OBSERVATIONS ON *CLADOPHORA* GROWTH IN SOME NEARSHORE AREAS OF LAKE HURON AND SOUTHERN GEORGIAN BAY

Field Work - 1981

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Observations on *Cladophora* Growth in some Nearshore Areas of Lake Huron and Southern Georgian Bay

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Water Resources Assessment Unit
Technical Support Section
Southwestern Region

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ABSTRACT

Localized areas of Lake Huron and Georgian Bay have demonstrated a sensitivity to inputs of nutrients, evidenced by increased growths of *Cladophora*. Through the use of underwater photography a documentation of *Cladophora* growth was carried out in 1981. Two areas were investigated, one in the vicinity of the Bruce Nuclear Power Development in Lake Huron, and the second in southern Georgian Bay (Nottawasaga Bay) from Meaford to Collingwood. The latter area includes the Mary Ward Shoals which were similarly photographed in 1979 and 1980 by the Water Resources Branch of the Ministry, offering a basis for comparison. The 1981 work was completed in anticipation of an increasing demand on nearshore waters for nutrient dispersal, particularly through the use of extended outfalls. Bottom substrate was observed to the 10-metre contour and was generally free from growth, excepting areas under the influence of point sources of nutrients. The method proved to be an effective means of documenting the range of observed *Cladophora* growth and will serve as a valuable permanent record of present conditions.

ACKNOWLEDGEMENTS

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INTRODUCTION

This report presents the findings to date of a baseline investigation of *Cladophora* growth in the nearshore. waters of Lake Huron and southern Georgian Bay, within the boundaries of the Southwestern Region of the Ministry of the Environment (Figure 1). The work was prompted by anticipated increasing demand on the nearshore waters for waste assimilation (nutrient dispersal) particularly through the use of extended outfalls. Much of the area is characterized by the presence of good substrate for the growth of the potentially nuisance aquatic alga, *Cladophora.* Presently *Cladophora* is only sustained in noticeable amounts where there is a nearby source of nutrients such as river mouths and sewage treatment plant discharges. Periodically growth proliferates, resulting in, among other things complaints from water users. These incidents are not common however and usually affect only very localized areas. On one occasion in 1978, sloughed *Cladophora* fouled approximately 10 kilometres of Lake Huron shoreline in the vicinity of Goderich. Therefore, documentation of the present *Cladophora* growth characteristics serves to help explain present problems and provides a valuable baseline for future comparisons in anticipation of changing developments and activities along the Lake Huron - Georgian Bay shoreline.

METHODS

Initially it was intended to determine station locations through the use of a sextant. Working in nearshore waters (within the confines of the 10 metre contour) however, precluded the use of a sextant as the distances from shore were inadequate for accurate sitings on nearby landmarks. Consequently, station locations were

