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A SURVEY OF ATTACHED ALGAE ON THE SHORELINE NEAR 7 CAGED-AQUACULTURE FARMS ON MANITOULIN ISLAND, ONTARIO

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NWRI Contribution No. 05-160

A survey of attached algae on the shoreline near 7 caged-aquaculture farms on Manitoulin Island, Ontario

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Abstract

Shorelines near seven fresh water caged-aquaculture farms were observed for attached algae. Potential increases in nutrient loading of phosphorus and nitrogen may occur from standard farm operations, including feeding and fish excrement. Attached algal growth provides a time integrated effect of nutrient loading. Overall, at most farms we found minimal attached algal growth in receiving waters near caged-aquaculture farms. Farms in areas with good water exchange allow a sufficient flushing of excess nutrients preventing undesirable effects.

Résumé

Nous avons examiné le littoral près de sept stations d'aquaculture d'eau douce en cages pour rechercher les algues fixées. Des hausses de la charge en matières nutritives (phosphore et azote) peuvent être occasionnées par les opérations courantes d'une exploitation aquacole, notamment par l'alimentation et les excréments des poissons. La croissance des algues fixées représente un effet dans le temps de la charge en matières nutritives. Dans l'ensemble, à la plupart des stations, nous avons trouvé une quantité minime d'algues fixées dans les eaux réceptrices près des cages d'aquaculture. Quand ces cages sont installées dans des eaux où l'échange d'eau est important, l'effet de chasse est suffisant pour empêcher les effets néfastes d'une quantité excessive de matières nutritives.

Introduction

Caged-aquaculture is a relatively new industry in Ontario, the oldest being 22 years. There are currently fewer than 15 commercial caged aquaculture sites in Ontario with most located in the Manitoulin Island / Georgian Bay area. Farms may have between 6 and > 20 cages in operation. Each cage can be up to 370 m2. Each cage can hold up to 100,000 fingerlings or 30,000 larger fish. Concerns have been raised about the potential impact on water quality from operations of caged aquaculture in the receiving waters. Loadings of Phosphorus and Nitrogen from fish farms could potentially increase algal populations if the concentrations from fish are high enough. Algal populations on shore provide a time integrated indication of nutrient effects. The purpose of this paper is to survey and document attached algae on shorelines near 6 caged aquaculture sites, searching for evidence of increased nutrient loading through algal growth and accumulation.

Methods

Freshwater caged-aquaculture farms located in Lake Wolsey; at East Rous Island; Manitowaning Bay, and the East shore of Little La Cloche Island (fig. 1) were surveyed July 16 and 17, 2003; a farm in the Wabuno Channel was surveyed July 25, 2001 and a farm near Eastern Island was surveyed June 18, 2005. Lake Wolsey is connected to the North Channel by an opening approximately 50m wide. The farm is located on the SW shore and has been in operation since 1986. The depth at the farm location is approximately 15-17m and is attached to shore by a 30 m walkway. The farm located near East Rous Island between Bedford Island and West and East Rous Island in Bedford Harbour has been in operation since 1992. The farm is approximately 30 m offshore. Total depth is approximately 15 m. Manitowaning Bay is located near the South end of Manitoulin Island and exposed to the North Channel to the North. The farm is located on the South East shore of Manitowaning Bay and has been in operation since 1998. It is attached to shore by a 30m walkway. Total depths at the farm range from 13 to 17 m. Two farms off the East shore of Little La Cloche Island are exposed to Frazer Bay and total depths are approximately 20 m. The farms have been in operation since 1995 and 1996. Both farms are approximately 100 m offshore. The farm located on the East shore of the Wabuno Channel on Great La Cloche Island has been in operation since 2000. Total depth ranges from 25 to 30m. The farm is attached to shore by a 30 m walkway. The farm located between Eastern Island and High Island is approximately 5 to 10m deep and approximately 50 m from shore. All sites are located in the vicinity of Manitoulin Island, Ontario. A boat was used to survey the shoreline. Digital and film cameras were used to take photographs of the shoreline on either side of the farms near the surf zone. Photographs were taken every 100 m or 200 m intervals depending on depth. In all, more than 300 photographs were taken. Positions were recorded using DGPS WGS84 datum. Substrate types, amount of algal growth, zebra mussels, and evidence of creeks and/or surface runoff were noted. Photographs were categorized according to the following scale: 0= no algal growth, L = light algal growth, M = moderate algal growth, and H = heavy algal growth.

