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Evaluating Beneficial Use Impairments in wetlands of the Massena Area of Concern using biotic, water quality, and landscape indicators

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ABSTRACT

Wetlands along the St. Lawrence River were severely impacted by habitat alteration and contamination as a consequence of construction of the St. Lawrence Seaway and the Moses–Saunders power dam, and associated industrial development. Due to environmental degradation, the St. Lawrence River at Massena, New York has been designated as an Area of Concern (AOC) in the Laurentian Great Lakes. Within this AOC, there is an information gap on the current status of two Beneficial Use Impairments (BUIs): (1) loss of fish and wildlife habitat and (2) degradation of fish and wildlife populations. Both BUIs have the same evaluation endpoint: no difference between the AOC and comparable reference areas outside of the AOC. We evaluated coastal and palustrine wetlands by surveying biological, water quality, and landscape indicators within a sample of 17 wetlands in the AOC and 10 reference wetlands outside the AOC to establish georeferenced indices of biotic integrity and water quality. We did not detect a difference between the AOC and reference wetlands in any of the 14 biotic and 16 water quality metrics, but did find a difference in landscape setting. AOC wetlands were smaller and fewer, especially for woody wetlands. These results suggest that wildlife habitat quality and communities are not impaired in AOC wetlands yet it would be beneficial for additional key fish and wildlife assemblages and habitat types to be surveyed, multi-year monitoring of key biotic indicators implemented, and more specific redesignation criteria for wetland habitat and matrix landscape composition defined and met.

Introduction

Many aquatic habitats within the Laurentian Great Lakes watershed have suffered degradation due to population growth and industrialization since the 19th century (Dahl, 1990; Environment Canada and the USEPA, 2005). As a result, in 1987, the International Joint Commission identified 43 Great Lakes Areas of Concern (AOCs) throughout the United States and Canada pursuant to the Great Lakes Water Quality Agreement. Within each AOC, fourteen Beneficial Use Impairments (BUIs) were assessed in the initial process (Stage I) to identify degradation. The St. Lawrence River (SLR) at Massena (NY) and Cornwall (ON) bi-national AOCs were originally listed because of elevated levels of heavy metals and polychlorinated biphenyls (PCBs) in the waters, fish tissue, and sediments of the SLR and local tributaries (NYSDEC, 1990). The SLR at Massena AOC currently has two BUIs and five likely and unknown BUIs; it also has a unique 15th BUI addressing trans-boundary impacts (NYSDEC, 2006b).

Following the drafting and implementation of the Stage II Remedial Action Plan (RAP), the SLR at Massena AOC Remedial Action Committee (RAC) concluded that data remained insufficient on the present status of the confirmed BUI no. 14, loss of fish and wildlife habitat and the suspected BUI no. 3, degradation of fish and wildlife populations (NYSDEC, 2006a). These two related BUIs are known or suspected to be affected by the physical disturbance associated with the construction and use of the St. Lawrence Seaway and the Moses–Saunders hydroelectric power dam, water quality degradation, and sediment contamination originating from nearby industrial sites. Affected habitats include shorelines and riparian zones, fish spawning beds, fish passages between the main-stem SLR and tributaries, nesting and feeding areas for birds, and inland wetlands. Affected wildlife populations include any that bioaccumulate contaminants such as PCB and mercury, and those known or suspected to be affected by physical and biotic changes to the river, its shoreline, and its coastal and nearby inland wetlands (NYSDEC, 2006a).

Previously, various entities have been monitoring water quality and animal populations within the limnetic and littoral zones of the SLR at Massena AOC and at nearby locations (Bode et al., 2004; NYSDEC, 2013; Twiss et al., 2010). However, much less attention has been given to habitat quality and biological diversity of freshwater wetlands

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within the AOC. The coastal riverine and palustrine wetlands of the SLR provide essential wintering, migratory stopover, and breeding habitat for waterfowl and other birds, spawning and foraging areas for fish, and critical habitat for many threatened species of plants and animals (NYSDEC, 1990, 2005).

The purpose of this study is to aggregate data on biodiversity, water quality, and landscape features to determine whether BUI no. 3 and no. 14 are presently impaired in the wetland component of the SLR at Massena AOC. For the Massena AOC, the redesignation endpoints for both BUI no. 3 and BUI no. 14 are specified by the RAC as no significant differences in fish and wildlife habitat or fish and wildlife communities between the AOC and appropriate reference areas outside the AOC (NYSDEC, 2012). However, little guidance is provided as to what data are valid, necessary, and sufficient to make a determination as to whether the redesignation endpoints have been achieved. Our study is one of very few evaluating Great Lakes AOCs to focus on BUI nos. 3 and 14, and the first to use a combination of environmental indicator and GIS-based landscape analyses. Our assessment is intended to provide the information needed by the Massena AOC RAC to evaluate whether these two BUIs can now be classified as unimpaired, or alternatively what forms of environmental mitigation and management are needed to bring about recovery, as the State of New York is working to satisfy the national obligation to the Great Lakes Water Quality Agreement at this AOC. While our study was intended to address information needs for the Massena AOC RAP, our approach and methodology may provide a useful model for other AOCs striving to assess and meet redesignation requirements for these BUIs.

