Recommendations to Protect and Restore the northern Old Ausable Channel and Mud Creek Oxbow Wetlands

Southcott Pines (oldausablechannel.ca)

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Background

The consequences of historic human interventions and development in the Dunes and Mud Creek sub-basins of the Ausable River watershed need to be continually managed to protect existing critical habitat for Species at Risk (SAR) fishes. The Old Ausable Channel (OAC) was cut off from the main river at Port Franks and later at Grand Bend in the late 1800s. Threats to critical habitat from infilling due to reduced flow from these 'cuts' as well as nutrient additions from more recent subdivisions near Grand Bend have been ongoing considerations (e.g., Ausable River Recovery Strategy 2005, Management Plan for the OAC 2008). More recently, changes observed in the Oxbow wetlands south of the cut at Port Franks have also raised concerns.

Objective

To summarize existing and potential monitoring, management and outreach strategies for the protection of critical SAR fish habitat in the northern OAC and Oxbow Wetlands.

SAR Fishes

The OAC and oxbow wetlands provide critical habitat for four SAR fishes (Table 1). In particular, these ecosystems support one of the most significant populations of pugnose shiner and lake chubsucker in Canada. Grass pickerel and northern sunfish are also found in these ecosystems.

The optimal habitat for SAR fishes in the OAC and oxbow wetlands is clear water with native aquatic macrophytes. Reduced water transparency results from particles in the water such as sediment from erosion, algae in the water and/ or bioturbation by carp. As illustrated in the following sections, clear water and low nutrient concentrations support native aquatic macrophytes in these ecosystem whereas reduced water clarity and/or excess nutrients promote nuisance growth and/ or dominance of non-native macrophytes.

Studies in the OAC have confirmed that the non-native Eurasian water milfoil (*Myriophyllum spicatum*) macrophyte is associated with high nutrient concentrations, poor SAR fish habitat quality and is likely exacerbating winter fish kills in the OAC. Jean (2013, 2015a) found that lower total phosphorus concentrations and associated native macrophyte communities provided optimal habitat for SAR fishes in the OAC but higher concentrations were associated with invasive macrophytes and poorer habitat. In addition, fish, including SAR, have been killed in the OAC during three recent winters due to low dissolved oxygen levels when the OAC was covered with ice (Coleman and Jean 2019). Algal and/ or plant biomass decomposes in winter and decreases the amount of dissolved oxygen available for fishes. Jean (2013) recommended various monitoring, management and outreach initiatives (Table 2).

Similar trends have more recently been seen in the oxbow wetlands. For example, prior to 2018, numerous Lake Chubsucker were captured in all age classes. However, in 2018, the same sampling was repeated and very few Lake Chubsucker were captured (Jean, pers. comm.). This drop in SAR fish numbers should be confirmed and if it persists, potential causes should be investigated.

Table 1. SAR fishes that inhabit the OAC and/or oxbow wetlands, their status and habitat preferences and threats (http://cosewic.ca/index.php/en-ca/status-reports).

SAR Fishes	COSEWIC/SARA Status	Habitat Preferences and Threats
Pugnose shiner (*Notropis anogenus*)	Endangered	Prefers clear water with submergent and emergent aquatic vegetation Threats are loss of habitat (including removal and control of vegetation), sediment and nutrient loading
Lake chubsucker (*Erimyzon sucetta*)	Endangered	Prefers clear, still and well vegetated water with low turbidity Threats are siltation, increased turbidity and loss of habitat
Grass pickerel (*Esox americanus vermiculatus*)	Special concern	Prefers warm, slow moving water with extensive submergent and emergent vegetation Threats are low water levels, loss of aquatic vegetation, decreased water transparency and lowering of stream temperature
Northern sunfish (*Lepomis peltastes*)	Special concern	Prefers shallow areas of warm water with little current Threats include turbidity and siltation, invasive round goby, bait fishing

Maintaining Water Levels

As well as critical habitat for SAR fishes, the OAC and oxbow wetlands provide other services such as recreation so management to halt or slow infilling is desirable. The historic cut near Grand Bend converted the OAC from a riverine system into a pond system and if left unmanaged it will eventually transition into a terrestrial system. Wetland ecosystems transition slowly into terrestrial systems through infilling with inorganic and/ or organic materials over time; this process can occur naturally and/or with human activities. Hence, the Oxbow wetlands near Port Franks will also follow this trajectory if left unmanaged.

