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Central and Arctic Region

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Science Advisory Report 2015/050

ASSESSMENT OF THE IMPACTS OF DREDGING ON FISH SPECIES AT RISK IN LAKE ST. CLAIR, ONTARIO

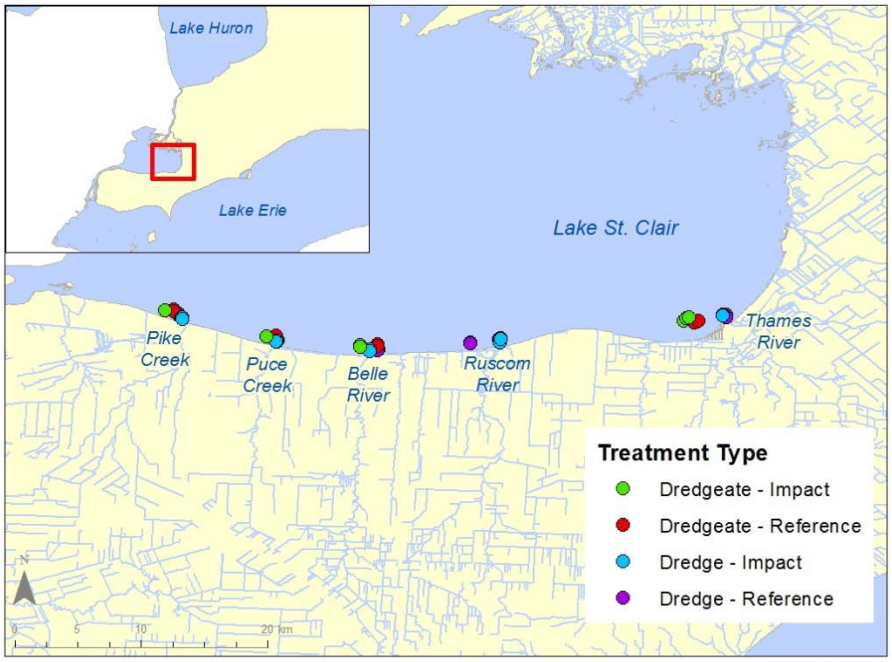

Figure 1. Location of dredging and dredgeate (impact, reference) survey sites within Lake St. Clair, Ontario.

Context:

Annual dredging in harbour mouths is undertaken to maintain safe and navigable waterways along the Lake St. Clair shoreline (Figure 1). Lake St. Clair, however is home to over 60 fish species, including species at risk fishes. There are concerns that dredging activities may have a negative impact on fish species listed under the federal Species at Risk Act *(SARA), whether directly (e.g., mortality of individuals) or indirectly (e.g., reduction in the amount of suitable habitat). Additionally, the impact of dredgeate disposal on species at risk in Lake St. Clair is currently unknown.*

Fisheries and Oceans Canada (DFO) Science has been asked to determine whether fish species at risk are currently present at dredging and spoil deposition sites (based on historical distribution data) and if these at risk fish are affected, either directly or indirectly by dredging activities, including those associated with the spoil deposition. In addition, DFO Science has been asked to review the potential use of fish salvage as a mitigation strategy and whether there are alternatives to annual dredging or additional mitigation measures that would help reduce the impacts of dredging on fish species at risk and their habitat.

This Science Advisory Report is from the November 28, 2014 regional peer review of the Impacts of Dredging on Fish Species at Risk in the lower Great Lakes Basin. Additional publications from this meeting will be posted on the DFO Science Advisory Schedule as they become available.

