

MATERIALS AND METHODS

MACROZOOBENTHOS

A total of 756 macrozoobenthos samples were collected with a standard Ponar grab (484 cm²) along 21 transects in the St. Clair River, Lake St. Clair, and the Detroit River (Fig. 3; Appendix A). The sampling locations were considered to be areas most likely to be affected by ice scour or vessel passage during winter navigation. Triplicate samples were taken at each of three stations on each transect in May and October in 1983 and 1984. Stations were located on the sloping side of the shipping channel (channel stations), immediately adjacent to the channel on the crest of the channel slope (near-channel stations), and between the crest of the channel slope and the adjacent shoreline (off-channel stations). Sampling was most difficult on the channel slope because the hard, current-swept bottom could not be sampled effectively with a Ponar grab; it was particularly difficult in the lower Detroit River, where the bottom type is mainly bedrock and boulders. Samples were concentrated in the field by washing them in a standard U.S. No. 30 sieve (0.65 mm mesh), preserved in a 10% formalin-phloxine B mixture, and taken to the laboratory for processing.

In the laboratory, each sample was divided into aliquots of a size convenient for processing and the organisms were then extracted manually from each. The residue from the aliquots collectively composing a sample was then pooled and mixed with a sugar solution to float any remaining organisms, which were then extracted manually from the sugar solution and added to those previously removed from the sample. Samples that required more than 20 man-hours to process (i.e., samples containing large numbers of Hydra and small oligochaetes) were reduced as follows. All organisms except Hydra and small oligochaetes were removed from the sample and the rest of the sample was then subdivided with a Folsom Splitter until a 1/8 aliquot was obtained. In this aliquot, the total numbers of Hydra and oligochaetes were counted and these counts were then used to estimate the total number of organism of each taxon that was present in the whole sample. Macrozoobenthos density data (No./m²) at each station is shown in Appendix B and summarized in Appendices C and D.

Macrozoobenthic organisms were placed on a glass fiber filter, dried in an oven at 60°C for 24 hours, and weighed to the nearest 0.1 mg for biomass determinations. Ash-free dry weight was obtained by reheating the dried samples in a muffle furnace at 525°C for 1 hour. The biomass data are given in Appendix E.

Organisms picked from the samples were identified to the lowest feasible taxon before they were dried. Most were identified to genus; when mature specimens were available (e.g. clams, leeches, copepods and cladocerans), identification was to species; and other forms such as nematodes, turbellarians, oligochaetes, and mites were identified only to family level or a higher taxon. Specimens of leeches were sent to Don Klemm (U.S. Environmental