As well as the upstream historic cut near Grand Bend that restricted flow into the OAC, factors such as proliferation of non-native aquatic plants and nutrient inputs have contributed to infilling in the OAC. This is particularly true in the shallower northern portion of the OAC where less groundwater, eutrophication, landowners adding organic material and the transition from an abundance of native common stonewort (*Chara*) to submergent macrophytes such as the Eurasian water milfoil has occurred.

Although the rates of infilling are thought to be slow, monitoring and mitigation are needed to slow, halt or reverse this process that threatens the critical habitat for SAR fishes in the OAC and oxbow wetlands. A study comparing artificially and naturally disconnected riverine channels showed much shorter lifespans of those naturally disconnected because of the initial sediment infilling that resulted in closing the entrance to flow (Depret *et al.* 2017). Hall (2009) also estimated slow rates of sedimentation (i.e., 0.75 – 1.0 cm/ year) in the OAC that remained about constant between when the dam was built in 1963 until 2009. Less is known about the specific rates of infilling in the oxbow wetlands.

There are current and potential management strategies to manage infilling in these ecosystems. The dam and culvert maintenance mid OAC maintains water levels in the northern section (Management Plan for the OAC Watershed 2008). Although cleaning out deposited sediments could harm SAR fishes and their habitat, mitigation in specific locations where sediment most frequently accumulates may be beneficial. Cabled debris jams are an effective way of controlling erosion, stabilizing riverbanks, increasing riparian vegetation and look more natural than crib walls or gabion baskets (Chang 2020a). Mitigation of nutrients that result in nuisance proliferation of algae and/ or invasive macrophytes such as the Eurasian water milfoil is likely to substantially slow succession in the OAC. Less is known about the mechanisms and potential mitigation approaches for succession in the oxbow wetlands so comparing existing and previous ecological conditions is needed.

Nutrient Management

The potential transfer of nutrients from septic systems to groundwater and ultimately aquatic systems has long been understood. For example, Witton (1986) cautioned that water quality is dramatically affected by nutrients entering surface waters via groundwater from septic systems. He estimated loadings of 5 pounds of nitrogen and 0.25 pounds of phosphorus per person per year for septic systems within 300 feet of a shoreline. The high septic density, sandy soil and high water table surrounding the northern OAC make transfer of nutrients from septic systems to the OAC even more likely.

A comparison between adjacent neighbourhoods with septic systems versus sewers showed analogous results. Measured surface water quality during seasonal high water table showed indications of environmental impacts from septic systems in terms of nutrients, microbial pathogen indicators and other water quality measures such as turbidity and conductivity (Meeroff *et al.* 2014). It is important to note that these effects were not detected when sampling was done when the water table was low.

There is also site-specific evidence that the subdivisions in the northern OAC are causing eutrophication. For example, a paleo-limnological study of northern OAC sediments suggested algal growth increased markedly in the early- to mid- 1980s, coincident with the development of the Huron Woods neighbourhood (Hall 2009). Steinbachs (1999) also found slightly elevated ammonium and phosphate concentrations in the groundwater of the northern OAC that may have originated in septic effluents and fertilizers associated with residential activities (Veliz and Wilson 2006). More recently, Jean (2013) found that the total phosphorus concentrations elevated above water quality objectives in Southcott Pines and Huron Woods were related to poor wetland macrophyte and fish indices (e.g., no SAR found in Southcott Pines).

