The Remarkable Recovery of Submerged Vegetation in Irondequoit Bay

By: Herman S. Forest
September 1987
The Remarkable Recovery of Submersed Vegetation
In Irondequoit Bay*

by
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Summary.

Submersed aquatic plants are indicators of water quality. Over a period of years, their occurrence, distribution, and growth pattern reflect pollution and other changes. Today, Irondequoit Bay supports eleven species of rooted aquatic plants, nine of them native. The low point in species diversity was 1970-71 when only four species, two native and two introduced, remained in the Bay. With improvement in water quality, species began to reenter, and by 1980 eight were counted. In 1986 the water buttercup was recorded for the first time since 1924, and in 1987 two additional rooted aquatics appeared which had last been collected in 1915 and 1924. The recovery of the community of rooted aquatic plants indicates that Irondequoit Bay is becoming a cleaner body of water. Nevertheless, without additional pollution control measures, water quality will decline again in the future.

*RCSI presents with pride a Bulletin which Dr. Forest describes as a record unique to lake ecology. No similar pattern of loss and recovery of rooted aquatics, he says, has ever been published. The credit for the recovery goes to the New York State ban on phosphate in detergents, the Pure Waters Program, and the Alum Project.
Background

Macrophytes, rooted aquatic vascular plants, and aquatic flowering plants are all names for submerged vegetation. These plants are useful as indicators of the condition of a lake. They are long lived (compared with algae), stationary (unlike most animals), and they can be preserved for future reference. Because some are more sensitive to polluted conditions than others, the macrophyte community can serve as a continuously monitoring instrument which responds to many environmental factors at once (1).

Where the Information Came From

The author of this Bulletin has been working for many years to document the relationship between species diversity of submerged aquatic plants and pollution. Systematic collections have been made from regional water since 1967 and from Irondequoit Bay from 1969 to the present. The only other comprehensive study of Irondequoit Bay was made by Dr. R.T. Clausen of Cornell in 1939 (2). This report includes a complete review of publications and examination of specimens from herbaria in Rochester, Buffalo, Albany and Ithaca (3). The record extends back over a century.

Irondequoit Bay - To the Brink and Back

There are twelve common species in area waters. All have been reported in Irondequoit Bay and it is assumed that all lived there together for some time over the past 100 years. Actually, sixteen native species are known to have lived in the Bay but not all at the same time. By 1939 seven native species remained, and one European species, crisped pondweed, had invaded. In 1969 only four native species remained and a second introduced species, spikate or Eurasian milfoil, had become established. Based on information from other regional waters, it is probable that this milfoil entered in the late fifties or early sixties. Species loss continued until 1970-71 when only four species remained, two of them native: sago pondweed and coontail (3).

With the ban of phosphate in detergents in 1973 and implementation of the Pure Waters Program, the water quality started to improve (4). The improvement in water chemistry was quickly reflected by the re-entry of submerged aquatic species into the Bay. This was the beginning of a record unique to science; no similar pattern of loss and recovery of rooted aquatic species has ever been published. By 1975-76 the species total was again six, and in 1977 narrow leafed pondweed was found for the first time since observations by the author began in 1969 (5). In 1986 water buttercup was found (1). Water buttercup had been collected in 1924, but not in 1939. In 1987 two more species were found, Richardson's pondweed and eel grass. Previous specimens had last been collected, respectively, in 1924 and in 1915. The total is now 11 species.

Species Diversity and Fertilization with Phosphate

The loss of species over the years in five lakes and two bays is plotted against phosphorus loading in Figure 1. The totals used were based on the cumulative record including preserved specimens and new collections (6). Irondequoit Bay is followed for more years than the other lakes. Measurements of phosphorus and species count were not necessarily done at the same time. Although the experimental setup is not precise, the record is unmistakable; the higher the phosphorus loading the fewer species survived.
Phosphorus loading and species loss in 2 bays and 5 lakes

Figure 1. Phosphorus loading data in grams of phosphorus per year per cubic meter of water, were obtained principally from Stewart and Markello (7). Current data on Irondequoit Bay were kindly supplied by T. T. Bannister. Regression line $R = 0.91$

Sediments and Algae Help to Evict Rooted Aquatics

Phosphorus in water is an indicator of the extent of pollution. It is not the direct cause of eviction of aquatic plants. Decrease of light can be a more direct cause. Light can be decreased by suspended particles which may carry phosphorus, or by a heavier crop of algae fertilized by phosphorus. The decrease in light contributes to the disappearance of light-dependent rooted aquatics. On the other hand, when water is clear and phosphate scarce, the available phosphate is preempted by rooted aquatic plants, and algae are limited by their more restricted diet.