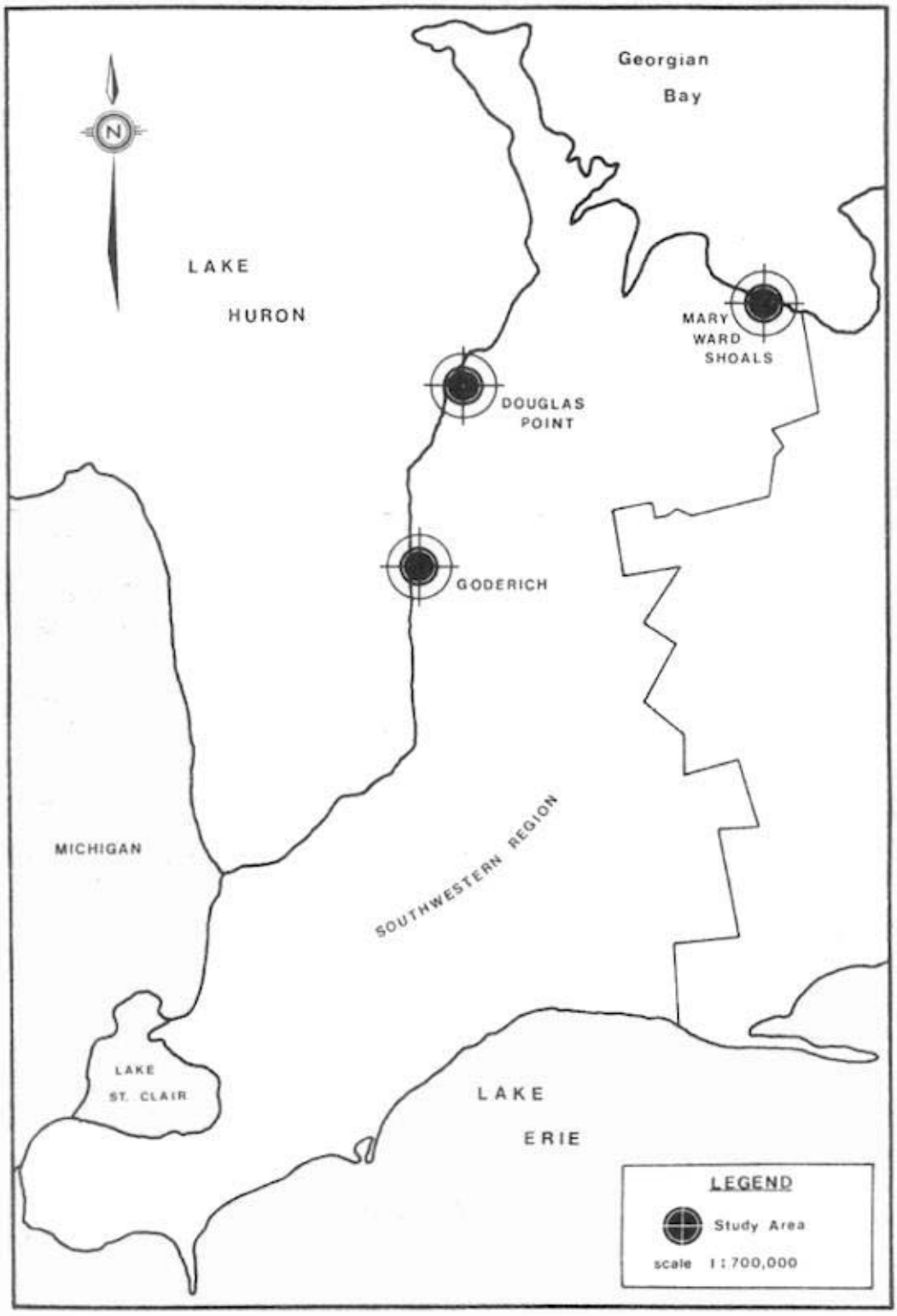

Figure 1. Location map showing study areas.

recorded photographically (through the use of single or composite photographs) accompanied by a sketch of the station location and a written description including information such as water depth and type of substrate'.

Cladophora growth at a station was documented by underwater photography either by scuba diving or snorkeling, depending on water depth. When sufficient growth was present, a quantity of plant material was removed to be analysed for total phosphorus content. Ambient total phosphorus was not measured since an area was visited only once and a single sample was thought to be insufficient to characterize the concentration of phosphorus in ambient waters. Data on ambient phosphorus concentrations at study locations were obtained from Ministry of the Environment water quality monitoring programs. Information such as station location, water depth, substrate characteristics, number of pictures taken etc. was recorded on individual field data sheets. Underwater photographs were taken under natural light conditions using a Nikonos IV-A underwater camera, with Ektachrome 64 ASA film.

Three areas were selected for investigation as part of this study (Figure 1).

One area investigated was the nearshore waters of southern Georgian Bay (Nottawasaga Bay) from Meaford to Collingwood (Figure 2). This area is highly used for water recreation. The Mary Ward Shoals, a valuable fish spawning area, are also located in this reach. "The Mary Ward Shoals comprise the largest area of white fish spawning habitat in Nottawasaga Bay." (Payne, 1982) Also, the Shoals are an historically important lake trout spawning area. Presently the Ontario Ministry of Natural Resources (MNR) stocks the shoals with approximately 100,000 lake trout (splake) a year. This programme began in 1979 and constitutes approximately ten percent of the present MNR-Lake Huron lake trout stocking programme.