The residents of Southcott Pines have collaborated on a groundwater tracer study to assess nutrient loadings from their neighbourhood and installed aerators to try and mitigate summer oxygen depressions. Although the groundwater study detected five instances of phosphorus levels above surface water guidelines, the artificial sweetener (acesulfame-K) tracer was not highly correlated with phosphorus and only weakly correlated with nitrogen (Robertson *et al.* 2015). These results are consistent with other studies that found tracer variability reflects differing use of artificial sweetener-containing products (Snider *et al.* 2017) so a combination of multiple chemical and physical tracing approaches should be employed to detect septic tank effluent (Richards *et al.* 2017). The three water aerators installed in two locations in 2010 and 2011 showed variable and localized increases in oxygen levels and decreases in the density of vegetation.

Septic maintenance, streamside restoration and property naturalization (Chang 2020b) in the short term and transitioning to a sewer system in the long term are consistent with the understanding of nutrient, oxygen, macrophyte and SAR fish impacts of residential areas to the northern OAC. Pinery Provincial Park has installed sewers and nutrient concentrations remain within guidelines, native *Chara* dominates the macrophyte community and SAR fishes and habitat are present in the OAC within the park. Biological Oxygen Demand (BOD) is a measure of how much oxygen will be used to break down organic compounds (such as algae) in water. Therefore, adding BOD to the parameters measured in existing monitoring (e.g., nutrient concentrations) will help predict the extent of oxygen limitation. The northern OAC is more sensitive to anthropogenic stressors due to less groundwater input and shallower water depths so even stronger mitigation than in the Pinery may be required to achieve the same level of restoration.

Aquatic Macrophytes

As with infilling and nutrients, the overall goal of monitoring, management and outreach concerning aquatic macrophytes is to slow, halt or preferably restore anthropogenic changes in OAC and oxbow wetland communities. Aquatic macrophytes would not have been as abundant in the original early 1800s river channel but ideally a community dominated by the common stonewort (*Chara*) would be restored, similar to the community upstream of the dam in Pinery Provincial Park. As described previously, a *Chara* dominated macrophyte community is much more favorable for SAR fishes than the current non-native Eurasian water milfoil community in the northern OAC. Similarly, the goal for the Oxbow Wetlands would be to prevent, reduce or preferably eliminate invasive plants such as *Phragmites*.

A study of macrophyte communities in the Grand Bend to Port Franks area showed that total phosphorus, conductivity, water depth and light penetration were key determinants in wetland condition (Wiklund 2013, Figure 1). The study showed that both water quality and wetland conditions in 2012 were good in the two Oxbow Wetlands (L Lake and Old River Mouth), moderate for most sites in the OAC, except for the Southcott Pines subdivision in the northern OAC which had poor/ impaired conditions. Eurasian water milfoil (*Myriophyllum spicatum*) dominated communities were associated with high phosphorus and conductivity whereas *Chara* dominated communities were common in locations with more light penetration and increased depth.

Similarly, (Schincariol *et al.* 2004) concluded *Chara vulgaris* was the dominant species north of the OAC dam whereas macrophytes such as Eurasian water milfoil suggested eutrophication adjacent to subdivisions in the northern OAC and below the dam. *Chara* was associated with very low turbidity and elevated calcium and magnesium carbonates and bicarbonates in the OAC. Dominance by macrophytes such as the Eurasian watermilfoil (i.e., *Myriophylulum spicatum - Elodea canadensis or Vallisneria americana - Potamogeton pulcher* dominated communities) were associated with higher turbidity and nutrient rich water.