Results

Figure 2 illustrates algal growth on Lake Wolsey shoreline July 16 and 17, 2003. Most substrate had light algal growth. 14% of the areas surveyed on Lake Wolsey had 0 algal growth; 55% had light algal growth; 23% had moderate algal growth and 7% had Heavy algal growth. Four of the 5 heavy growth areas observed, had moss growing on shoreline rocks suggesting evidence of an on-going source of spring, creek or surface runoff. No obvious evidence of spring, creek or runoff was noted at the fifth area of heavy algal growth and therefore it is unknown what caused the heavy algal growth. The immediate area adjacent to the fish farm showed mostly light algal growth. Buoys surrounding the site showed light algal growth as well, although length of exposure is unknown at this time.

Figure 3 illustrates algal growth in Manitowaning Bay. Approximately 2 km of the East and West shoreline was observed. On the East shoreline, where the fish farm is located, 0 to light algal growth was noted in 35% and 65 % respectively of the sites surveyed. No medium or heavy growth was noted. No algal growth was noted on buoys surrounding the fish farm. On the West shoreline 0 to light algal growth was observed in 46% and 23 % respectively of the sites surveyed. 8%

had moderate growth and 23% had heavy growth. In the first area of heavy growth algae, numerous cottages/homes are evident suggesting faulty or outdated septic systems, lawn fertilization may be responsible. Area 2 and 3 of heavy algal growth were noted south of cottage area. Evidence suggests possible creek or surface runoff.

Figure 4 illustrates algal growth on 1.5 km of the North West shoreline of East Rous Island. Algal growth was 0 (47%) to light (47%). One area showed medium growth (6%). This area was near a marsh. Whether this is the cause of increased algal growth in the area is unknown. The buoys at the farm showed light algal growth. Wildlife was noted near the site. No areas of heavy growth were observed.

Figure 5 illustrates algal growth on approximately 4 km of shoreline. Two caged-aquaculture sites are located within approximately 1 km of each other on the East shore of Little LaCloche Island. Most of the shoreline had 0 to light algal growth 40 % and 45% respectively. In this case "light" indicates very patchy algae. 2 areas near the northern farm had medium algal growth (15%). No obvious sources were noted. A buoy on the southern farm had 0 algae. No heavy algal growth was noted.

Figure 6 illustrates algal growth on approximately 0.5 km of shoreline and buoys at a farm located in the Wabuno Channel. All the shoreline and buoys surveyed had 0 algae.

Figure 7 illustrates algal growth on approximately 1km of shoreline on High Island and Eastern Island. All shoreline observed had 0 algae.

Discussion

Waste from caged-aquaculture can impair the water quality of the receiving water.

Waste consists of three different forms: fish faeces, dissolved waste, and food waste (C. Young Cho, 1997). Fish faeces consist of undigested starch, fiber and ash (C. Young Cho, 1997). This may include up to 30% of eaten food secreted as faeces (Axler, 1996). Dissolved waste consists of byproducts of metabolism – ammonia, urea and phosphate (C. Young Cho, 1997). These compounds are secreted through the gills and kidneys. Food waste is primarily uneaten food. This may include up to 30% dry feed unconsumed (Axler, 1996). Phosphorus concentrations in fish feed may be between 0.7 and 1.6% dry weight (Kelly, 1992). Depending on the type of diet, solid nitrogen biological waste can be between 5 to 10 kg/mt of fish produced; soluble nitrogen biological waste between 25 and 40 kg/mt of fish produced; solid phosphorus biological waste can be between 3 and 4 kg/mt of fish produced; and soluble phosphorus biological waste between 1 and 5 kg/mt of fish produced (C. Young Cho, 1997). Also, with deposition of waste under cages SRP in sediment is released more readily than away from the cages (Kelly, 1992).