Methods

Site description

Unless otherwise stated, in this paper the term "AOC" refers specifically to the SLR at Massena AOC. The wetlands surveyed in our study were located in St. Lawrence County, New York State, USA in the towns of Massena (pop. dens. 89/km^2) and Louisville (pop. dens. 19/km^2; Fig. 1). Both towns are located on the shore of the SLR and together encompass 310 km^2. The boundary of the AOC includes a 25 km section of the SLR that encompasses the Moses–Saunders hydroelectric power dam, the Long Sault Dam, the Eisenhower and Snell lock system, and the sections of three tributaries: the Raquette, St. Regis, and Grasse rivers. The natural land cover of the area is dominated by northern hardwood forest (Gawler, 2008). Massena (including areas of the town outside the AOC) has a higher proportion of developed land cover (15%) than Louisville (4%), but both towns have equal proportions of agricultural land cover (11%). Forested and emergent wetlands make up approximately 12% of Louisville and 7% of Massena (Homer et al., 2015).

The redesignation endpoints for both BUI no. 3 and BUI no. 14 are defined as no significant difference in fish and wildlife habitat and populations between the AOC and reference areas outside the AOC (NYSDEC, 2012). Our study is designed to specifically address these redesignation targets for freshwater wetlands. We selected seventeen wetlands (eight SLR coastal wetlands and nine palustrine wetlands) within the AOC and ten reference sites (five coastal and five palustrine) from outside of the

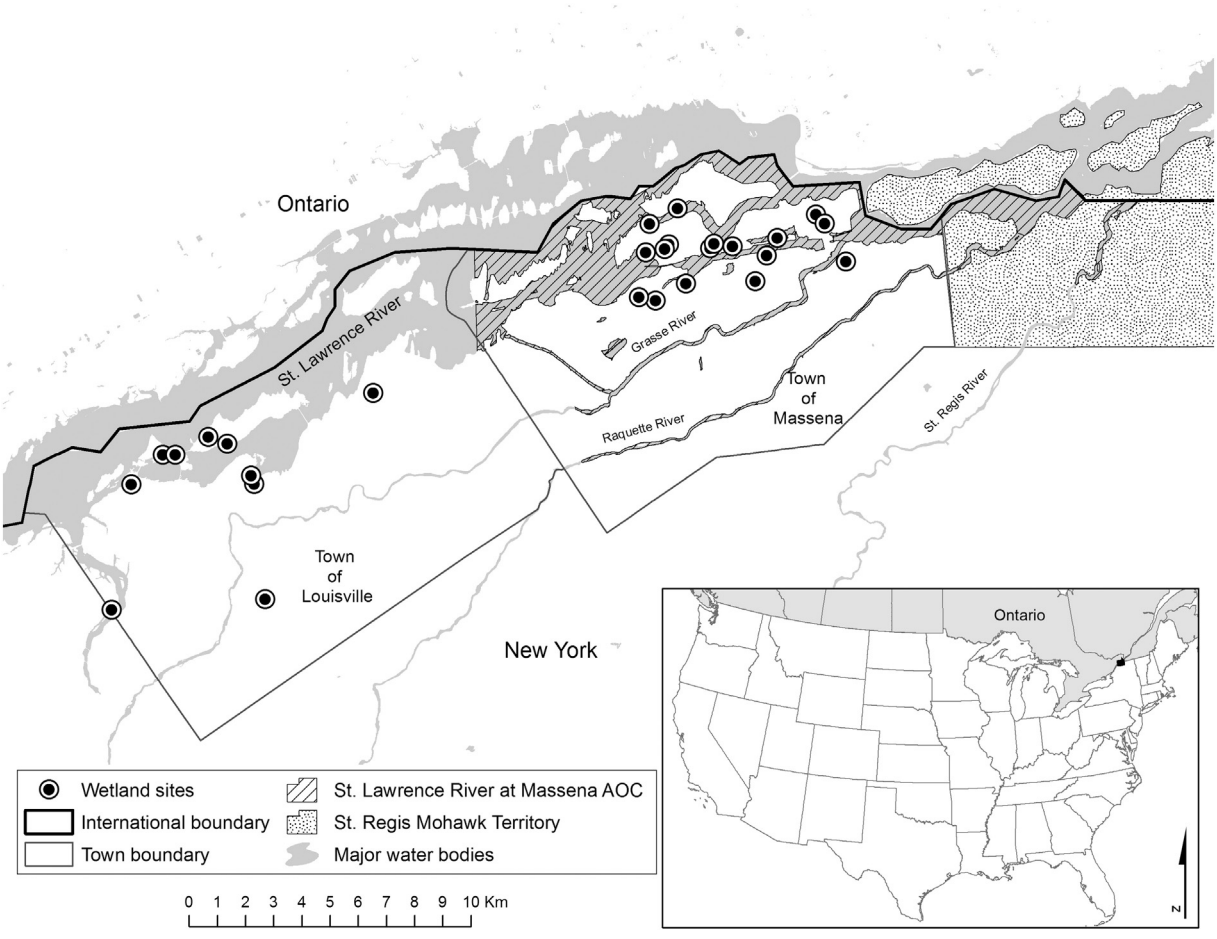

Fig. 1. Surveyed wetlands in the St. Lawrence River at Massena Area of Concern and reference area in Louisville, NY.

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