Bay of Quinte Area of Concern: Coastal Wetland Assessments and Remedial Action Plan Delisting Target Recommendations

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March 2006

Environment Canada – Canadian Wildlife Service

Executive Summary

The Bay of Quinte was designated as a Great Lakes Area of Concern (AOC) in 1985 due to problems with the chemical, physical and biological integrity. Eleven of 14 possible impaired beneficial uses (IBUs) were identified here including: degradation of fish and wildlife populations and loss of fish and wildlife habitats (i.e., IBUs 3 and 14).

There has been much effort directed toward improving and restoring the aquatic ecosystem of the Bay of Quinte to address the IBUs. This process has included evaluations of the Bay of Quinte ecosystem, nature and causes of impairments, and the development and implementation of a restoration plan.

In most cases, before specific restoration actions can be undertaken, the magnitude of impairment must be evaluated. These evaluations have been occurring for many IBUs, but there is a lack of available data for fish and wildlife populations and their habitats in Bay of Quinte coastal wetlands.

This report details how the implementation of a regional coastal wetland monitoring framework can be used to assess: 1. fish and breeding bird communities, and 2. elements of fish and wildlife habitats, in the Bay of Quinte AOC coastal wetlands.

In 2005, pilot data were collected in several Bay of Quinte coastal wetlands. Water quality, submerged aquatic vegetation (SAV), aquatic macroinvertebrates, fish, and breeding marsh birds were evaluated and reported using indices.

In general, Bay of Quinte AOC coastal wetlands had good water quality and biotic communities that were in very good or excellent condition relative to other coastal wetlands occurring along the Canadian shoreline of Lake Ontario.

In this report, suggested refinements to delisting criteria and measures of success for habitat and fish and wildlife population IBUs are made in reference to the Bay of Quinte RAP Restoration Council (BQ RAPRC) Report "Bay of Quinte RAP Monitoring and Delisting Strategy IBU Assessment Statements". For coastal wetland fish and breeding bird communities, recommended measures of success could include showing that these communities are among the best in Lake Ontario. Coastal wetland fish and breeding bird community data should be used together with available data from existing programs (i.e., near- and off-shore fish communities assessment, upland bird community surveys) to provide a better representation of overall fish and wildlife community condition in the Bay of Quinte.

For loss of fish and wildlife habitats, it is recommended that indices be used to evaluate various elements of habitat in coastal wetlands, (i.e., water quality, submerged aquatic vegetation, and aquatic macroinvertebrates). Although there are other variables that contribute to overall habitat quality in coastal wetlands, this approach can provide a tool to monitor habitat quality and determine whether the measures of success (i.e., no

decrease in habitat condition) are met. These assessments can be used to augment existing near- and off-shore water quality, aquatic invertebrate, and SAV data for the purpose of refining delisting criteria of IBU 14 - Loss of fish and wildlife habitat.

The index approach used in this report provides a method for the BQ RAPRC to assess and monitor fish and breeding bird communities and elements of habitat quality in Bay of Quinte AOC coastal wetlands. This method is useful to the BQ RAPRC because it can provide quantitative data to monitor measures of success throughout the delisting process.

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Acknowledgements

This report was written by Greg Grabas (Environment Canada – Canadian Wildlife Service; EC-CWS). Comments on drafts were provided by Nancy Patterson (EC-CWS), Lesley Dunn (EC-CWS), Shawn Meyer (EC-CWS), Joel Ingram (EC-CWS), Paul Johanson (Quinte Conservation), Carolyn O'Neill (Environment Canada – Restoration Programs Division), and Scott Millard and Susan Doka (Fisheries and Oceans Canada).

Data for this study were collected by Environment Canada – Canadian Wildlife Service, and Central Lake Ontario Conservation Authority with contributions from Toronto and Region Conservation Authority and Ganaraska Region Conservation Authority.

Pilot study direction and advice were provided by Bay of Quinte RAP Restoration Council, Quinte Conservation, Cataraqui Region Conservation Authority, Lower Trent Conservation Authority, Fisheries and Oceans Canada.

Financial support from Environment Canada –Canadian Wildlife Service and Environment Canada's Great Lakes Sustainability Fund is gratefully acknowledged.

Cover Photos: Environment Canada – Canadian Wildlife Service.

Introduction

Bay of Quinte Area of Concern

In 1985 the International Joint Commission identified the Bay of Quinte as a Great Lakes Area of Concern. This designation was due to problems with the chemical, physical and/or biological integrity within the Bay of Quinte. These problems are called Impaired Beneficial Uses (IBUs). Eleven of 14 possible IBUs were identified for the Bay of Quinte (Table 1).