Location of farms may be a factor in exchange of waters near the farm. Farms located in Manitowaning Bay (fig. #2), East Rous Island (fig. #3); the Wabuno Channel (fig. #6); and the East shore of Little La Cloche Island (fig. #4) have 0 to light algal growth. These sites have good exchange with the North Channel. This may allow a sufficient flushing of excess nutrients preventing undesirable effects. Farms with relatively constricted receiving waters and high fish production have had undesirable eutrophication problems including increased levels of P and N, DO depletion, and increased organic waste accumulation (Axler, 1996). The farm at Eastern Island showed 0 algal growth, however, the potential for increased localized nutrient loading is greater as the farm is located between two islands in shallow water, therefore, decreasing the exchange of water between the farm and the North Channel. More observations will be needed at this site.

Lake Wolsey (fig. 1) had the greatest areas of light and moderate algal growth with 5 areas showing heavy growth. Livestock agriculture is evident on the shoreline of Lake Wolsey. The land surrounding Lake Wolsey consists of a thin layer of topsoil over rock, therefore any surface runoff may not be absorbed and flow directly into the lake bringing with it a potentially large nutrient load. Because

Lake Wolsey has restricted exchange with the North Channel, flushing may not occur on a regular basis, nevertheless, the photographs do not indicate a clear effect of the farm rather, other near shore effects were more apparent.

Conclusions

Overall, the observable effects of fish farms on nearshore algae seem to be minimal. Little or no algae were evident in Manitowaning Bay, East shore of Little La Cloche Island, East Rous Island, Wabuno Channel possibly because of good exchange with surrounding water. Light to Moderate algal growth was evident in Lake Wolsey. Other potential sources of land based nutrient loading may be a factor in this area. Further studies need to be completed. At all farms, studies need to be completed on methods to minimize nutrient loading including, but not limited to, waste collection, specialized diets (*C. Young Cho 1997*), controlled feeding systems (*C. Young Cho 1997*), and fallowing.

Acknowledgements

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References

Axler R., C.Larsen, C. Tikkanen, M. McDonald, S. Yokom and P. Aas. 1996. Water Quality issues associated with aquaculture: A case study in mine pit lakes. Water Environment Research. 68(6) 995-1011.

Kelly L.A. 1992. Dissolved reactive phosphorus release from sediments beneath a freshwater cage aquaculture development in West Scotland. Hydrobiologia. 235/236:569-572.

Young Cho C. and D.P Bureau. 1997. Reduction of Waste Output from Salmonid Aquaculture through Feeds and Feedings. The Progressive Fish Culturist. 59:155-160.

List of Figures

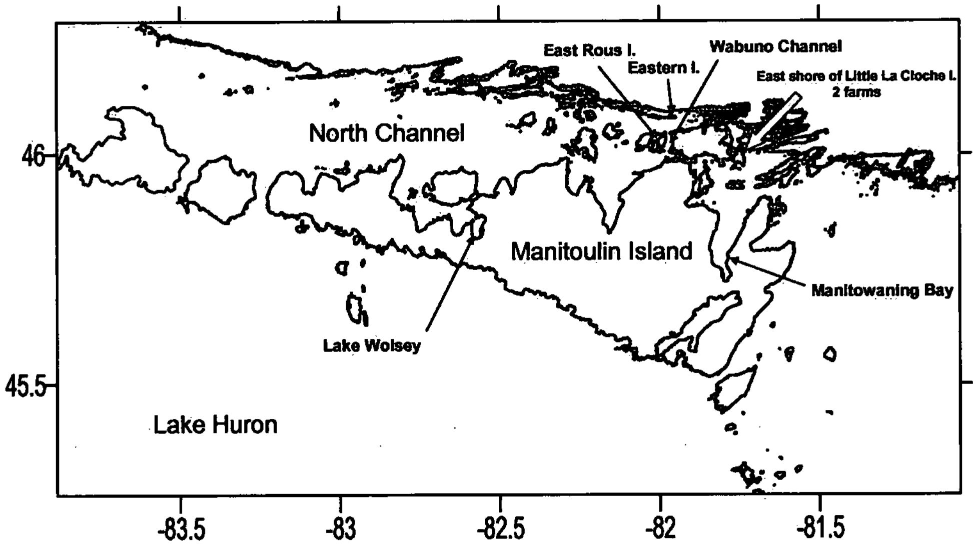
East Rous I.
Eastern I.
Wabuno Channel
East shore of Little La Cloche I.
2 farms
North Channel
Manitoulin Island
Manitowaning Bay
Lake Wolsey
Lake Huron
46
45.5
-83.5
-83
-82.5
-82
-81.5