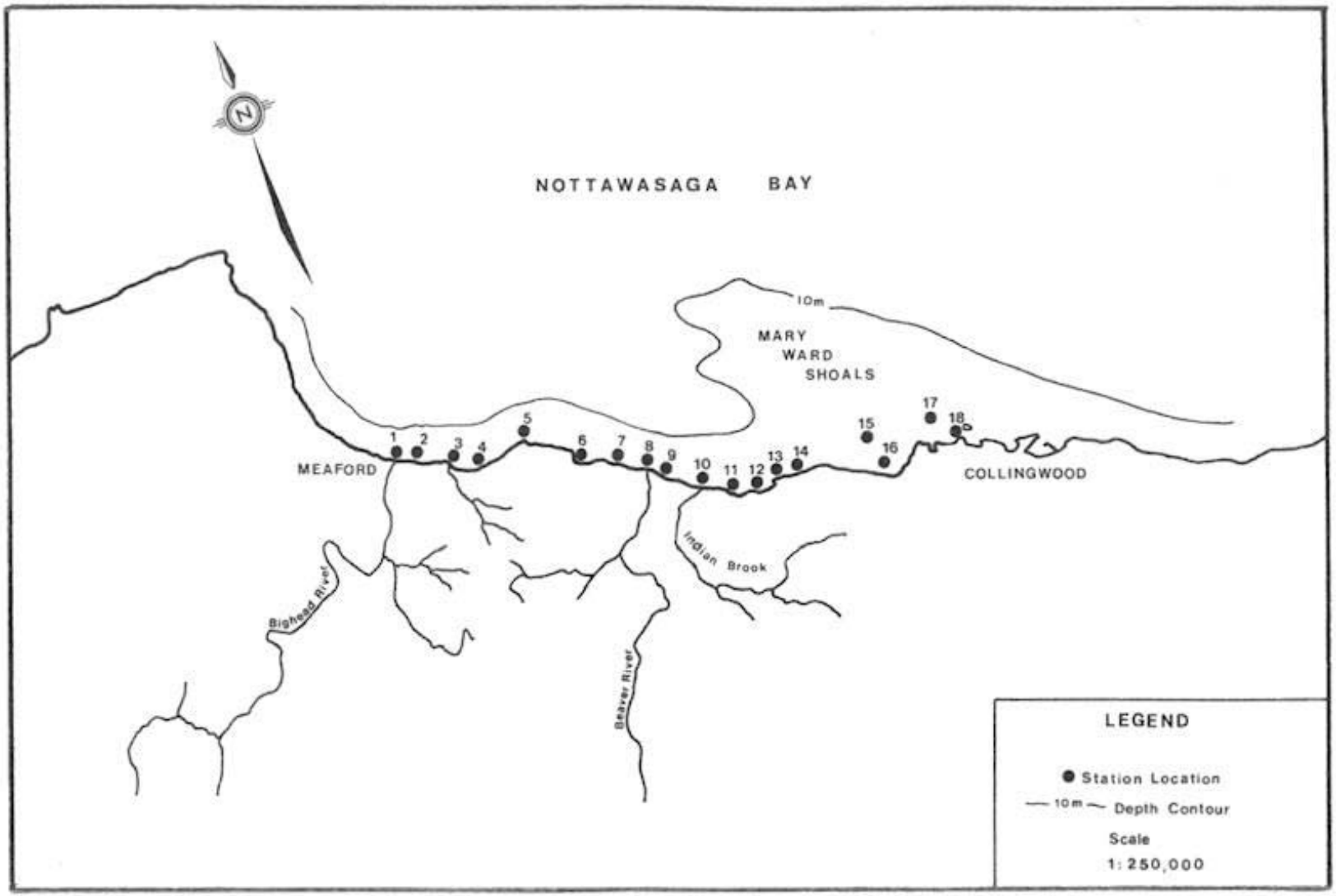

Figure 2. Sampling locations in Nottawasaga Bay, 1981.

There are existing waste discharges to this area which cause known localized areas of increased *Cladophora* growth. A proposal is currently under development to discharge treated sewage from the Craigleith-Camperdown area onto the Mary Ward Shoals through the use of an extended outfall. Hence, the possibility of increased *Cladophora* growth on the shoals has been under discussion. In light of this proposed development, a documentation of existing *Cladophora* growth is needed.

A second area chosen was offshore from the Bruce Nuclear Power Development complex near Douglas Point (Figure 3). Among other concerns, local ratepayers expressed concern about possible impacts from a proposed Bruce Energy Centre and its associated activities upon the aquatic plant growth in Inverhuron Bay. Therefore, an area from Douglas Point south to McRae Point was investigated.

Finally, a third area selected for investigation was the shoreline of Lake Huron immediately south from the mouth of the Maitland River (Figure 4). This area is offshore from the Town of Goderich and receives various point source discharges. The shoals in this area are known to support substantial growths of *Cladophora* and heavy accumulations were documented in 1977 and 1978 (Plate Nos. 1 and 2). This area could not be adequately surveyed however, because of adverse weather conditions causing rough water and high turbidity.

Investigations continued in 1982 but were curtailed for reasons of diver safety. It was decided that divers should not be exposed to waters in the immediate vicinity of certain outfalls. The purchase of equipment to keep divers isolated from ambient water at certain locations is presently being pursued. A greater effort was to se made to obtain *Cladophora* samples for nutrient analysis in 1982. At each location where *Cladophora* growth was observed, 3 samples were to be collected from the area. Each sample was to be analysed for total phosphorus and total nitrogen. In addition, water

