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Lake Sediment Alteration for Macrophyte Control

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ABSTRACT

The bottom of Marion Millpond, Wisconsin was partly blanketed with sand, gravel and plastic liners to control macrophytes by altering sediment texture and preventing roots from contacting the sediments to extract nutrients. Other areas were dredged to expose nutrient-poor soil. For the first two summers after treatment, filamentous algae invaded the blankets and *Chara* spread to both dredged and blanketed areas. By the third summer the vegetation changed to broad-leaved pondweeds (*Potamogeton* spp.) on the dredged areas and to najas (*Najas flexilis* (Willd.) Rostk. & Schmidt) and elodea (*Elodea canadensis* Michx.) on the blanketed areas. By the seventh year, all areas were densely covered with coontail (*Ceratophyllum demersum* L.), watermilfoil (*Myriophyllum exalbescens* Fern.) and pondweeds. Dredging and covering sediments, consequently, proved ineffective for long-term vegetation control in the pond.

Key words: coontail, dredging, pondweeds, sediment blanketing, watermilfoil.

INTRODUCTION

Shallow impoundments accumulate fine, nutrient-rich sediments that support abundant aquatic macrophyte growth. Dredging can remove sediments and expose a firmer, more nutrient-deficient soil layer. Covering lake sediments with sand, gravel and plastic liners can restrict nutrient release from the sediments, alter substrate texture, and prevent plant roots from reaching the organic deposits. Dredging and sediment covering were implemented at Marion Millpond, Waupaca County, Wisconsin to test if the techniques would reduce plant growth sufficiently to improve the recreational use of the pond.

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Marion Millpond is a 44 ha pond formed in 1856 by damming a branch of the Pigeon River. The water presently averages 1.6 m deep with a maximum depth of 3.7 m. The alkaline mineral-rich water is stained reddish-brown and supports few phytoplankton (Table 1). Because of nutrient and sediment loading, submersed macrophytes have nearly covered the entire pond since at least the 1930's. Dredging and bottom covering are part of a lake renewal effort, begun in 1969, that included both in-lake and watershed treatments (1).

TABLE 1. WATER QUALITY OF MARION MILLPOND.[a]

Parameters	27 July 1972	25 July 1978
Chlorophyll *a* ($\mu g/l$)	—	7
pH	8.8	8.4
Secchi disk (m)	2.4	2.0
Specific conductance (μmhos/cm)	268	298
Total alkalinity (mg $CaCO_3/l$)	158	167
Total nitrogen (mg N/l)	0.92	1.13
Total phosphorus (mg P/l)	0.03	0.02
True water color (PtCo units)	60	53

[a]Several water samples were averaged for 0-2 m depths in the central pelagic area of the pond.

MATERIALS AND METHODS

Black polyethylene sheeting of 0.1 mm (4 mil) thickness was spread on about 10 ha of the pond in 1970-71. Most liners were located along shore in water less than 2 m deep. Some liners were spread directly on the frozen bottom during winter drawdown; however, most liners were stretched on the pond ice after partly refilling the basin. Dropping the water level then lowered the sheeting to the bottom (1). All liners were perforated to release trapped gases and then covered with 7 to 20 cm of sand, gravel, or a mixture of sand and gravel. Several adjacent areas received the same amount of sand and gravel, but remained unlined