Fig. #1

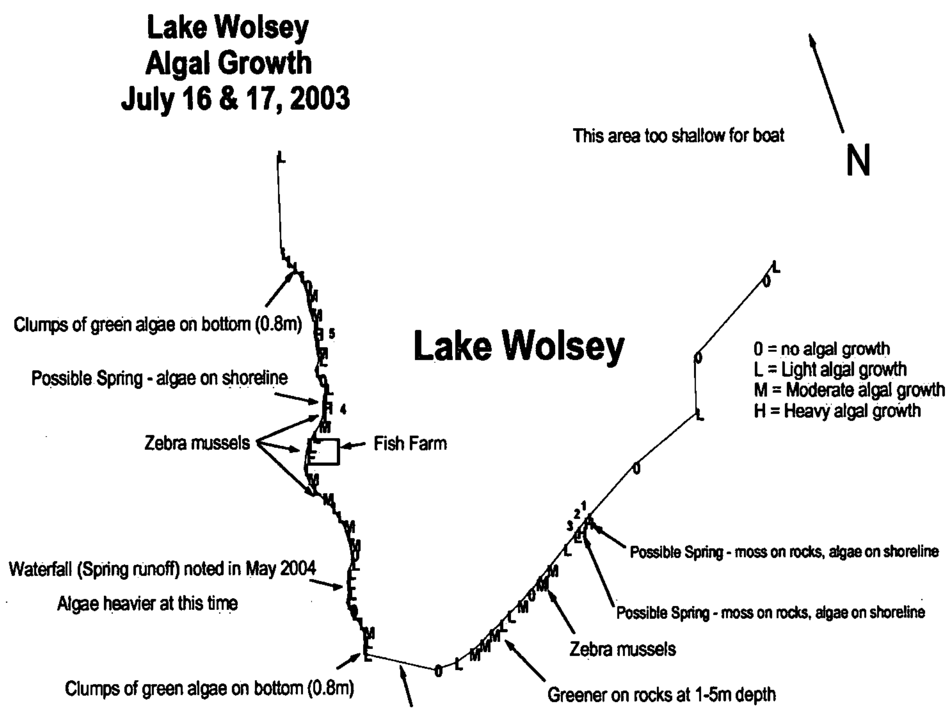
Lake Wolsey
Algal Growth
July 16 & 17, 2003
This area too shallow for boat
N
Lake Wolsey
0 = no algal growth
L = Light algal growth
M = Moderate algal growth
H = Heavy algal growth
Clumps of green algae on bottom (0.8m)
Possible Spring - algae on shoreline
Zebra mussels
Fish Farm
Waterfall (Spring runoff) noted in May 2004
Algae heavier at this time
Clumps of green algae on bottom (0.8m)
Area too shallow for boat
Greener on rocks at 1-5m depth
Zebra mussels
Possible Spring - moss on rocks, algae on shoreline
Possible Spring - moss on rocks, algae on shoreline