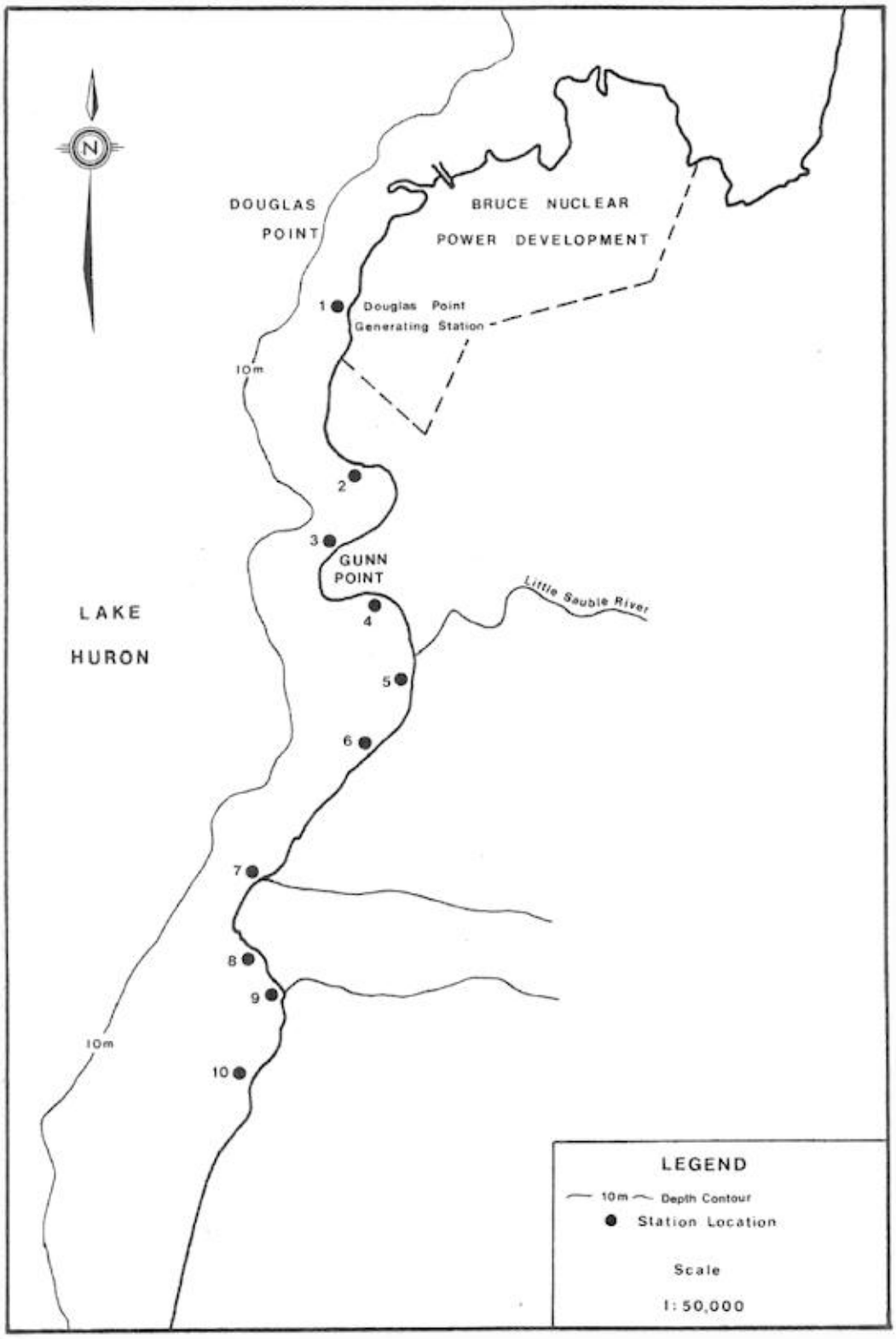

Figure 3. Sampling locations near Douglas Point, 1981.