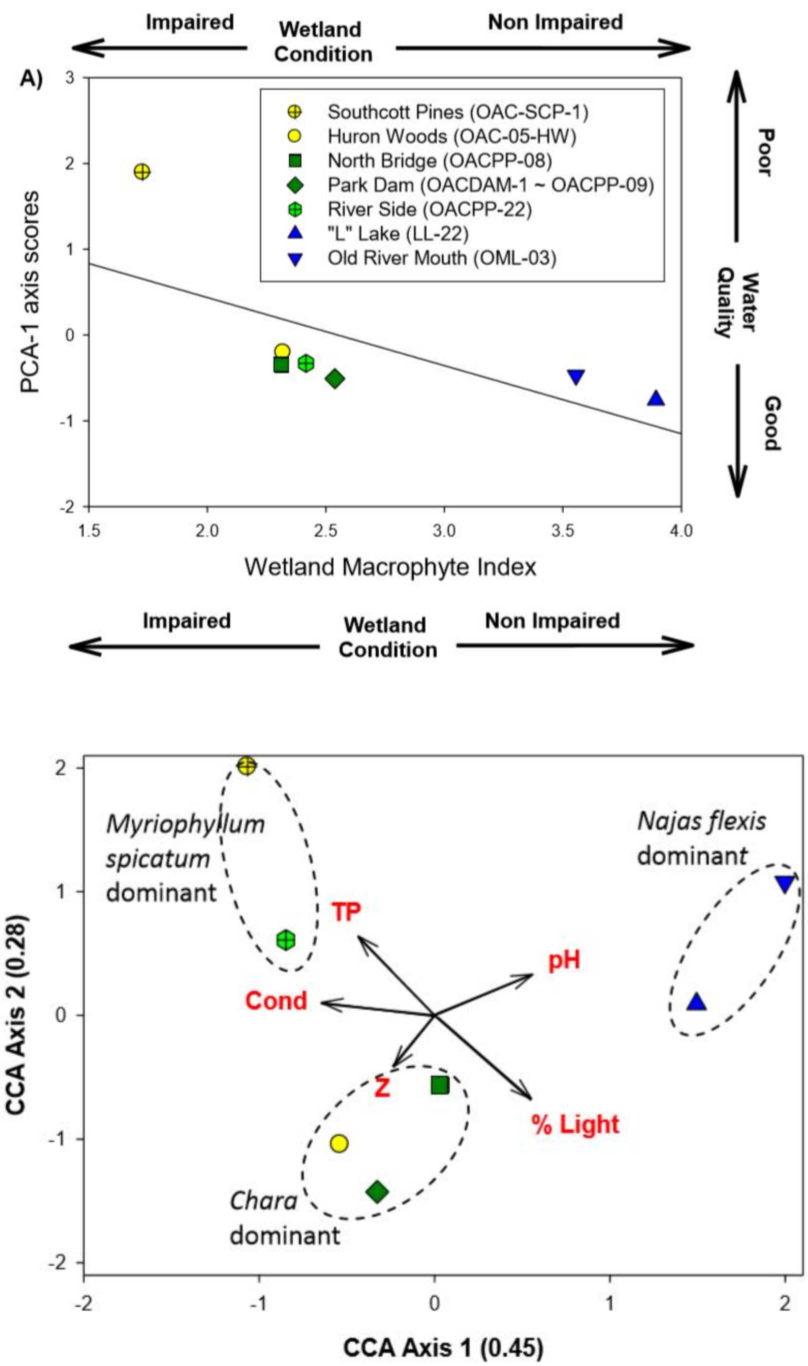

Figure 1. Relationship between wetland condition and water quality in OAC and Oxbow Wetlands (L Lake and Old River mouth, From Wiklund 2013).

Traditional Eurasian water milfoil control methods (e.g., harvesting or herbicides) are not appropriate for the SAR fish habitat in the OAC however, methods such as bottom shading and/ or biomanipulation (see next section) maybe effective. Although control with herbicides was quite effective for controlling milfoil, many herbicides and their associated surfactants are banned in Canada and/ or have shown to be hazardous in the aquatic environment (e.g., Hussner *et al.* 2017). For example, glyphosate can be very noxious in ponds and toxicity can be exacerbated by water quality characteristics such as low oxygen (e.g., Pérez et al. 2011). Although some studies have concluded the benefits outweigh the risks of using herbicides to control nuisance aquatic plants in Canada, unforeseen issues such as toxicity of certain surfactants used to apply herbicides have become apparent (e.g., Breckels and Kilgour 2018). Using herbicides in the rare, critical SAR habitat of the OAC and oxbow wetlands should be avoided until there is a better understanding of the specific chemical, physical and biological interactions involved.

