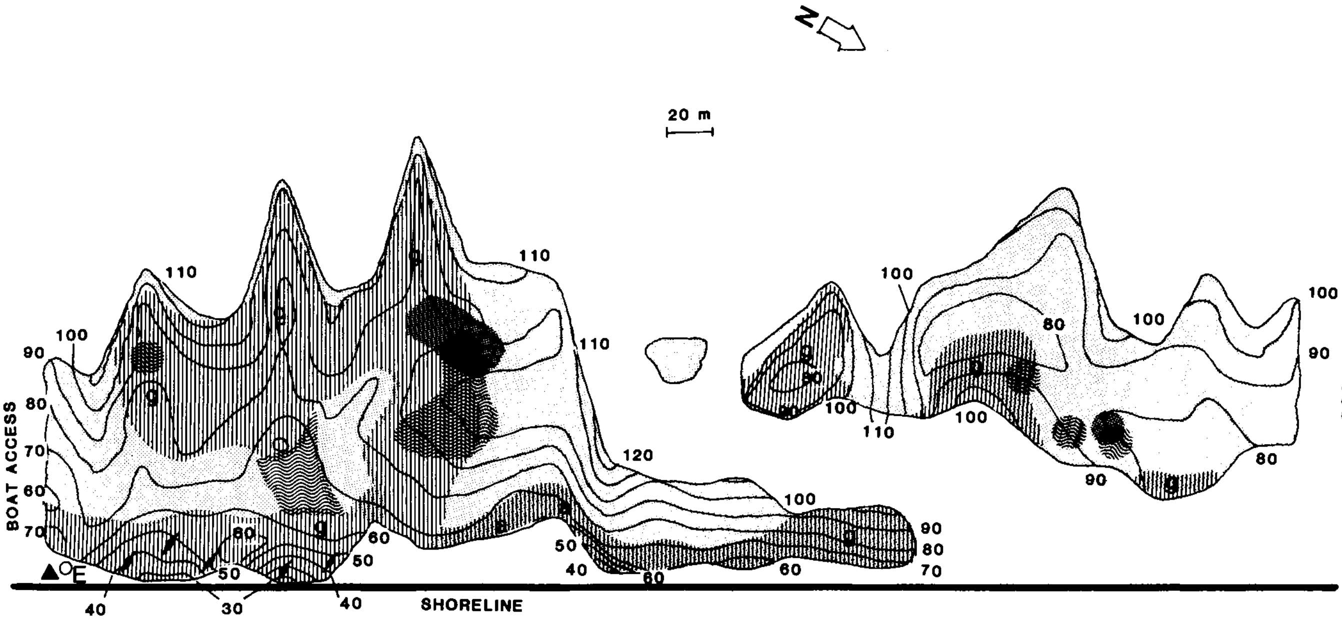


Fig. 5. Kaster's Kove vegetation bed, summer 1981. Depth contours in centimeters.

LITERATURE CITED

BACHMANN, R. W., M. R. JOHNSON, M. V. MOORE, and T. A. NOONAN. 1980. Clean lakes classification study of Iowa's lakes for restoration: final report. Iowa Coop. Fish. Res. Unit and Dept. Animal Ecol., Iowa State Univ., Ames. 715 p.

BAILEY, R. M. and H. H. HARRISON. 1945. The fishes of Clear Lake, Iowa. Iowa State Coll. J. Sci. 20:57-77.

BOIVIN, B. 1967. Enumeration des plantes du Canada. Nat. Can. 74:155.

DABBS, D. L. 1971. A study of *Scirpus acutus* and *Scirpus validus* in the Saskatchewan River delta. Can. J. Bot. 49:143-153.

FASSETT, N. C. 1975. A manual of aquatic plants. Univ. Wisc. Press, Madison. 405 p.

FERNALD, M. L. 1950. Gray's manual of botany. American Book Co., New York. 1632 p.

KOYAMA, T. 1958. Taxonomic study of the genus *Scirpus* Limm. J. Fac. Sci. Univ. Tokyo, Sect. III, Bot. 7:271-366.

MILLER, M. and E. O. BEAL. 1972. *Scirpus validus* and *S. acutus* — a question of distinctness. J. Minn. Acad. Sci. 38:21-23.

MRACHEK, R. J. 1966. Macroscopic invertebrates on the higher aquatic plants at Clear Lake, Iowa. Proc. Iowa Acad. Sci. 73:168-177.

PARSONS, J. W. 1950. The life history of the yellow perch, *Perca flavescens* (Mitchell), of Clear Lake, Iowa. M. S. Thesis, Iowa State Univ., Ames. 55 p.

PEARCY, W. G. 1952. Some limnological features of Clear Lake, Iowa. M.S. Thesis, Iowa State Univ., Ames. 71 p.