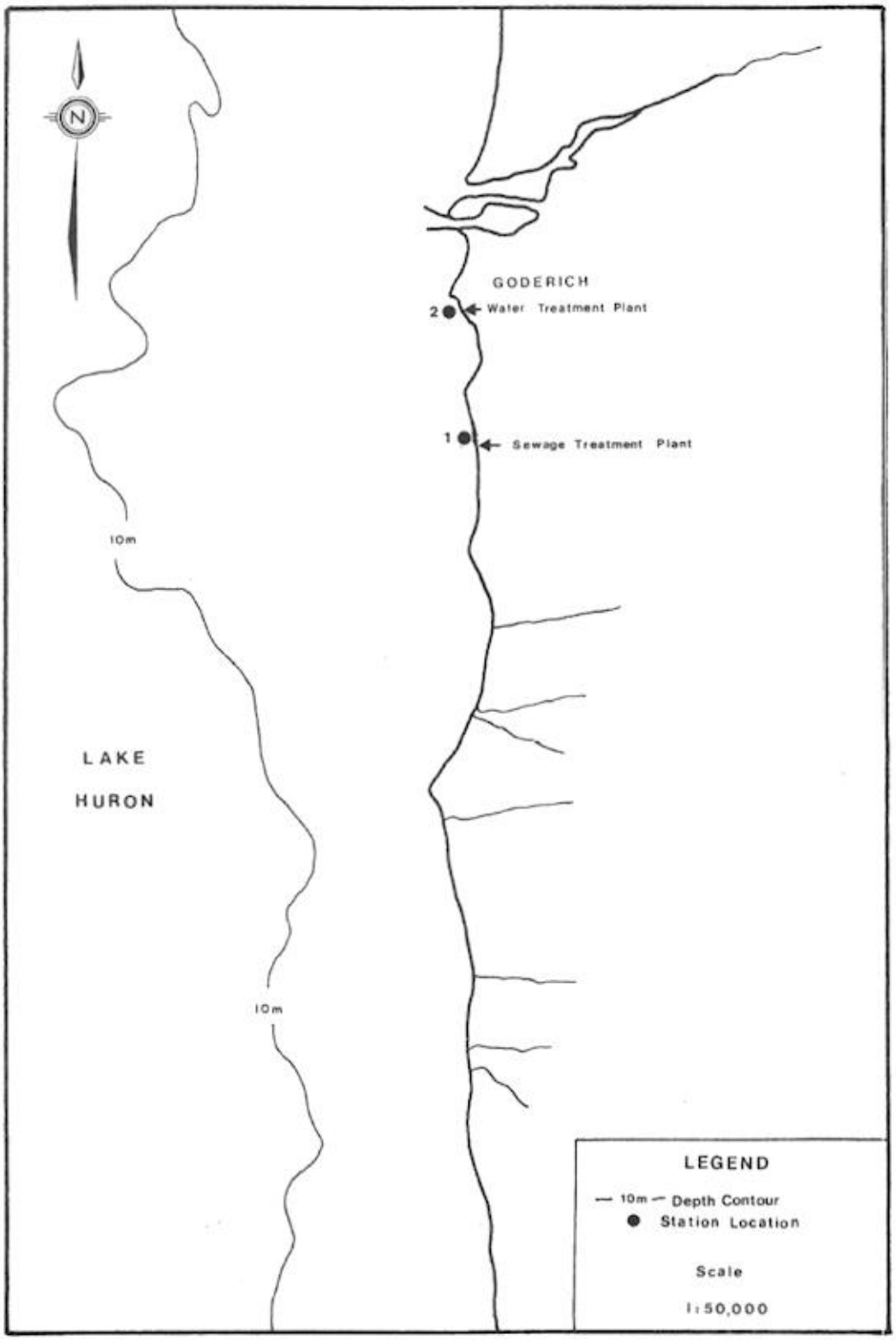

Figure 4. Lake Huron near Goderich.

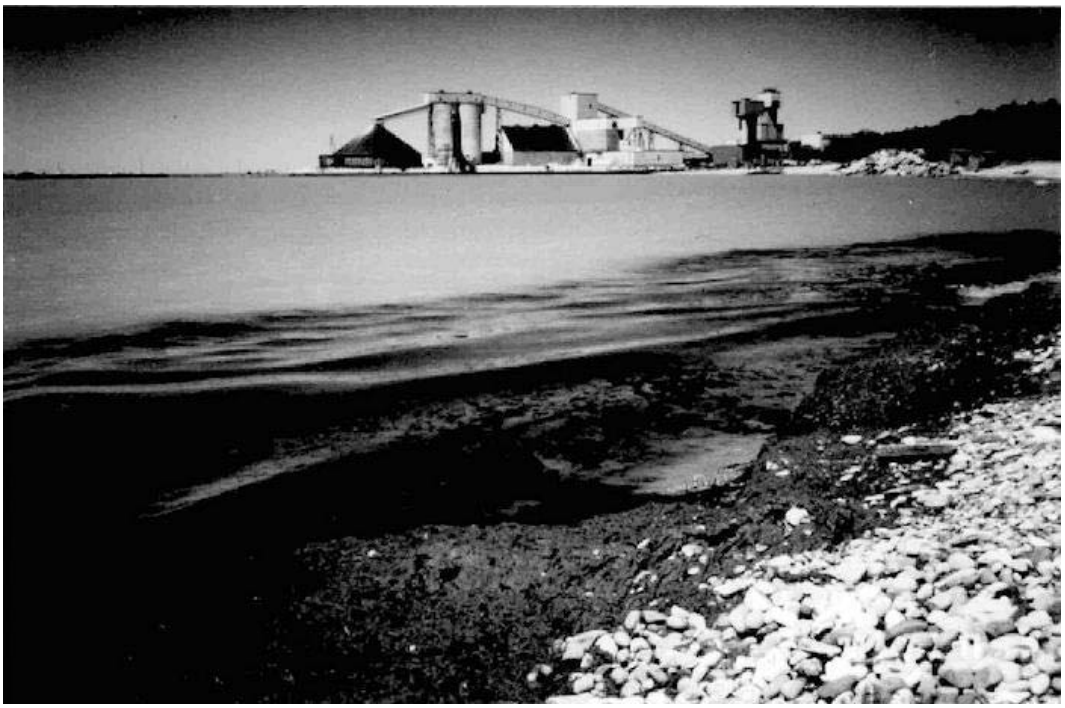

Plate 1. *Cladophora* along the Lake Huron shoreline, looking north toward the dock and salt mine at the mouth of the Maitland River, 1978.

Plate 2. *Cladophora* near the Goderich water treatment plant,, 1978

samples were to be collected at sampling locations and analysed for total phosphorus, soluble reactive phosphorus and nitrogen. Investigations were planned for early June, early July and early August. Investigations were stopped part way through the early July period. Once the issue of diver safety is resolved, survey work will continue.

RESULTS

Any observed growths can best be described as minimal and affecting only very localized areas. However, a range of *Cladophora* growth was found and photographed. Generally, very little or no growth was observed (Plate Nos. 3 and 4).

Growth was found in response to nearby point source discharges of treated sewage such as the extended outfall discharging treated sewage from the Town of Meaford (Plate No. 5). Similarly a shoreline discharge combining cooling water with treated sewage from the Bruce Nuclear Power Development complex produced *Cladophora* growth as shown in Plate No. 6. As can be seen, the growth in response to these types of discharges was a carpet of stubbly growth only a few centimetres long.

Areas of increased growth were also found near river mouths. Growth in response to these point sources was more, localized and *Cladophora* filaments were longer, typically 5 to 10 centimetres in length (Plate Nos. 7 and 8)

The inshore waters in the survey areas were observed to a maximum depth of approximately 10 metres. Additional slides and pictures are available, along with the field data sheets, at the Southwestern Regional Office of the Ministry of the Environment.