Alternatively, an international review of management and control of invasive freshwater aquatic plants listed various bottom-shading and biological control agents that have been shown to effectively control *Myriophylulum spicatum* (Hussner *et al.* 2017). For example, jute matting can control milfoil while allowing growth of comparatively fine stemmed native charophytes. Hand-weeding of milfoil could be used as an interim measure, particularly in the Southcott Pines location, until the suitability control with bottom shading and /or biomanipulation (see next section) is more thoroughly investigated.

With respect to the oxbow wetlands, *Phragmites* is difficult to eradicate once established so early detection and/ or prevention initiatives are warranted. Potential control methods include herbicide application, mowing/ cutting, compression/rolling, prescribed burning, hand pulling, flooding and tarping (e.g., https://www.opwg.ca/wp-content/uploads/2017/06/Phragmites_BMP_FINAL.pdf). Although herbicide applications are the most effective method, they must be used in conjunction with other methods, should not be used in areas with standing water and will eliminate other desirable species. Phragmites is a significant problem in many regions so research on prevention, control and eradication is advancing quickly.

Biomanipulation

Restoration of the northern OAC from its current turbid water state to the desirable clear water state could be achieved through various biological restorations or biomanipulations. Anything that increases the abundance of piscivores (fish eating fish), decreases undesirable zooplankton eating fish, increases zooplankton and/ or decreases phytoplankton (Figure 2) could increase the desirable macrophytes such as Chara that are important SAR fish habitat. In addition, a reduction in the number of turbidity-producing carp would likely be as beneficial to the OAC as it was in the Cootes Paradise Marsh (Ausable River Recovery Strategy 2005, Thomasen and Chow-Fraser 2011). Other examples include catch-and-release piscivore fishing, bait fish bans and removal or relocation of non-native fishes.

Enhancing the abundance of the milfoil weevil is another example of biomanipulation. Borrowman *et al.* (2014) have outlined the following justification for using a native milfoil weevil (*Euhrychiopsis lecontei*) for milfoil control. The Eurasian water milfoil has become one of the most invasive aquatic macrophytes in North America and can decrease macrophyte and macroinvertebrate richness and diversity, degrade fish habitat, reduce dissolved oxygen levels, disrupt flow, decrease property values and negatively affect recreational activities. Historic management of milfoil in Ontario was done with mechanical harvesters and herbicides but they can exacerbate the problem by removing beneficial native macrophytes. Native milfoil weevil (*Euhrychiopsis lecontei*) populations have been augmented in southern Ontario lakes as a method of biological control of milfoil. Favorable water quality conditions and limiting predation by sunfish are examples of attributes required for effective control of milfoil by weevils.