RIDENHOUR, R. L. 1958. Ecology of young game fishes of Clear Lake, Iowa. Ph.D. Dissertation, Iowa State Univ., Ames. 119 p.

SHIMEK, B. 1897. Notes on aquatic plants from northern Iowa. Proc. Iowa Acad. Sci. 4(1896):77-81.

VAN DER VALK, A. G. and C. B. DAVIS. 1980. The impact of natural drawdown on the growth of four emergent species in a prairie glacial marsh. Aquat. Bot. 9:301-322.

WELLER, M. W. 1981. Freshwater marshes: ecology and wildlife management. University of Minnesota Press, Minneapolis.

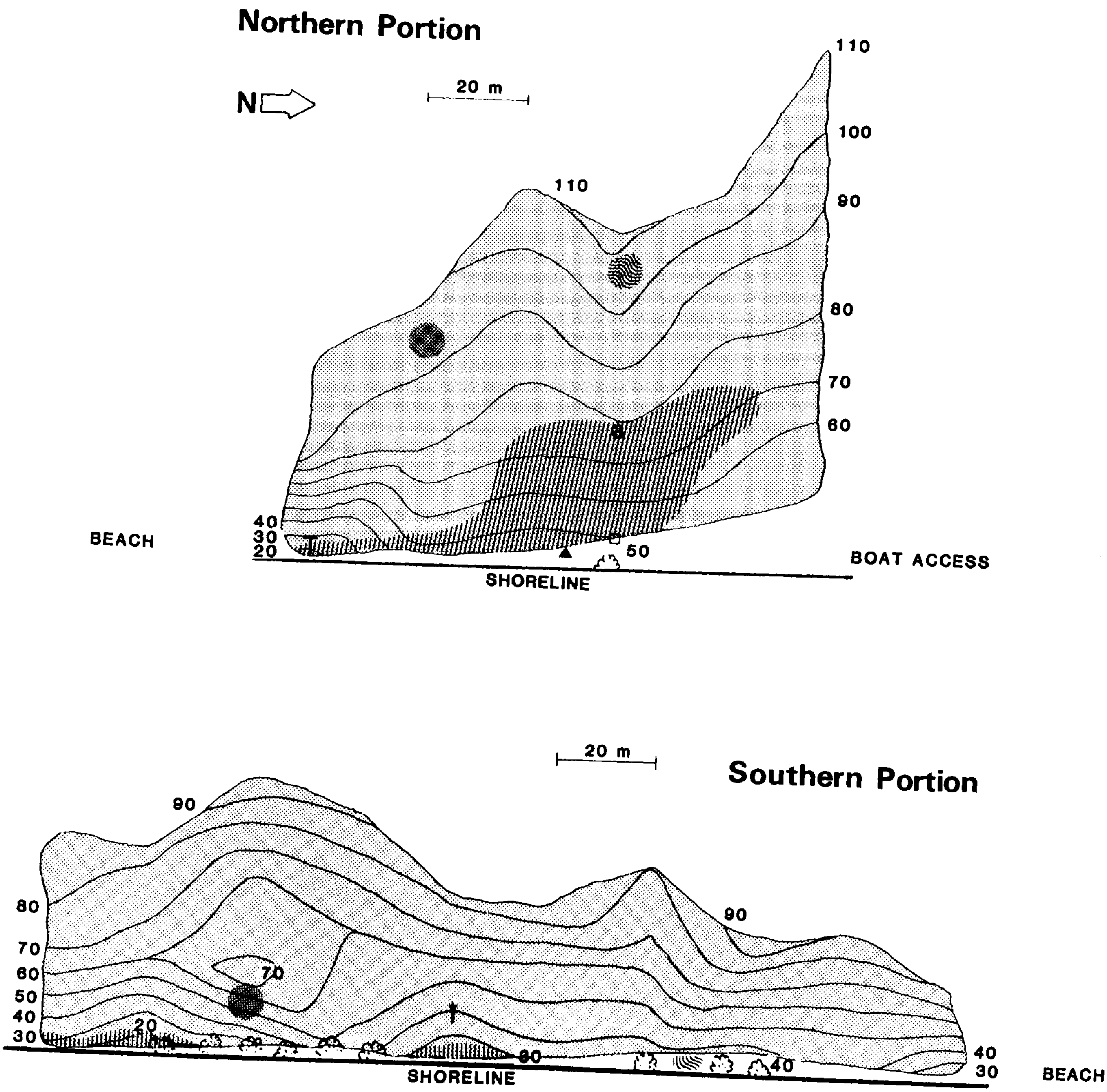


Fig. 6. McIntosh West vegetation bed, summer 1981. Depth contours in centimeters.