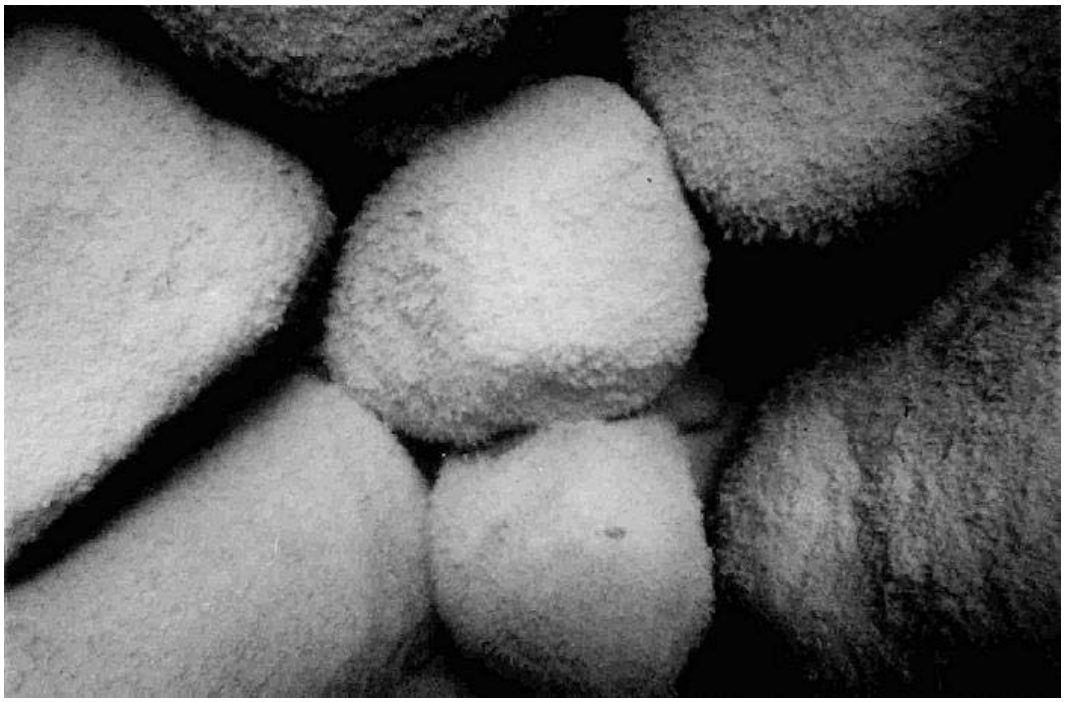

Plate 3. Minimal *Cladophora* growth and silted substrate at Station 4 (Figure 2), July 13, 1981.

Plate 4. Clean substrate in Lake Huron at Station 3 off Gunn Point (Figure 3), August 18, 1981.

Plate 5. *Cladophora* growth at Station 2 near the extended outfall from the Meaford sewage treatment plant (Figure 2), July 13, 1981.

Plate 6. *Cladophora* growth in Lake Huron at Station 1 in the discharge channel from the Douglas Point Generating Station (Figure 3), August 18, 1981.