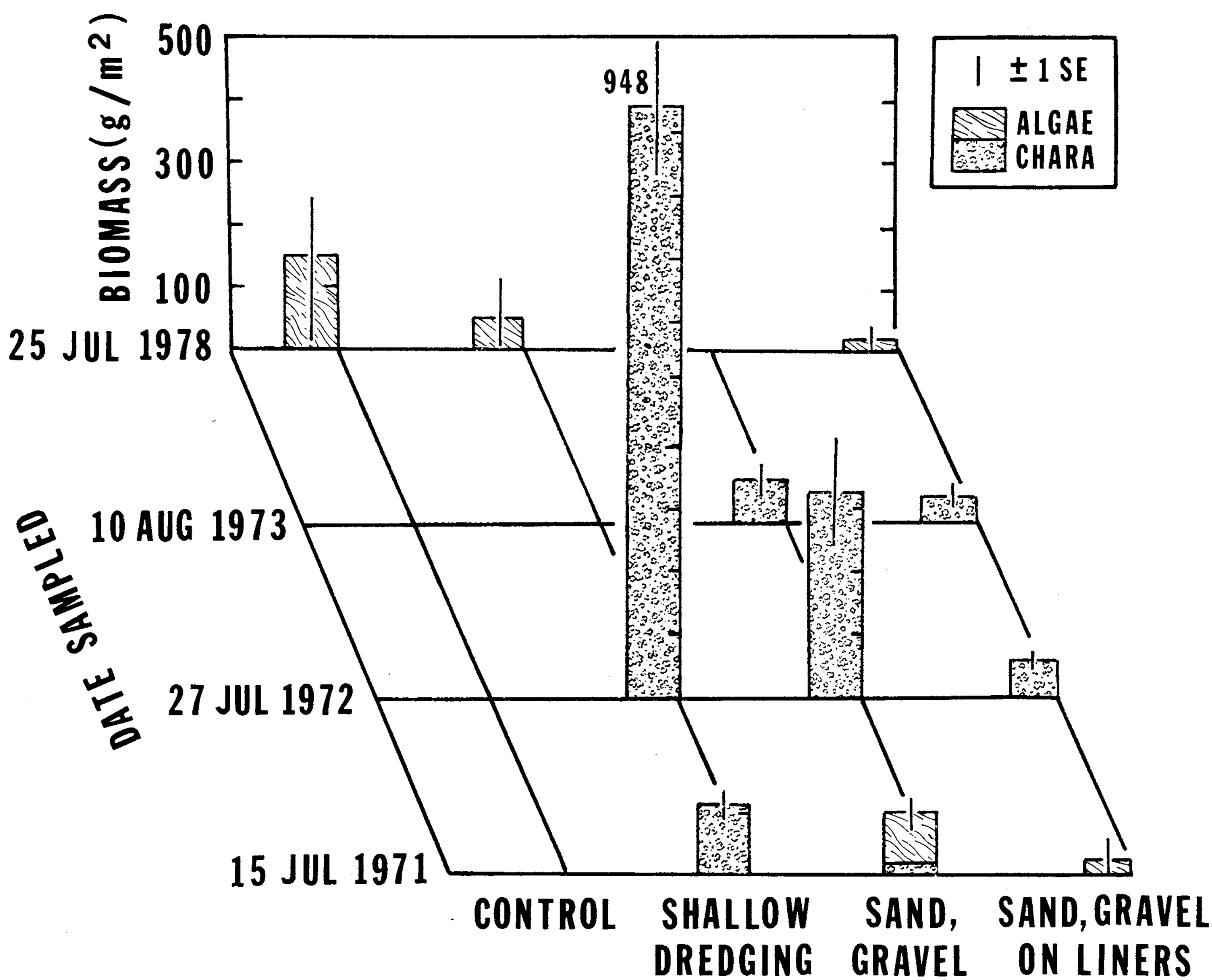

Figure 1. Mean dry-weight biomass of *Chara* spp. and filamentous green algae on control and treated areas of Marion Millpond. Sediment blankets (treatments) were installed in the winter of 1970-71.

with plastic. An area along shore was dredged to remove organic sediment and expose an underlying sand bottom, but remained uncovered with additional sand, gravel or plastic.

Plants were sampled in July and August of 1971 through 1973 and again in July of 1978. Divers collected 10 random samples from each treated and untreated area. Each sampling plot covered an area of 0.1, 0.2 or 1.0 m², depending on plant abundance. Vascular plants were identified from Fassett (2) and their plant densities were determined by counting basal stems. Biomass of filamentous algae and chara (*Chara* spp.) were determined by drying collected samples in an oven at 60 C for 48 hours before weighing.

RESULTS AND DISCUSSION

Chara and filamentous green algae quickly invaded the treated areas (Figure 1). In 1971, dredged areas had an average dry-weight biomass of 100 g/m² of chara; unlined blankets (sand and gravel only) had about 80 g/m² of filamentous algae. In 1972, chara replaced filamentous algae and reached 325 g/m² on unlined blankets and 60 g/m² on lined ones. Treated areas supported little chara and algae after 1972.

Initial high densities of vascular plants in 1971 (Figure 2) were due to clumps of emergent plants, chiefly arrowhead (*Sagittaria* spp.), spikerush (*Eleocharis robbinsii* Oakes), and stonecrop (*Penthorum sedoides* L.). These species grew rapidly inshore on control and dredged areas exposed by the drawdown. They disappeared in 1972 when the pond became completely flooded.

Submersed macrophytes spread to all treatment areas by 1973. Control plots supported mostly American pondweed (*Potamogeton nodosus* Poir.) with a mean density of 130 stems/m². Dredged areas contained mostly floating-leaf pondweed (*P. natans* L.) at 220 stems/m². The blankets supported a denser and more varied composition of vascular plants than did the control and dredged areas. Najas and elodea comprised about 85% of plants on the blankets; American pondweed and coontail comprised most of the remaining plants. Lined blankets had a mean density of about 400 stems/m²; unlined blankets averaged about 150 stems/m².