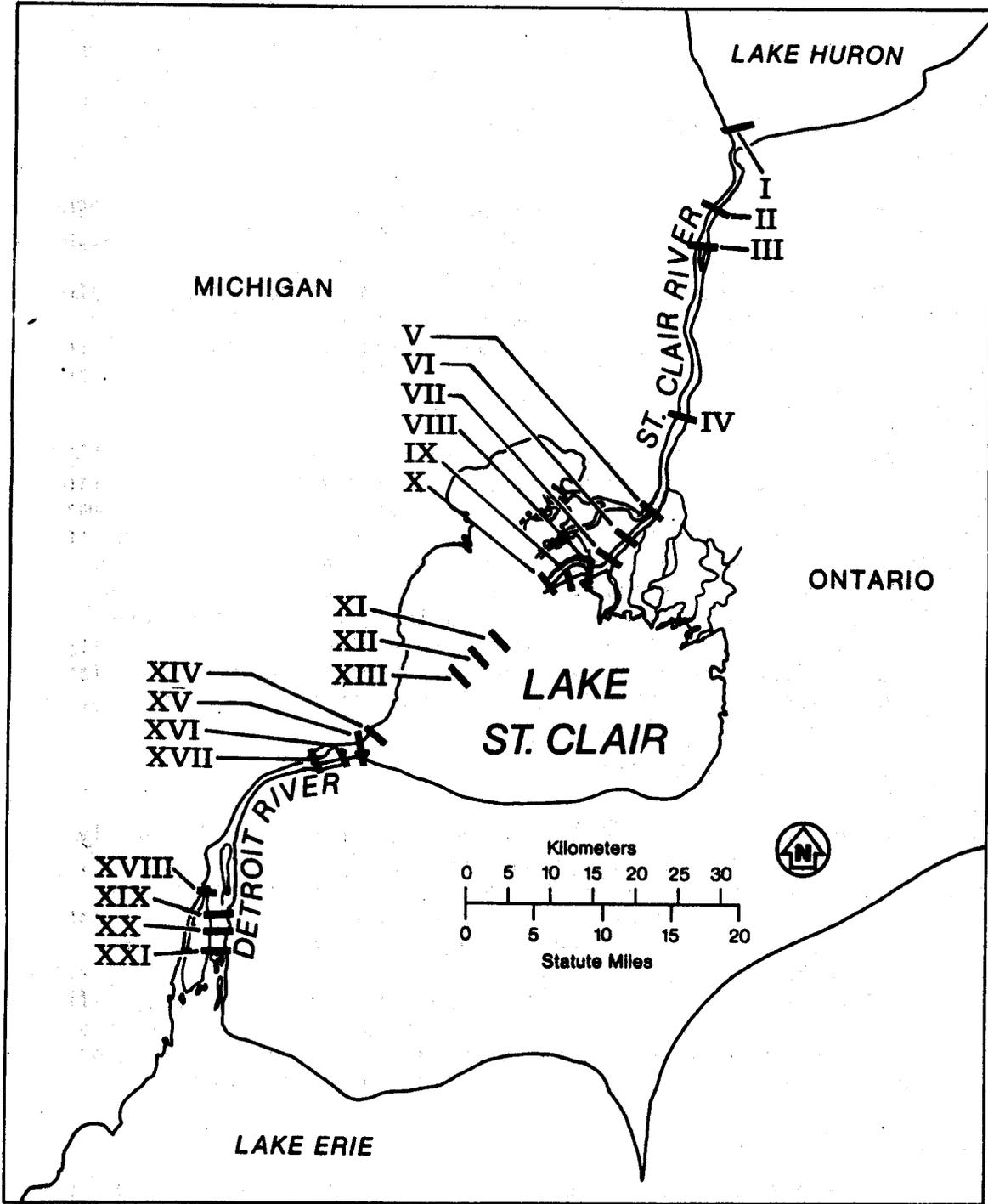


Figure 3. Macrozoobenthos sampling locations.

Protection Agency), and freshwater mussels to Tom Freitag (Corps, Detroit District), for identification and verification. To complement the collection of immature insects and to develop a species composition list of aquatic insects living in SCDRS, adult insects were collected periodically with sweepnets and light-traps from May to October during both years. Adults of major taxa were sent to the following specialists for identification and verification: Brian Armitage, Athens University, Athens, AL (Trichoptera); Ken Tennesen, Tennessee Valley Authority, Decatur, AL (Odonata); Manny Pescador, Florida Agricultural and Mechanical University, Tallahassee, FL (Ephemeroptera); and Ole Saether, University of Bergen, Bergen, Norway (Chironomidae).

At each macrozoobenthos station we recorded Loran coordinates (TI 9900 Loran C Navigator; accuracy given in manual as ± 300 ft), water depth (sounding line or Ray Jefferson Model 202, depth computer), surface and bottom measurements of current velocities (Marsh McBirney Model 201 Portable Water Current Meter), bottom type (e.g. silt, sand) as estimated by visual and textural means, and water temperature (Yellow Springs Instruments Model 54 Oxygen Meter^{1/}). The physical data set is given in Appendix F and summarized in Appendix G.

The macrozoobenthos data were subjected to analysis of variance (ANOVA) to test for significant ($P < 0.05$) differences in abundance between stations, transects, months, and years (Appendix H). We transformed density estimates using square root transformations ($\text{No./m}^2 + 0.5$)², so that ANOVA assumptions of normality and homogeneity of variance were better met. We used Tukeys Studentized Range Test to distinguish among levels of abundance at each station, transect, month, and year. To assess the relationship between macrozoobenthos density and environmental variables (depth, water velocity, bottom type, and temperature), we used the Pearson Product-Moment Correlation procedure. We performed all statistical analyses with SAS (SAS Institute Inc. 1982).