Table 1. Impaired Beneficial Uses identified in the Bay of Quinte Area of Concern.

Impaired Beneficial Use		
#	Description	Designation
1	Restrictions on fish and wildlife consumption	Impaired
2	Tainting of fish and wildlife flavour	Not impaired
3	Degradation of fish and wildlife populations	Impaired
4	Fish tumours and other deformities	Impaired
5	Bird or animal deformities or reproduction problems	Not impaired
6	Degradation of benthos	Impaired
7	Restrictions on dredging activities	Impaired
8	Eutrophication or undesirable algae	Impaired
9	Restrictions on drinking water or taste and odour problems	Impaired
10	Beach closures	Impaired
11	Degradation of aesthetics	Impaired
12	Added costs to agriculture or industry	Needs assessment
13	Degradation of phytoplankton and zooplankton populations	Impaired
14	Loss of fish and wildlife habitat	Impaired

Much effort has been spent improving and restoring the aquatic ecosystem of the Bay of Quinte to address the IBUs. In 1990, the Remedial Action Plan Coordinating Committee, with support from the Public Advisory Committee produced "Stage 1 – Environmental Setting and Problem Definition" as an initial phase of the Bay of Quinte Remedial Action Plan (BQ RAP). The Stage 1 document was a framework for action and intended to:

- describe the Bay of Quinte and its environs;
- outline what is known about past and present environmental conditions, including a description of those beneficial uses that are impaired; and,
- confirm and evaluate the causes of impaired beneficial uses, including sources of pollution.

The second phase of the BQ RAP was completed in 1993 and included the Stage 2 Report – "Time to Act" and the technical reports that resulted from Stage 1. The Stage 2 document identified a comprehensive action plan to restore and protect the Bay of Quinte Area of Concern. It outlined the ecosystem problems, causes, restoration objectives and remedial options as well as an implementation strategy. Stage 2 also identified 80 recommendations to restore beneficial uses and improve water quality in the Bay of Quinte Area of Concern.

Stage 3 of the Remedial Action Plan involves cleanup, monitoring, and delisting. To facilitate this stage, a multi-agency group called the Bay of Quinte RAP Restoration Council (BQ-RAPRC) was formed in 1997. The Restoration Council's mission focuses on "...provision of coordination and facilitation services to restore beneficial uses, delist the Bay of Quinte Area of Concern, promote ecosystem management actions and stewardship, review emerging issues, and seek cost-effective solutions to sustain environmental quality in the Bay of Quinte watershed into the future."

Delisting Targets for Fish and Wildlife IBUs

Since 1997, part of the RAP Restoration Council's work included updating the 1993 Bay of Quinte IBU delisting targets with new scientific data. This parsed most of the IBUs to more logically reflect the specific issues. For example, IBU 3, degradation of fish and wildlife populations, was divided into two components:

- 3.1 – Degradation of fish populations, and
- 3.2 – Degradation of wildlife populations.

Before beneficial uses can be considered restored, it is essential to define an end point for restoration – a delisting target. To define a delisting target, the current state of the IBU must be known. The level of impairment has been well documented for some IBUs, while for others, data are limited or absent.

For IBU 3.1 - Degradation of fish populations, there are sufficient data to report on the state of walleye populations, but limited data exist for other fish species (BQ-RAPRC 2003; Table 2). There is very little information specific to the Bay of Quinte regarding the condition of wildlife populations (BQ-RAPRC 2003). Setting and evaluating delisting targets requires specific knowledge of fish and wildlife communities in several habitats – including coastal wetlands.

Impaired Beneficial Use 14 was also divided to reflect separate fish and wildlife issues:

- 14.1 – Loss of Fish Habitat, and
- 14.2 – Loss of Wildlife Habitat.

To delist these IBUs, function, diversity, and quantity of significant natural fish and wildlife habitat features should be protected to the greatest extent possible (BQ-RAPRC 2003). Plans to attain delisting targets for fish and wildlife habitat impairments rely heavily upon natural heritage strategies (i.e., "Backgrounder – Wildlife and Wildlife Habitat in the Bay of Quinte" and "Bay of Quinte Fish Habitat Management Strategy") which are under development. There are few programs in place to report on the status or quantity of fish and wildlife habitat in the Bay of Quinte (BQ-RAPRC 2003). In particular, there are no programs that specifically address fish and wildlife habitat issues in Bay of Quinte coastal wetlands. Yet BQ RAP (1993) identifies the loss of coastal wetland habitats through urban encroachment as a factor contributing to IBU 14.