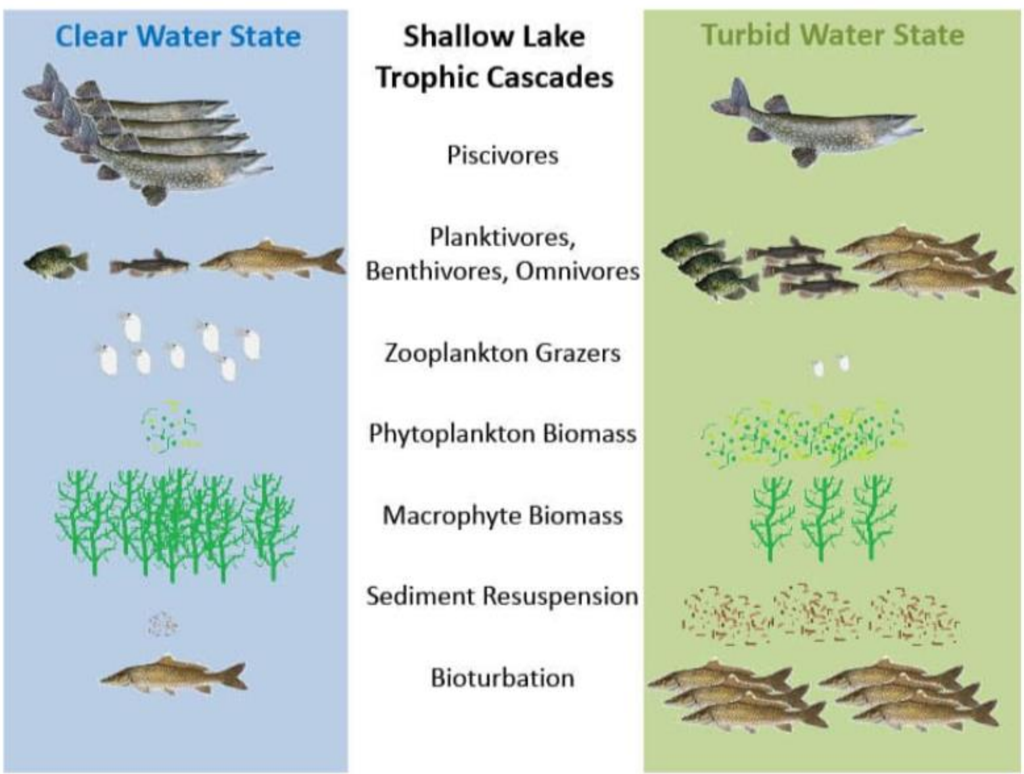

Figure 2. Trophic cascades in shallow lakes with carp (https://www.wenck.com/news/off-the-hook-carp-and-shallow-lake-ecology/)

Whole Ecosystem Approach

A Whole Ecosystem Approach is recommended to achieve the goal of protecting and restoring critical habitat for SAR fishes in the northern OAC and Mud Creek Oxbow Wetlands (e.g., Ausable River Recovery Strategy 2005, Management Plan for the OAC 2008). Following this approach, all components of the ecosystems within the watersheds are considered. For example, less conspicuous nutrient loadings from groundwater are considered along with more conspicuous additions from adjacent sources and tributaries. Examples of strategies in a Whole Ecosystem Approach range from encouraging landowners throughout the watershed to naturalize their properties to promoting a desirable trophic cascade in aquatic ecosystems.

The Landowner's Guide to OAC Living (Chang 2020b) provides recommendations such as septic maintenance, streamside restoration and property maintenance. A strip of native vegetation adjacent to the OAC is a relatively obvious way to protect the ecosystem. However, strategies throughout the watershed would be beneficial. For example, the Toronto and Region Conservation Authority provides guidance on building and maintaining a rain garden (https://trca.ca/news/complete-guide-building-maintaining-rain-garden/). Rain gardens replace a low lying area of lawn to absorb and naturally filter runoff from the grass, roof and/ or driveway on a property. They contain loose, deep soil and native plants that prevent pollutants such as fertilizers, pesticides, bacteria and salt from ending up in storm and ultimately surface waters.

Currently there is a wide range of knowledge and stewardship among landowners in the northern OAC and oxbow wetlands watersheds. The goal is to enhance communication with all landowners. This will involve promoting enhanced stewardship in certain areas as well as supporting the existing activities of more proactive and knowledgeable land owners.

Summary of Recommendations

The northern OAC and Mud Creek Oxbow Wetlands are part of one of the most unique and diverse ecosystems in the province and country. Summarizing the current ecological understanding of these ecosystems has highlighted the interactions among SAR fishes, water levels, aquatic macrophytes, nutrient management and whole ecosystem restoration. In particular, the summary has also highlighted the limited current information on the Mud Creek Oxbow Wetlands. A summary of selected previous recommendations are summarized in Table 2. Consistent with previous assessments, a whole ecosystem approach is recommended for monitoring, management and outreach related to these important ecosystems.