SUMMARY

- Newly proposed and ongoing annual dredging activities in harbour mouths in the lower Great Lakes, and specifically along the Lake St. Clair shoreline, may have direct and indirect negative effects on fish currently listed under the federal *Species at Risk Act* (SARA).
- Near shore bathymetric surveys revealed dredgeate disposal locations showed no drastic changes in depth. Therefore, the dredgeate disperses quickly after disposal or the survey locations were not conducted at the dredgeate disposal sites as proposed. Additional research is needed to determine the speed at which dredgeate disperses after disposal.
- Accurate reporting on the location, timing, and depth of dredging and dredgeate disposal locations, as well as an estimate of the volume of substrate dredged, are important to determine the impact that dredging activities have on fish species at risk.
- The dominant substrate within all sampling sites in Lake St. Clair was sand; therefore, the results of this report apply exclusively to areas where the dredgeate is placed on like substrate – in this case sand-on-sand in Lake St. Clair.
- This report did not review the impact of side casting during dredging.
- As no significance difference was detected between impact (dredged and dredgeate) and reference sites, it was concluded that maintenance dredging and dredgeate disposal may not have a significant impact on fishes within the areas along the south shore of Lake St. Clair.
- Considering the apparent low abundance of fish species at risk (a single fish species at risk, Eastern Sand Darter (*Ammocrypta pellucida*) was detected in this study) in the surveyed areas of Lake St. Clair, it is suggested that if sufficient mitigation steps are taken, the direct and indirect impacts to fish species at risk could be considered minimal.
- As no significant difference in fish abundance was noted across repeated trawls, indicating no depletion in fish abundance, trawling for fish salvage purposes prior to maintenance dredging is not a recommended mitigation strategy.
- Considering the apparent low abundance of fish species at risk in the surveyed areas of Lake St. Clair, it is suggested that the current timing window of March 15th to July 15th be maintained and remain flexible.
- This survey was conducted using a Control/Impact design utilizing local reference sites as control sites. Sampling sites were surveyed with no prior knowledge of the last maintenance activity for any location. It is recommended that future research on maintenance dredging impacts be conducted using a before/after/control/impact (BACI) approach. Sampling sites should be sampled immediately before and after maintenance dredging activities. Subsequent surveys of sampling sites should follow a time line of weeks and months after maintenance dredging activities. Reference sites would require sampling during this time to account for local variation in fishes and habitat during sampling.

INTRODUCTION

Dredging of lake sediments to increase depth by removing excess sediments is a common activity along the Lake St. Clair shoreline in order to maintain safe and navigable waterways. However, there are concerns that dredging activities, including dredgeate disposal, may have

an impact on fish species listed under the federal *Species at Risk Act* (SARA), whether directly (e.g., mortality of individuals) or indirectly (e.g., reduction in the amount of suitable habitat).

The objectives of this study were to provide advice on the effects of dredging in the lower Great Lakes on fish species at risk. Specifically, to determine whether fish species at risk are currently present at dredging and dredgeate deposition sites where they were known to exist historically; to determine if fish species at risk are directly or indirectly being affected by the dredging activities both at the dredging and spoil deposition sites; to review the potential use of fish salvage as a mitigation strategy; and, to review whether there are alternatives to annual dredging activities or mitigation measures that would reduce the impacts on fish species at risk and their habitat.

This report summarizes the conclusions and advice from the Canadian Science Advisory Secretariat (CSAS) peer-review meeting, held in Burlington, Ontario on November 28, 2014. Two research documents, one assessing the bathymetry of sites where dredging activities and dredgeate disposal occur (Gardner Costa et al. 2015) and a second that reported the presence of fish species at risk at sites impacted by dredging activities (Barnucz et al. 2015) provide in-depth accounts and references of the summarized information below. Proceedings that document the discussions and conclusions of the meeting are also available (DFO 2015).

ASSESSMENT

Sampling Procedure

Two studies were undertaken to address the impacts of dredging and spoil deposition sites on fish species at risk. The first study, conducted by the University of Windsor, assessed the bathymetry of sites where dredging activities and dredgeate disposal occurred using an unmanned Remote Operated Vehicle for Environmental Research (ROVER) study boat, which collected high-resolution bathymetry data in shallow areas (Gardner Costa et al. 2015). Using these data, substrate profiles and bathymetry were assessed in the navigation channels of Belle River, Pike Creek, Puce River, Ruscom River, Thames River, and Mitchell's Bay. In addition, 1 km^2 zones adjacent to these rivermouths, identified as dredgeate spoil disposal sites, were surveyed to determine whether spoil piles could be detected. Data were interpreted using ArcGIS (ESRI v 10.1) interpretive GPS software.