AQUATIC MACROPHYTES

Aquatic macrophytes were collected during late June, late July-early August, and early September at Stag, Fawn, and Russell islands in the St. Clair River, and at Belle Isle, Point Hennepin, and Stony Island in the Detroit River. Plants were sampled at the upstream end of each island and on the side of the island adjacent to the navigation channel (Fig. 4). A sampling grid with 500-ft-square blocks was used to distribute sampling effort at each site (Appendix I). The grid was set by using a 100-ft tape, staff buoys, and line-of-sight compass readings on shore structures. After the grid buoys were in place, we made grapnel hauls at the grid intersections and collected Ponar or hand-harvested samples within individual blocks.

^{1/} Mention of name brands does not imply Government endorsement of commercial products.

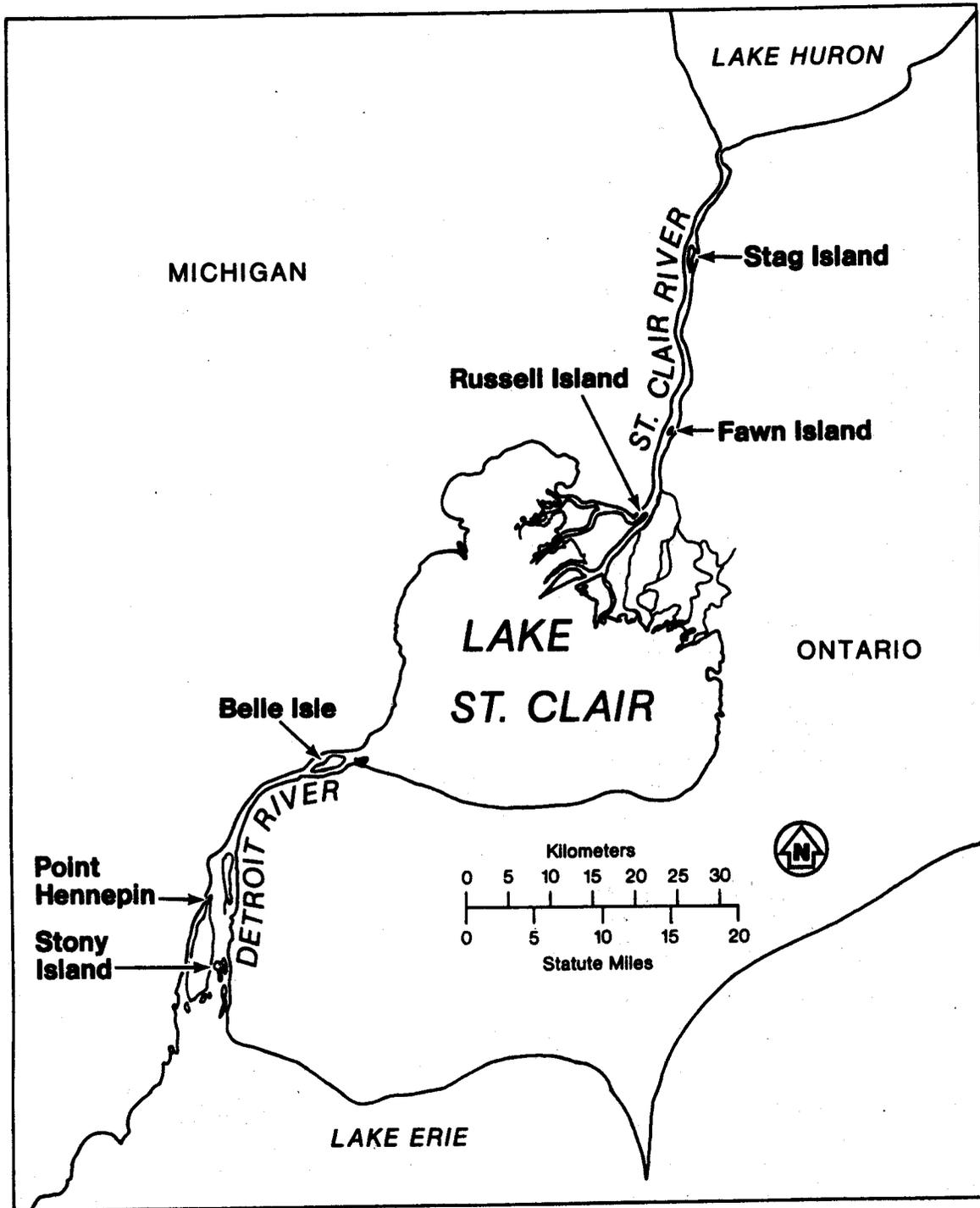


Figure 4. Sampling locations for aquatic macrophytes and juvenile fish.