Table 2. Summary of selected existing monitoring, management and outreach recommendations.

Source	Monitoring	Management	Outreach
Old Ausable Channel Literature Review (Veliz and Wilson 2006)		Maintain low turbidity & nutrients, increase streamflow and water depth	
Ausable River Recovery Strategy (2005)	Develop and implement specific OAC fish sampling protocol inside and outside of Pinery Provincial Park	Evaluate the impacts and feasibility of controlling pugnose shiner and lake chubsucker predators and common carp in the OAC	Evaluate the feasibility of prohibiting the use of live baitfishes in the OAC (inside and outside of Pinery Provincial Park)
Management Plan for the Old Ausable Channel Watershed (2008)	Estimate rate of succession (e.g., water levels, sediment depth)	Investigate potential mitigation measures to slow succession and infilling	
	Determine effects of lawn chemicals and septic impacts on water quality		Promote native buffer strips and septic inspections, maintenance & repair
OAC SAR Fishes Habitat Monitoring (Jean 2015a)	Enhance SAR fishes and habitat monitoring, study relationship between nutrients and aquatic macrophytes	Revisit OAC management plan and Ausable River action plan recommendations	Involve community in monitoring, threat identification and stewardship actions
	Continue DO monitoring, identify groundwater inputs and oxygen refuge areas (i.e., telemetry)	Develop landowner nutrient mitigation and aquatic vegetation control options	Work with OAC Management Plan committee to direct recovery actions

Although recommended short-term initiatives should help slow deterioration of the northern OAC and Mud Creek Oxbow Wetlands, more challenging and long-term measures are needed to protect and restore these unique ecosystems and their critical SAR habitat. The recommendations provided in this report are summarized below. As noted in previous assessments (e.g., Ausable River Recovery Strategy 2005, Management Plan for the OAC 2008), these recommendations should be re-evaluated and updated on a regular basis, as we gain a better understanding of the interactions among SAR fishes, succession, macrophyte communities, water quality, anthropogenic stressors and climate change.

Ongoing Recommendations

- Ensure protection and restoration of SAR fish populations by documenting their abundance, habitat quality and ecological requirements
- Establish water level indicators, monitoring frequency, benchmarks and management goals
- Maintain and/ or restore a clear water state to protect SAR habitat such as *Chara* dominated macrophyte communities
- Improve understanding of the interactions among SAR fishes, succession, macrophyte communities, water quality, anthropogenic stressors and climate change
- Ensure information from older literature (e.g., 2006 OAC Literature Review) are incorporated into newer reports to prevent the problem of sliding benchmarks
- Research and consider the effects of climate change on management decisions
- Maintain and enhance communication between ABCA and land owners

Shorter-term Recommendations

- Initiate a monitoring program in the Oxbow Wetlands comparable to that in the OAC (e.g., aquatic macrophyte and SAR fish monitoring)
- To maintain water depth, continue maintenance (e.g., OAC dam) and test the efficacy of shoreline erosion control and removal of sediments in high erosion areas
- Use hand-weeding to reduce the abundance of the Eurasian water milfoil in Southcott Pines and assess the feasibility of more effective control measures (e.g., bottom shading, biomanipulation)
- Encourage ecologically responsible septic maintenance, streamside restoration and property maintenance (e.g., naturalization, installing rain gardens)
- Investigate the steps required to transition the northern OAC residential neighbourhoods from septic to sewer systems and promote sewer systems for any new developments in the watershed

Longer-term Recommendations

- Develop programs to prevent, control and where possible eliminate invasive aquatic macrophytes such as Eurasian water milfoil and *Phragmites*
- Facilitate the transition of the northern OAC residential neighbourhoods from septic to sewer systems through communication, education and collaboration
- Collaborate with landowners in the OAC and oxbow wetland watersheds to use a whole ecosystem approach to protect the unique and diverse ecosystems

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