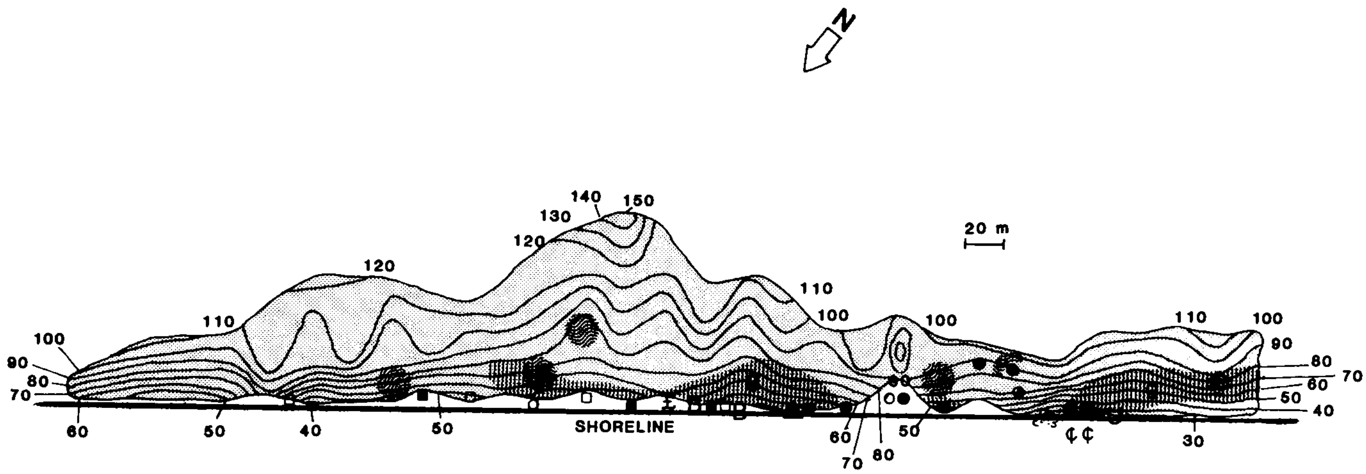
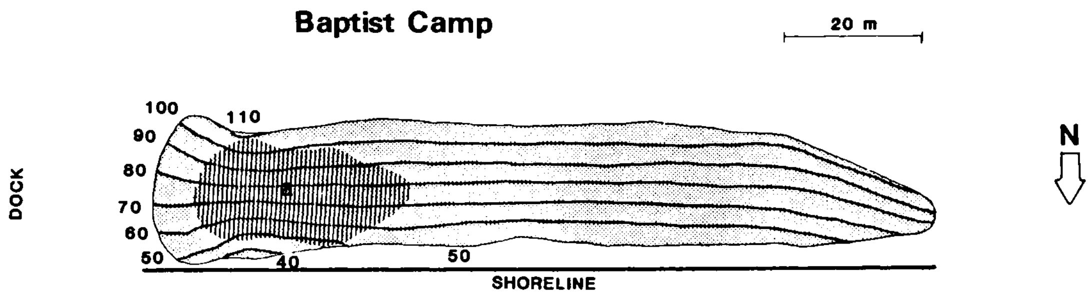


Fig. 7. McIntosh East vegetation bed, summer 1981. Depth contours in centimeters.