Dr. T. Bannister of the University of Rochester, who has been studying the Bay since the Pure Waters project started, predicted that there would be a threshold effect for light; water clarity would improve markedly when suspended particles and phosphorus dropped below a critical level. The marked increase in species of submerged aquatic plants is a biological confirmation of the prediction. Irondequoit Bay appears to have crossed the water clarity threshold.

The Water in the Beds is Clearest of All

Shape and size of a lake and distribution of hospitable bottom sediments are also important in the reestablishment of a healthy flora. The plants themselves stabilize the bottom by rooting there in large enough numbers. Within the beds themselves,
there is evidence that the plants increase the clarity of the water beyond that in the open bay, thereby aiding their own further growth. In 1986 plants were found in some of the coves on the west side of the Bay growing at a depth of 7 feet (2.1 meters). This is about 2 feet (0.6 meters) deeper than they have ever grown there before (1). There is also an element of chance in which seeds are available to take root at any given time. The beds of rooted aquatic plants in the Bay have increased in area, depth and crop size (or amount) as well as in species composition during the last few years. Another evidence of increasing transparency is the change in growth pattern of individual plants. Many plants now show leaf growth beneath the water surface.

**Dredging had a Definite Effect**

In 1985 a navigable channel was dredged between Irondequoit Bay and Lake Ontario. The dredgings were placed behind a dike which later failed (9). A bed of rooted aquatics at the northwest end of the Bay was largely destroyed by contamination of the water when the dike failed.

Interestingly, the eel grass that returned to the bay in 1987 has rooted in that area, but closer to the outlet where historically the water has been a bit clearer than in most of the Bay.

**Conclusion**

Irondequoit Bay water is becoming clearer, and the number of rooted aquatic plant species is increasing. The area covered and the depth of growth are also increasing. These are measures of cleanliness. The latest two species arrived in 1987, a year after alum treatment greatly increased the clarity of the water (9). Changes in submerged vegetation reinforce other evidence that water quality in the Bay is improved. The aquatic community has not yet recovered to the level of most regional lakes. Further improvement may be observed in the near future because a threshold has been crossed which permits some additional species to grow well. In the longer time period, however, improvement may give way to degradation unless further measures are taken to control the inflow of pollution from non-point sources.

**References**

(1) Forest, H.S. "Aquatic Vegetation in Irondequoit Bay, Monroe County, New York" Report to the Environmental Health Laboratory, Monroe County Department of Health, 1986


(4) Bannister, T.T. "Irondequoit Bay Improves after Detergent Ban (1973) and Sewage Diversion (1978-80)" Unpublished manuscript orally presented at symposium "Lake Ecology - Lake Management: The New Perspective" May 27, 1984

(6) Kimber, Anne. "The Importance of Aquatic Plants in the Western Finger Lakes Region" RCSI Bulletin No. 207, June 1977

Although the data are now out of date, the fundamental ideas are valid. This is probably the best source of information on local submersed plants in relation to water quality. It was completed under a Margaret Mead Undergraduate Internship awarded by the Scientists Institute for Public Information.


(8) Berg, O. "Disposal of Dredgings and Building a Wetland Behind a Dike: The Case of Irondequoit Bay" RCSI Bulletin No. 294, 1987

### ROOTED AQUATIC SPECIES REPORTED FROM IRONDEQUOIT BAY 1865-1987

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### TOTAL NUMBER OF SPECIES

### NUMBER OF NATIVE SPECIES

### NUMBER OF INTRODUCED SPECIES

### GENUS NAME | SPECIES NAME | COMMON NAME
--- | --- | ---
**NATIVE**
* Ceratophyllum demersum | Coontail
* Elodea canadensis | Elodea
* Myriophyllum exalbescens | Northern milfoil
* Najas flexilis | Niad
* Potamogeton freisi | Fries' pondweed
* Potamogeton illinoiensis | Illinois pondweed
* Potamogeton nodosus | Knotty pondweed
* Potamogeton pectinatus | Sago pondweed
* Potamogeton richardsonii | Richardson's pondweed
* Potamogeton pusillus L. | Narrow leafed pondweed
* Potamogeton zostericornis | Flat stemmed p.w.
* Ranunculus aquatilius L | Water buttercup
* Vallisneria americana | Eel grass
* Zosterella dubia | Water star flower

**INTRODUCED SPECIES**
* Myriophyllum spicatum | Spicale milfoil
* Potamogetum crispus | Crisped pondweed

**SPECIMEN** = ONE PLANT PRESERVED AND MARKED WITH PLACE AND DATE OF COLLECTION

**SURVEY** = THE COLLECTIONS FROM 1939 ON WERE MADE TO INCLUDE ALL THE KINDS OF ROOTED AQUATICS IN THE BAY AT THE TIME OF COLLECTION

* = SPECIES COMMON IN ALL THE LAKES IN THE AREA. ALL 12 HAVE BEEN REPORTED FROM IRONDEQUOIT BAY.