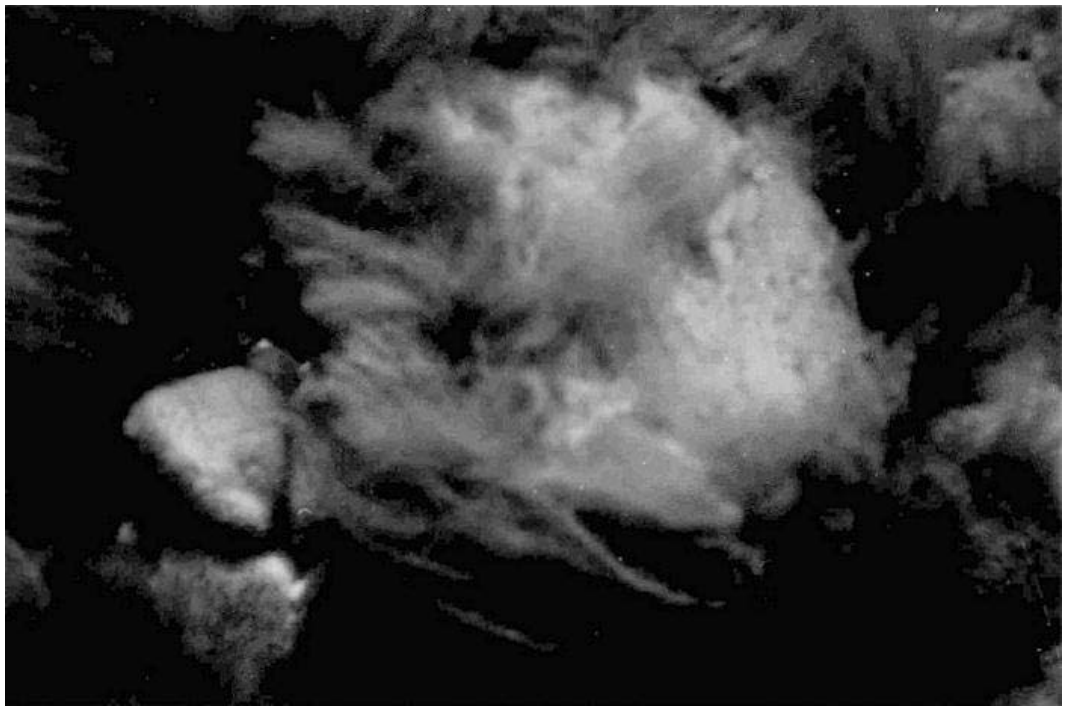

Plate 7. *Cladophora* growth at Station 5 near the mouth of the Little Sauble River in Inverhuron Bay (Figure 3), August 18, 1981.

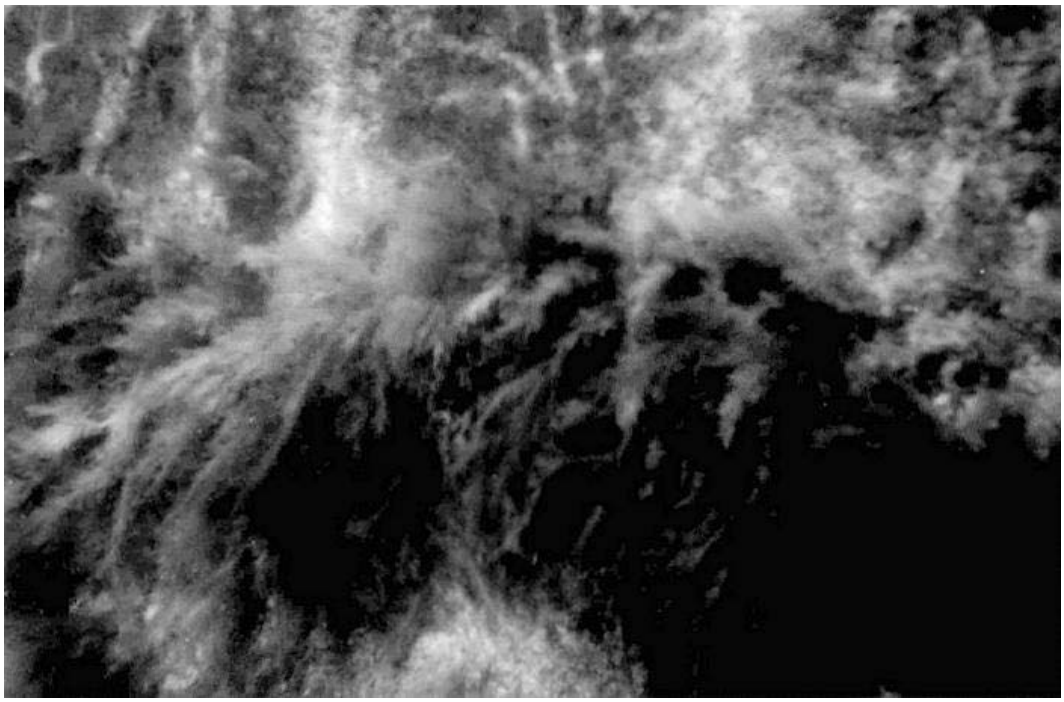

Plate 8. *Cladophora* growth at Station 10 near the mouth of Indian Brook (Figure 2), August 20, 1981.

In addition to growth in response to various nutrient sources, differing growth habits were also noted presumably in response to varying physical conditions. Again, pictures and slides are retained on permanent file. No efforts were made to explain influences on growth habit.

Owing to the generally sparse growth and the difficulty in properly cleaning such short *Cladophora* filaments only a limited number of samples of plant material have been collected for the analysis of phosphorus content.

DISCUSSION

Although somewhat labour intensive, the use of underwater photography proved to be a useful method of documenting the range of growth that existed in the survey areas. A photographic record serves as a valuable documentation of the type of growth present, or the lack of it, and through substrate depiction emphasizes the sensitivity of areas to nutrient inputs. In most areas, *Cladophora* growth was virtually absent and where present the plant filaments were usually very short.

The presence of *Cladophora* quite reliably signalled the presence of a nearby source of nutrients. Most observed growth, in close proximity to a nutrient point source, was a stubble growth. Occasionally filaments obtained lengths of 5 to 10 centimetres and rarely up to 15 to 20 centimetres. The longer filaments were typical of areas of the lake under the immediate influence of discharges from rivers or streams and in the lap zone of structures such as piers. Man-made point sources of nutrients such as the outfall from the sewage treatment plant or the cooling water discharge were observed to more typically produce a carpet of growth.

Values for ambient total phosphorus in Lake Huron are available in the literature. A recent study by the Ministry of the Environment suggests that the general ambient total phosphorus in Georgian Bay is at a border line concentration for *Cladophora* growth (approximately 5 micrograms/litre) such that increases of even 1 microgram/litre above ambient will likely cause colonization of *Cladophora* in areas susceptible to but presently void of the algae. (Jackson and Hamdy, 1969) The study also substantiates the presence of *Cladophora* almost exclusively in the presence of nutrient point sources and further suggests that the growth of *Cladophora* in southern Georgian Bay is severely phosphorus limited.