The BQ RAP has recently focused on addressing the need for quantitative assessments of coastal wetland fish and wildlife populations and habitat in the Bay of Quinte. This can be achieved through regional coastal wetland monitoring.

Table 2. Existing IBU and delisting targets (Selected text from Tables 5, 6, 29 and 30 in BQ-RAPRC 2003).

IBU #	Description	Delisting Target	Measure of Success (MS)	Do Data Exist to Support MS ?
3.1	Degradation of fish populations	• Demonstrate that key fish and wildlife species (including walleye, bass and pike) are present in numbers consistent with a stable, diverse and healthy aquatic ecosystem	• Demonstrate that key fish and wildlife species are present in numbers consistent with an unimpaired ecosystem • Demonstrate that walleye, bass and pike populations are all self-reproducing and that none of these species dominates the fish community • Demonstrate that targeted fish species are healthy, abundant and self-sustaining in the Bay of Quinte	• Data are available for walleye. • There is less and possibly insufficient data for other fish species such as bass.
3.2	Degradation of wildlife populations	• Demonstrate that key indicator species for upland wetlands and forests are present and in sufficient numbers to be self-sustaining.	• Through wildlife monitoring programs, demonstrate that key indicator species for coastal and upland wetlands and existing forests are present and in significant numbers to be self-sustaining.	• There is very little data or research information specific to the Bay of Quinte RAP area. In most cases, data are collected for the Great Lakes, and from that information, trends in populations are reported. For this Measure of Success, it is assumed that increased populations of birds of prey, waterfowl and songbirds within the Ontario Great Lakes regions suggest increased populations in the Bay of Quinte area.
14.1	Loss of Fish Habitat	• To the greatest extent possible, protect and restore fish habitat in the Bay of Quinte • To the greatest extent possible, protect the quantity, function and diversity of significant natural features as identified in Natural Heritage Strategies completed for partnering municipalities and First Nations fronting the Bay of	• The Natural Heritage Strategies will be completed • The use of the Natural Heritage Strategies will be monitored with respect to municipal planning • A Bay of Quinte Fish Habitat Management Strategy will be completed. • An education and awareness program will be developed and implemented to gain support for the Natural Heritage Strategies and the Fish Habitat Management Strategy	• Work is underway to prepare the required strategies and stewardship program. The actions are not complete. • Official Plan information has been assessed and summarized in the report Prospectus for Implementing Natural Heritage Strategies: Part A – Contrasting Natural Heritage Strategies with Municipal Official Plans. • Natural Heritage Reports have been completed for some Bay of Quinte municipalities including Belleville and Quinte West. Similar reports will be produced for Greater Napanee and Prince Edward County. • Work was initiated in 2003 to develop a Bay of

		Quinte • Encourage municipalities and broad public and sectoral support/advocacy for the Natural Heritage Strategies and Fish Habitat Management Strategies availability, findings and recommendations • Establish a self-sustaining, volunteer, community-based wildlife monitoring program for the Bay of Quinte area	• A stewardship program will be developed and delivered for the protection, creation and rehabilitation of fish habitats identified in the Natural Heritage Strategies and the Fish Habitat Management Strategy	Quinte Fisheries Habitat Management Strategy. A final strategy is pending. • Bay of Quinte RAP targets need to be aligned with the fish community objectives for the Bay of Quinte being considered by the Ontario Ministry of Natural Resources.
14.2	Loss of Wildlife Habitat	• To the greatest extent possible, protect the quantity, function and diversity of significant natural features as identified in Natural Heritage Strategies completed for partnering municipalities and First Nations fronting the Bay of Quinte • Encourage municipalities and broad public and sectoral support/advocacy for the Natural Heritage Strategies availability, findings and recommendations • Establish a self-sustaining, volunteer, community-based wildlife monitoring program for the Bay of Quinte area	• The Natural Heritage Strategies will be completed • The use of the Natural Heritage Strategies will be monitored with respect to municipal planning • An education and awareness program will be developed and implemented to gain support for the Natural Heritage Strategies and the Fish Habitat Management Strategy • A strategy has been developed and implemented for recruiting and coordinating volunteers for existing "wildlife watchers" programs (e.g., Marsh Monitoring Program)	• Official Plan information has been assessed and summarized in the report Prospectus for Implementing Natural Heritage Strategies: Part A – Contrasting Natural Heritage Strategies with Municipal Official Plans. • Natural Heritage Reports have been completed for some Bay of Quinte municipalities including Belleville and Quinte West. Similar reports will be produced for Greater Napanee and Prince Edward County. • Education and awareness actions are underway to promote the Natural Heritage Strategies. Outcomes of the outreach campaign have not been assessed. • Wildlife Watchers actions have been introduced in the Bay of Quinte.