Fig. 2

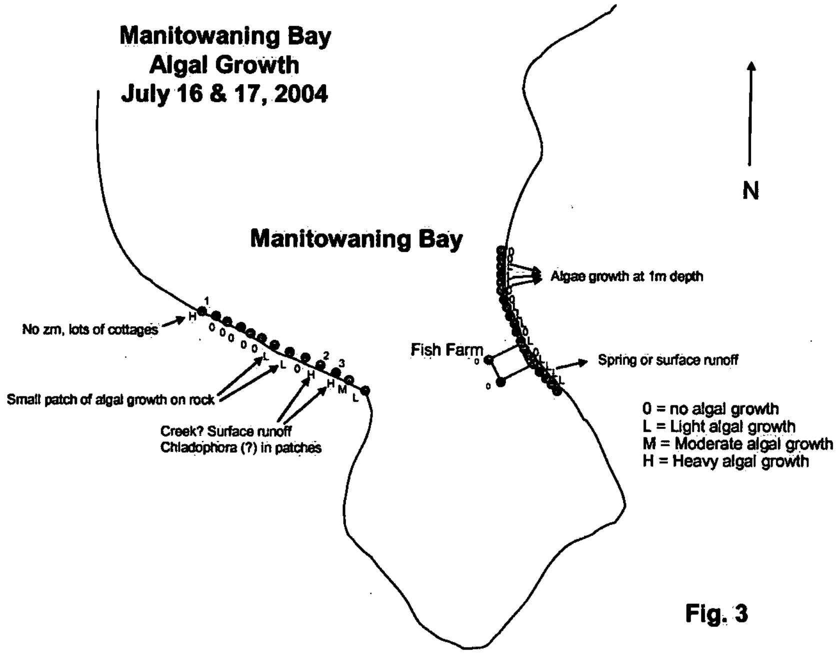
Manitowaning Bay
Algal Growth
July 16 & 17, 2004
N
Manitowaning Bay
Algae growth at 1m depth
No zm, lots of cottages
Fish Farm
Spring or surface runoff
Small patch of algal growth on rock
Creek? Surface runoff
Chladophora (?) in patches
0 = no algal growth
L = Light algal growth
M = Moderate algal growth
H = Heavy algal growth

Fig. 3

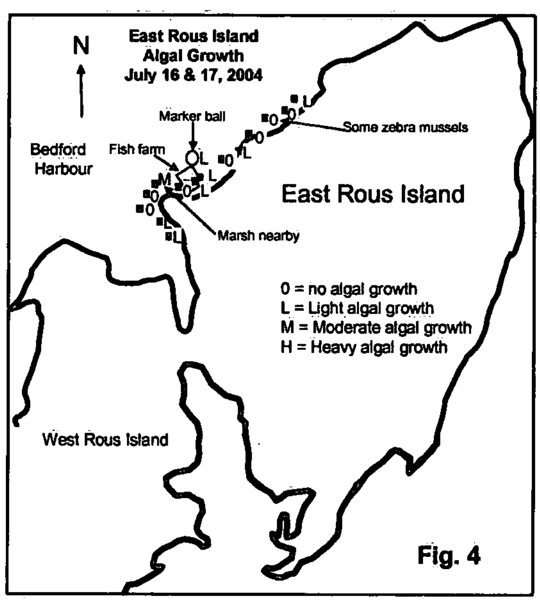
N
East Rous Island
Algal Growth
July 16 & 17, 2004
Marker ball
Some zebra mussels
Bedford
Harbour
Fish farm
East Rous Island
Marsh nearby
0 = no algal growth
L = Light algal growth
M = Moderate algal growth
H = Heavy algal growth
West Rous Island

Fig. 4

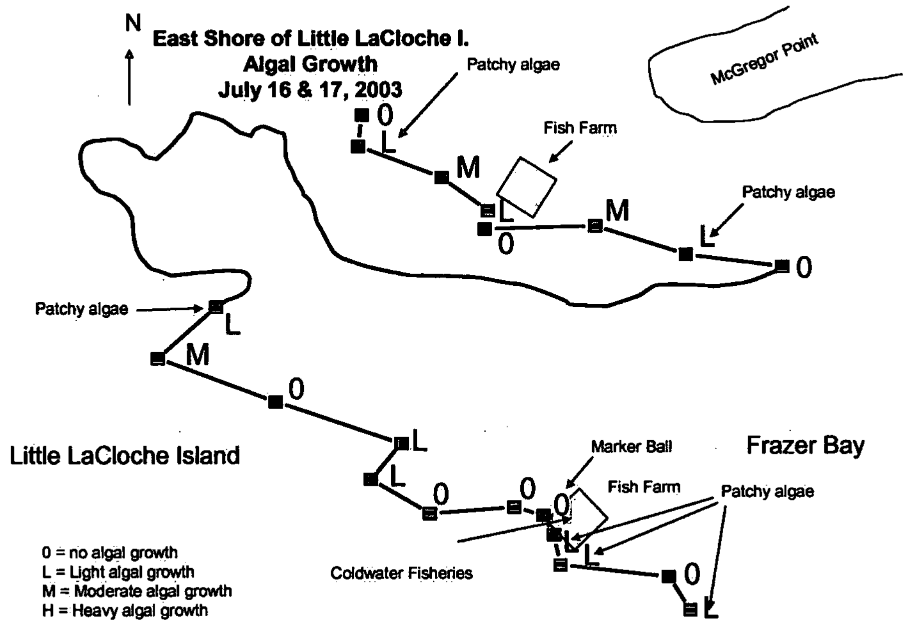
N
East Shore of Little LaCloche I.
Algal Growth
July 16 & 17, 2003
Patchy algae
McGregor Point
Fish Farm
Patchy algae
Patchy algae
Little LaCloche Island
Marker Ball
Frazer Bay
Fish Farm
Patchy algae
Coldwater Fisheries
0 = no algal growth
L = Light algal growth
M = Moderate algal growth
H = Heavy algal growth