The second study, completed by DFO Science evaluated the impact of maintenance dredging on fish species at risk by sampling impact sites (dredged, dredgeate) and reference sites (Barnucz et al. 2015). Impact sites were locations experiencing periodic maintenance dredging and dredgeate disposal and reference sites were nearby locations with no known prior disturbance from dredging activities. Impact and reference sites were located in close proximity and had similar depths and substrate type. A repeated trawling survey was conducted to compare the fish community and fish abundance between impacted and reference sites. Habitat parameters were completed following trawling and consisted of: water temperature (°C), water depth (m), and % substrate (qualitative measurement). Three data analyses were performed for this study:

1) comparison of the catch per unit effort (CPUE) between impact sites and reference sites to determine the potential effects of maintenance dredging on fish abundance;
2) comparison of CPUE between seasons to determine if variation in fish abundance was observed between seasons; and
3) comparison of CPUE between repeated trawls to determine if there were variations in fish abundance between repeated trawls within the same sampling event.

All of these analyses were conducted in JMP using ANOVA, Kruskal-Wallis, and ANOVA, respectively.

Results

The results from the bathymetric study showed that navigation channel conditions varied from site to site. Some channels had well-maintained trenches and others were unnavigable by boat. Sites were characterized with little to no vegetation and substrate was generally sand interspersed with some fine clays. Spoil piles were not conclusively identified (it was expected that these sites would be characterized by a marked decrease in depth within the spoil disposal areas) and this suggests that either the dredgeate was not dumped in the specified location or that the spoil sites dissipate quickly (Gardner Costa et al. 2015).

Barnucz et al. (2015) hauled a total of 162 trawls over 54 sites in the second study. These trawling surveys detected 4736 individual fish representing 26 species. However, no fish species at risk were captured at any impact sites (dredged or dredgeate locations). Throughout the study one fish species at risk, Eastern Sand Darter (*Ammocrypta pellucida*), was captured at one reference location. The results of the Barnucz et al. (2015) data analysis showed:

1) no significant difference in CPUE between the dredged and reference sites ($p=0.6414$), and between dredgeate and reference sites ($p=0.9156$).
2) a significant difference in CPUE between spring and fall ($p=0.0026$) and spring and summer ($p=0.0102$). Fish abundance within sites was lowest during the spring and fall sampling periods, which supports the continued use of fisheries timing windows to mitigate impacts of maintenance dredging on the local fish community.
3) no significant difference in CPUE between trawl repeated trawls (three passes) across all treatments ($p=0.4831$). Therefore, repeated trawling is not recommended as a fish removal/savage technique.

These results suggest that the abundance of fish species at risk in these Lake St. Clair areas is likely low. Therefore, the direct impact of maintenance dredging on these fishes is expected to be low.

Sources of Uncertainty

The location of dredgeate disposal site is difficult to determine because Lake St. Clair is shallow near shore; therefore, additional studies are required to study the depths at reference and impact sites.

Sediment transport dynamics in the nearshore of Lake St. Clair are not well understood and these may impact dredging activities and/or dredgeate disposal sites.

The disposal location may change as water levels fluctuate; therefore, water depth should be considered at any proposed spoil site and future studies should address this issue. The bathymetric maps created from this study are a useful tool for determining suitable locations in which to dump dredgeate. In addition, the navigation channel maps created within this bathymetric study will provide guidance on which areas within the channels require maintenance dredging (Gardner Costa et al. 2015).

CONCLUSIONS AND ADVICE

Clearing obstructions from river mouths is necessary to ensure the maintenance of safe and navigable waterways; however, the direct and indirect effects of dredging activities on fish species at risk must be addressed.

Spoil piles could not be clearly identified at any site, which suggests that either the spoil sites dissipate quickly or that their locations were not accurately reported (Gardner Costa et al. 2015). Accurate reporting (e.g., multiple GPS points to accurately delineate a spoil site location, depth, date, time, volume of substrate dredged) is essential to monitoring and collecting data to determine the potential impact of spoil disposal sites.