Based on a working knowledge of the area in conjunction with published information on substrate characteristics (Thomas, 1973, Rukavina and LaHaie, 1980) it is roughly estimated that over 70% of the nearshore area (within the 10 metre contour) of Lake Huron from Sarnia to Tobermory provides suitable substrate for *Cladophora* growth while virtually all of Georgian Bay from Tobermory to Collingwood contains suitable substrate in the inshore areas. Coupling this with the demonstrated sensitivity of the nearshore areas to increases of ambient total phosphorus concentrations, the need for phosphorus limitation is clear. Present IJC policy has targeted both Lake Huron proper and Georgian Bay along with the other Great Lakes for reductions in phosphorus loadings in recognition of the need to keep algal growth under control (IJC, 1980).

The 1976 base loads and the future target loads for Lake Huron proper and Georgian. Bay for total phosphorus are 3,000 - 2800 and 630 - 600 tonnes per year respectively. Putting these objectives into a different management perspective, the goals translate into the "maintenance of the oligotrophic state and relative algal biomass of Lake Huron", along with the "the elimination of algal nuisance growths in bays and other areas wherever they occur" (IJC, 1980). As this statement implies,

general target loadings for large bodies of water may be insufficient to protect certain localized areas such as the nearshore area of Lake Huron near Goderich where nuisance accumulations of *Cladophora* affected approximately ten kilometres of shoreline (Plate Nos. 1 and 2). Decisions concerning the acceptable loadings of phosphorus and the placement of sewage outfalls will have to be made with consideration to local substrate, water depth, current patterns and other local conditions.

Should the concentration of total phosphorus in the nearshore waters of Lake Huron and southern Georgian Bay be allowed to approach the total phosphorus concentrations of other Great Lakes, the impact upon recreation and tourism could be of major proportions. The sensitivity of Lake Huron and Georgian Bay to inputs of phosphorus has been well demonstrated both by the 1981 work and by the more serious *Cladophora* growths in 1977 and 1978 near Goderich.

Data collected in 1979 from the nearshore waters of western Lake Ontario averaged 19 micrograms/litre (Hamdy, 1982). Data collected the same year from the western, central and eastern basins of Lake Erie averaged 22, 26 and 19 micrograms/litre respectively for total phosphorus (MOE, unpublished data). As a comparison, twenty five stations sampled in 1980 from southern Georgian Bay (Meaford to Collingwood), many within the 10-metre contour, averaged only 5.3 micrograms/litre (Hamdy, report under preparation). Although this average does not reflect the localized growth conditions very near river mouths and sewage outfalls, it does. demonstrate the present general picture for the inshore waters of southern Georgian Bay and reflects the general absence of growth already noted.

Nearshore stations in Lake Huron also sampled in 1980 near Southampton, Grand Bend and Goderich had average total phosphorus concentrations of 5, 9 and 10 micrograms/litre respectively. During the heavy shoreline *Cladophora* accumulations in 1977 and 1978, 9 stations sampled in 1977 averaged 21.8 micrograms/litre. This latter concentration coincided with the *Cladophora* growths which fouled 10 kilometres of shoreline.

RECOMMENDATIONS

1. Permission to discharge wastes containing phosphorus into the waters of Lake Huron, Georgian Bay or any of their bays should be given only after careful consideration of both local and possible more Lake-wide effects.

2. Increased effort is required to ensure that the stimulation of *Cladophora* growths as a result of river inputs is minimized. Programs to achieve reductions in soil, silt and associated nutrient losses from agricultural lands and urban areas should be encouraged.

REFERENCES

1. Hamdy, Y. S. and Herdendorf, C. E., Synoptic mapping of water quality in Western Lake Erie. Paper presented at the 25th Conference - International Association for Great Lakes Research, 1982.

2. Hamdy, Y. S., Report on Lake Huron international surveillance plan, under preparation.

3. International Joint Commission, Phosphorus management for the Great Lakes, final report of the phosphorus management strategies task force. Windsor, Ontario, 1980.

4. Jackson, M. B. and Hamdy, Y. S., Projected *Cladophora* growth in southern Georgian Bay in response to proposed municipal sewage treatment plant discharges to the Mary Ward Shoals; Journal of Great Lakes Research, Volume 1, 1982.

5. Ontario Ministry of the Environment, Great Lakes Section, unpublished data.

6. Payne, N.R., Unpublished report, Lake Huron Fisheries Assessment Unit, Ontario Ministry of Natural Resources, 611 Ninth Avenue East, Owen Sound, Ontario N4K 3E4, 1982.

7. Rukavina, N. A. and LaHaie, G. G., 1980, Summary data for Lake Huron nearshore sediment samples - interim report (preliminary results); CCIW Sedimentology Laboratory, Hydraulics Research Division Technical Note 80-11.

8. Thomas, R. L., The Distribution of mercury in the surficial sediments of Lake Huron; Can. J. Earth Sci., Volume 10, pp. 194-204.