Fig. 5

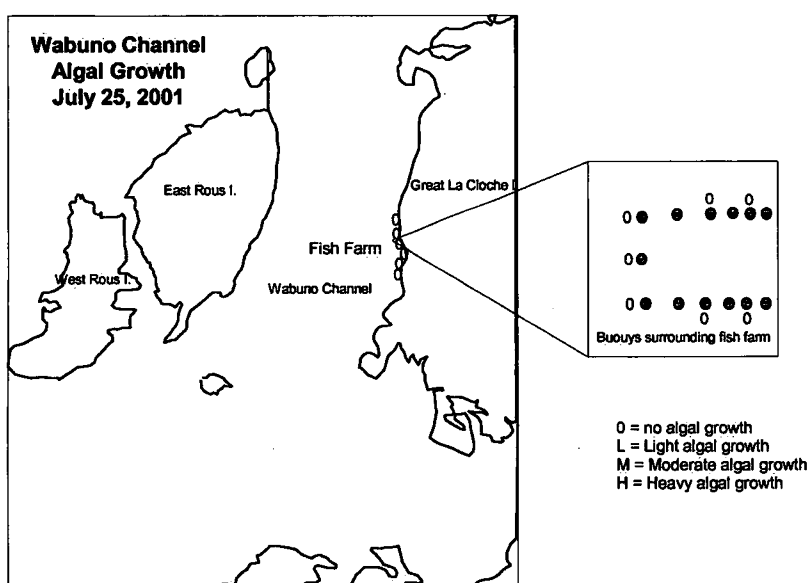
Wabuno Channel
Algal Growth
July 25, 2001
East Rous I.
West Rous I.
Great La Cloche I
Fish Farm
Wabuno Channel
Buouys surrounding fish farm
0 = no algal growth
L = Light algal growth
M = Moderate algal growth
H = Heavy algal growth

Fig. 6

Eastern Island
North Channel
June 18, 2005

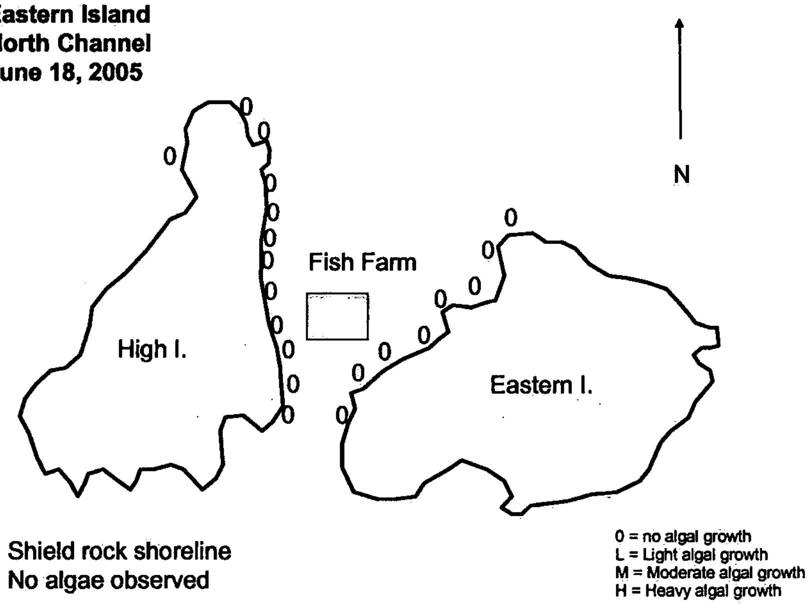

Fig. 7

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