The grapnel was lined with 1-cm-square mesh hardware cloth and was dragged along the bottom for a distance of 30 ft at each grid intersection. Submersed macrophytes collected with the grapnel were sorted to species, the percent abundance of each taxon collected was estimated, the total weight of the sample was taken, and the sample was discarded in the field. Water depth at grapnel stations was 2-35 ft. The data set is in Appendix J and is summarized in Appendix K.

Once the grapnel collections were completed, the dominant stand of submersed or emergent vegetation in each block was selected on the basis of the grapnel collections and visual observation. Each block was then sampled in triplicate, either with a standard Ponar dredge (for submersed plants), or by hand with a 0.6-m² steel hoop (for emergent plants). Sampling depths were 2 to 13 ft. At several locations, some blocks contained no vegetation and others contained several stands that were considered to be dominant. Blocks that had several dominant or subdominant stands were revisited and were sampled in triplicate until the following minimum number of samples had been obtained during each sampling period at each location:

<u>St. Clair River</u>		<u>Detroit River</u>	
Stag Island	60	Belle Isle	40
Fawn Island	44	Point Hennepin	56
Russell Island	36	Stony Island	44

Samples of vegetation from each Ponar grab or steel hoop collection were placed in plastic bags, stored in a portable cooler, and transported to the laboratory. In the laboratory, macrophytes were sorted and identified by consulting taxonomic keys (Hotchkiss 1967, 1970; and Voss 1972). Dry weight (105°C for 24 hours) and ash-free dry weight (525°C for 24 hours) of each taxon in each sample was determined to the nearest 0.1 mg and reported as grams of plant matter per square meter of substrate sampled. Data for submergent macrophytes are in Appendix L and those for emergent macrophytes are in Appendix M. The analysis was done on dry weight biomass, but results can be converted to ash-free dry weight (AFDW) by using the following equation: $\log_e \text{AFDW (g)} = -0.5436 + 0.9984 \log_e \text{dry weight (g)}$, where $n = 4100$ and $R^2 = 96\%$.

We encountered taxonomic difficulties with the narrow-leaf pondweeds and the Potamogeton gramineus-praelongus-illinoensis group. There were at least two narrow-leaf pondweeds in SCDRS (P. pectinatus and P. filiformis), that were difficult to identify to species when they were without flowers or seeds. Consequently we routinely identified them as narrow-leaf forms of Potamogeton and in the text refer to them as Potamogeton spp. Potamogeton natans, a broad-leaf form in its early stages of development, is superficially characterized by narrow leaves. Early in the season we identified it only as Potamogeton spp. Identification of P. gramineus, P. praelongus, P. illinoensis, and the occasional hybrid was difficult without seed structures, due to variations in leaf form (which depend on temporal and spatial growing conditions). Schloesser and Manny (1982), in an extensive survey of SCDRS in fall 1978, did not collect P.

praelongus, but recorded P. illinoensis at about 1% of the stations and P. gramineus at 6-15%. Probably P. gramineus made up 90% of this particular group of broad-leaf pondweeds in the SCDRS.

The distribution of aquatic macrophytes in the 500-ft square sampling blocks was mapped to scale by using 9- x 9-in., color, aerial photographs taken at each location during or immediately after each sampling period. The photographs were taken during mornings or afternoons when there was little cloud cover or wind, with a Wild Heerbrugg RC-8 camera (15.24-cm focal length, F 5.6 at 1/300 second) and Aerochrome MS aerographic (transparency) film (type 2448). The transparencies had a nominal scale of about 1:5000 and a minimum resolution of 1.5 m. Photograph coverage at each location was indexed on 1:15,000 scale NOAA charts by reference to landmarks visible on both the transparencies and the charts (Appendix N). Transparencies were examined with the aid of a translucent light table. The photointerpreter prepared a macrophyte map for each location and sampling period maps based on color, texture, and relative density of the submersed and emergent beds. Collateral ground truth information was also used in interpretation and preparation of the maps. One 9- x 9-in. color print (one-color balancing, no enhancement) was produced from each transparency (Appendix N) and used to construct the macrophyte maps shown in Appendix O.