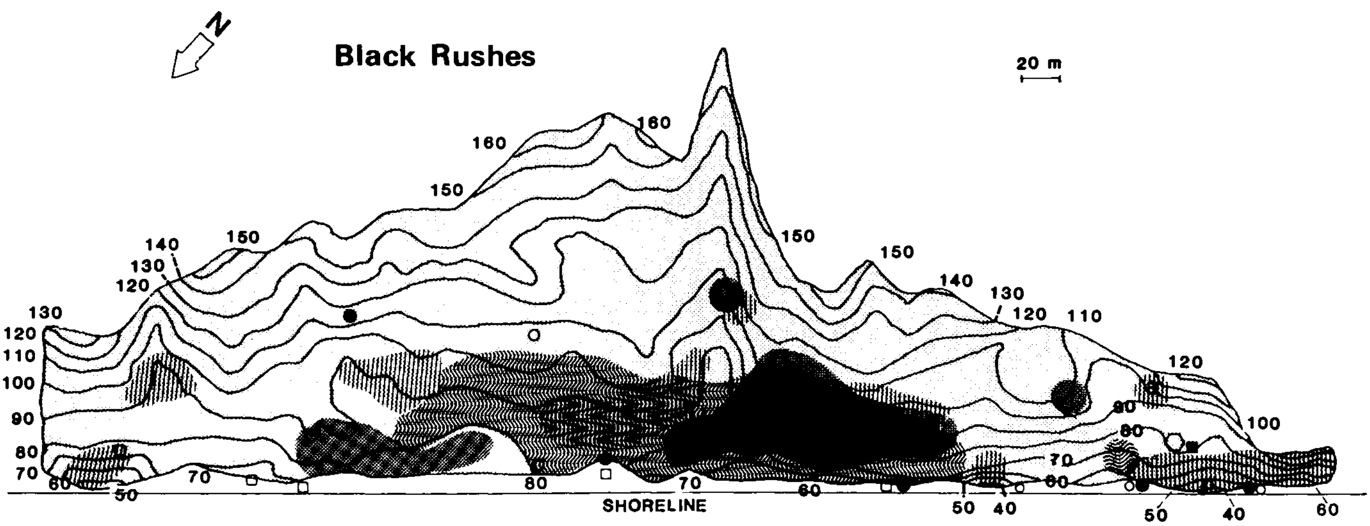


Fig. 8. Baptist Camp and Black Rushes vegetation beds, summer 1981. Depth contours in centimeters.

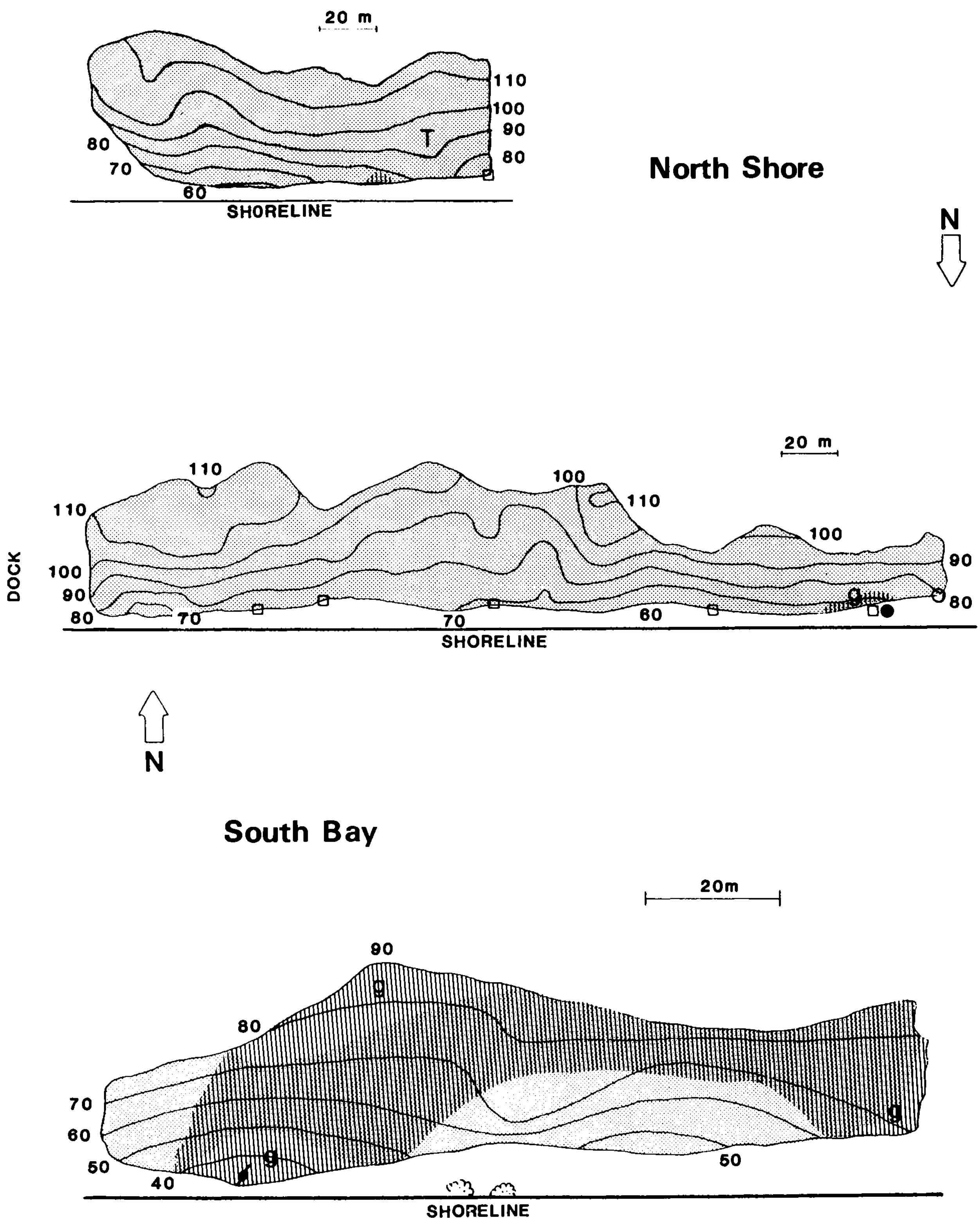


Fig. 9. North Shore and South Bay vegetation beds, summer 1981. Depth contours in centimeters.