By 1978, all areas were overgrown with coontail, broad-leaved pondweeds, and watermilfoil. Total plant densities averaged nearly 300 stems/m² for all areas; total dry-weight biomass was about 600 g/m². Coontail comprised about 75%

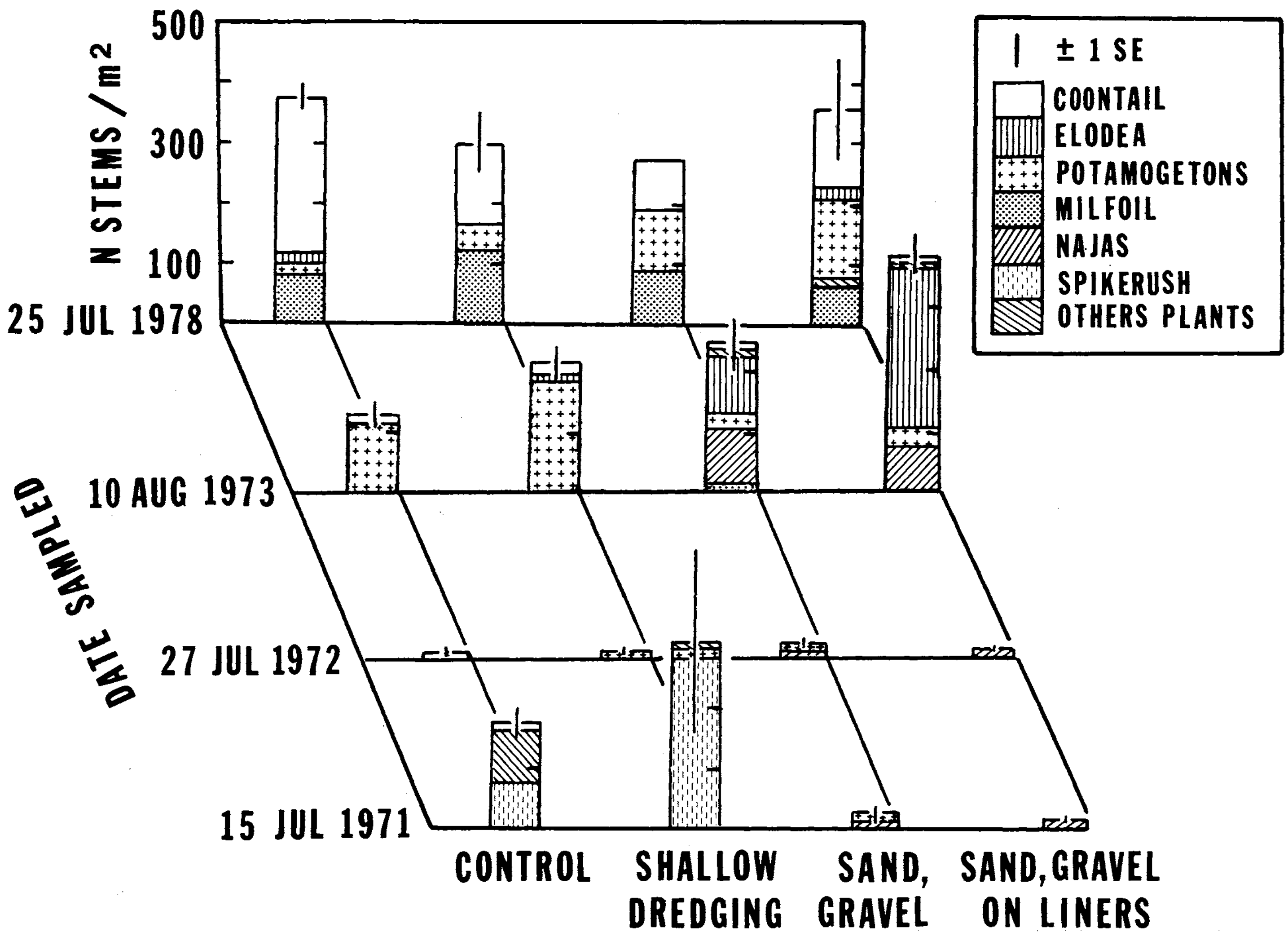

Figure 2. Mean stem density of vascular plant species on control and treated areas of Marion Millpond.

of the plant density on control plots, 45% on dredged areas, and 35% on blankets. Pondweeds accounted for only about 10% of the plant density on control and dredged areas, but over 35% on blankets. Floating-leaf pondweed was the most important pondweed on control and dredged areas; whitestem pondweed (*P. praelongus* Wulf.) was the most important pondweed on blankets. Watermilfoil grew at about 100 stems/m^2 on all areas.

We conclude that blanketing and shallow dredging were ineffective at controlling aquatic plants in Marion Millpond. Chara and filamentous algae, lacking roots, rapidly invaded all blankets and the mineral soil exposed by the dredging. Submersed vascular plants may require organic sediments for rooting and nutrient uptake, however. Although the submersed plants invaded the treated areas more slowly, growth was still rapid enough to render these techniques useless as long-term management options. Removable blankets might work better than fixed blankets by permitting occasional cleaning (3).

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