At each macrophyte station we recorded Loran coordinates, water depth, surface and bottom measurements of water velocities, and incident light (Protomatic Incident Light Meter, foot candles). The physical data set for the grapnel collections is in Appendix J and is summarized in Appendix K. The physical data set for the Ponar grab collections is in Appendix L.

An ANOVA procedure was used to determine if the biomass of aquatic plants varied significantly ($P < 0.05$) among blocks, or sampling dates at each of the six islands (Appendix P). We used square root transformations to normalize the biomass estimates and Tukey's Studentized Range Test to distinguish between levels of abundance at each block, month, and year. Because replication within blocks was unequal, we used only the first three replicates (dominant stand) for analysis. This procedure resulted in a balanced design that is more accurate and computationally efficient than an unbalanced design. The Wilcoxon Signed Rank Test was used to test absolute differences between paired yearly biomass estimates of different taxa at each location and month. The Pearson Product-Moment Correlation procedure was used to assess the relation between taxa and environmental variables (depth, water velocity, and incident light).

JUVENILE FISH

Fish were sampled with hoop nets in the St. Clair River at Stag, Fawn, and Russell islands, and in the Detroit River at Belle Isle, Point Hennepin, and Stony Island (Fig. 4) during late May, late June, late July-early August, early September, and early October in 1983 and 1984. The nets were 2.5 feet in diameter and 10 feet long, and constructed of 1-inch (stretched measure)

nylon mesh. Each net was fitted with wings about 6 feet long and 3 feet high, constructed of 2-inch mesh nylon. Nets were set in the gridded area used for macrophyte sampling, in water 3-6 ft deep, for 24 hours; the net mouth faced downstream. At each location, two nets were set in submersed aquatic vegetation and two others in nearby non-vegetated areas. A total of 240 net sets were made. Fish caught in each set were sorted to species, weighed to the nearest gram, measured (total length to the nearest millimeter), and released. Age was determined by consulting age-at-length records for fishes of Ohio, including western Lake Erie (Trautman 1981). The fish data set is in Appendix Q.

We used ANOVA techniques based on a factorial model for comparing catches. Because the lack of vegetation in spring 1984 unbalanced the study design for that year, we computed by regression with dummy variables. The factorial model included the effects of location (river); month and year, which were fixed; and the effect of plant density, which was considered random. Because of the relatively large number and levels of effects, we made the analysis by location (Appendix R). Catch data were normalized by using a square root transformation. The analysis was done on total catch, total number of species, and the catch of the two most common species--yellow perch and rock bass. We used Tukey's Studentized Range Test to distinguish among the levels of catch for each main effect. To assess the relation between catch and environmental variables (depth, current velocity, incident light, temperature, bottom type), we used the Pearson Product-Moment Correlation procedure.

At each station we recorded Loran coordinates, water depth, surface and bottom measurements of current velocities, incident light, bottom type, and water temperature. The physical data set for the fish collections is in Appendix S.

RESULTS

MACROZOOBENTHOS

Taxonomic Composition

The diversity of macrozoobenthos in SCDRS was highest in the upper Detroit River, where we identified 101 distinct taxa, and lowest in Lake St. Clair, where we recorded 65. We counted 98 taxa in the upper St. Clair, 95 in the lower St. Clair, and 80 in the lower Detroit River. The taxonomic composition and abundance of macrozoobenthos, by location and year, are summarized in Appendix C where the 21 transects are grouped into five geographic regions (transect numbers in parentheses): upper St. Clair River (I-V), lower St. Clair River (VI-X), Lake St. Clair (XI-XIII), upper Detroit River (XIV-XVII) and lower Detroit River (XVIII-XXI). Many of the 162 taxa listed in Appendix C are higher level designations that include unidentifiable, immature, or damaged specimens; these taxa may include genera or species already listed. However, when counting taxa by location or year, we excluded those for which