The results of these two studies apply only to areas where the dredgeate is placed on like substrate (sand-on-sand) in Lake St. Clair. Little to no vegetation was observed at these navigation sites, which suggests that these areas may not be preferred habitat for fish (Gardner Costa et al. 2015).

No significant differences were observed between the impact (dredged and dredgeate) and reference sites; therefore, if sufficient mitigation steps are taken (e.g., appropriate timing windows), the impacts of dredging activities to species at risk would be minimal. See Coker et al. (2010) for full details on mitigation.

No fish species at risk were caught at any impact sites (dredged or dredgeate locations); however, one Eastern Sand Darter was captured at one reference site. These results, as well as the current knowledge of fish species at risk detectability (Dextrase et al. 2014) suggest that, if present, the abundance of fish species at risk (Northern Madtom (*Noturus stigmosus*), Channel Darter (*Percina copelandi*) and Eastern Sand Darter) is very low. Therefore, maintenance dredging, and dredgeate disposal may not have a significant impact on fishes in these areas. Furthermore, any direct or indirect impacts caused by dredging on these fishes is suspected to be low.

Based on the results of this study, implementing fish salvage as a mitigation strategy for maintenance dredging in Lake St. Clair may be difficult. Each survey site was sampled using three repeated passes of a trawl and no significant difference was found among fish abundance (i.e., no depletion). Therefore, the use of trawling for fish salvage prior to maintenance dredging is not a recommended mitigation strategy.

DFO uses restricted timing windows for works in, and near water, which protect fishes during spawning and other critical life history stages (DFO 2014). The period where no in-water work occurs is from March 15 to July 15, however depending on the species of fish present there is some flexibility within this timeframe. The results of this study show that fish abundance within sites was lowest during the spring and fall sampling periods. This result supports the continued use of fisheries timing windows to mitigate impacts of maintenance dredging on the local fish community.

This report reviewed mitigation measures (e.g., using appropriate timing windows, placing dredgeate on like substrate) that would reduce the impacts on fish species at risk and their habitat. No alternatives to annual dredging were discussed.

A repeated measures study should be completed that includes sampling before, immediately after and periodically after dredging and spoil disposal has occurred. This would yield important information regarding: (1) the movement and persistence of spoil piles (a short-lived spoil pile may dissipate before it impacts resident fish or their habitat); and, (2) the impacts of dredging on fish species at risk in Lake St. Clair.

OTHER CONSIDERATIONS

Studies on how disposal of dredgeate in areas with aquatic vegetation affect fish species at risk are required as the potential impacts on the fish community may be higher if the dredgeate alters fish and fish habitat.

Impact of dredging activities on other species at risk (e.g., mussels) was not evaluated during this study although mussel species at risk may occur in these same areas. There is a need to consider how dredging and dredgeate disposal affect other species at risk (e.g., mussels) as this report focused on fish.

SOURCES OF INFORMATION

This Science Advisory Report is from the November 28, 2014 regional peer review of the Impacts of dredging on fish species at risk in the lower Great lakes basin. Additional publications from this meeting will be posted on the DFO Science Advisory Schedule as they become available.

Barnucz, J., Mandrak, N.E., Bouvier, L.D., Gaspardy, R., Price, D.A. 2015. Impacts of dredging on fish species at risk in Lake St. Clair, Ontario. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/018. v + 12 p.

Coker, G.A., Ming, D.L. and Mandrak, N.E. 2010. Mitigation guide for the protection of fishes and fish habitat to accompany the species at risk recovery potential assessments conducted by Fisheries and Oceans Canada (DFO) in Central and Arctic Region. Version 1.0. Can. Manuscr. Rep. Fish. Aquat. Sci. 2904: vi + 40 p.

DFO. 2014. Project near water: Ontario restricted activity timing windows for protection of fish and fish habitat. (Accessed: 10 June 2015)

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Gardner Costa, J., Wang, L., Mackey, S.D., and Ciborowski, J.J.H. 2015. Remote sensing of the bathymetry and substrate of selected areas of Lake St. Clair - using the Remote Operated Vehicle for Environmental Research (ROVER) to detect dredging spoil piles near selected river mouths. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/017. v + 23 p.

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