Regional Coastal Wetland Monitoring and Delisting Targets

Over the last century, Great Lakes coastal wetlands have decreased in size and quality or have disappeared entirely in some areas. Government agencies, local groups, and individual citizens have identified the need for conservation and monitoring of these important ecosystems. Through recommendations at the State of the Lakes Ecosystem Conferences, and with United States Environmental Protection Agency funding, the Great Lakes Commission responded by creating the Great Lakes Coastal Wetland Consortium. The Consortium is a bi-national group of scientists and agency personnel responsible for developing coastal wetland health indicators and a basin-wide implementation framework for monitoring.

In support of this effort, and regional requirements for coastal wetland monitoring, the Durham Region Coastal Wetland Monitoring Project (DRCWMP) was initiated in 2002 by Environment Canada – Canadian Wildlife Service (EC-CWS) and the Central Lake Ontario Conservation Authority (CLOCA). The project has been designed to monitor the biological condition of 15 coastal wetlands using a coordinated multi-partnered approach at a regional scale.

In 2004/05, the Great Lakes Sustainability Fund (GLSF) provided funds to EC-CWS to assess the application of DRCWMP regional coastal wetland monitoring framework to support regional monitoring and delisting targets in the Bay of Quinte Area of Concern. The proposed assessment was timely since the BQ RAP Restoration Council was exploring methods to refine delisting targets for impaired beneficial uses involving fish and wildlife.

The assessment of the DRCWMP framework occurred through two workshops that were well attended by federal and provincial governments, conservation authorities, BQ RAP Restoration Council members, Ducks Unlimited Canada, and the Mohawks of Tyendinaga. Workshop recommendations indicated that the coastal wetland monitoring framework used for the DRCWMP could be used in the Bay of Quinte AOC for regional monitoring and as a means of refining delisting targets. A pilot study was recommended to confirm this.

With funding provided by GLSF in 2005/06, EC-CWS initiated a pilot study in 2005 to assess biotic communities (i.e., aquatic macroinvertebrates, submerged aquatic vegetation, marsh birds, and fish) and water quality parameters in a subset of Bay of Quinte AOC coastal wetlands. The results of the assessment are also intended to:

- Support refinement of delisting targets based on the current state of Bay of Quinte coastal wetland fish and wildlife populations and habitats in reference to other Lake Ontario coastal wetlands; and
- Provide the BQ RAP Restoration Council with a tool to monitor and report on the state of Bay of Quinte coastal wetlands throughout the Area in Recovery stage.

General Methods

Site Selection

Eight coastal wetland sites were selected for assessment (excluding Belleville Marsh: See *Field Data Collection* section). In general the sites were selected to represent a range in size, geomorphic type, exposure to human disturbance, and public and conservation interest.

Four of the coastal wetlands, Parrott's Bay, Robinson's Cove, and two sites in Hay Bay were chosen because EC-CWS completed site assessments using the DRCWMP methodology in 2002/03. Three other sites (Big Island, Blessington Creek, and Sawguin Creek) were chosen in consultation with Bay of Quinte agencies including conservation authorities, Ontario Ministry of Natural Resources, Fisheries and Oceans Canada, and the Bay of Quinte RAP Restoration Council. Brief site descriptions[1], colour infrared air photos, and selection rationale are below (Figures 2-9).

Figure 1. Names and locations of Lake Ontario coastal wetlands sampled in 2005.

[1] Data source for sizes and geomorphic type from the Great Lakes Coastal Wetlands Consortium: Inventory and Classification. Accessed at: http://www.glc.org/wetlands/inventory.html on October 20 2005.

Field Data Collection

Water quality and biotic community data (submerged aquatic vegetation, aquatic macroinvertebrates, fish, and marsh birds) were collected at most sites in the summer of 2005 (Table 3). Sampling locations are shown in Figures 2-9. For clarity, the 20 submerged aquatic vegetation sampling points are not shown in the figures. Parrott's Bay, Big Island Marsh West, and Blessington Creek marshes were not sampled for fish due to logistical, safety, or access constraints. Belleville Marsh (not shown) was only included in marsh bird surveys.

As part of EC – CWS coastal wetland monitoring and assessment commitments, several other Lake Ontario wetlands were surveyed (Figure 1) using the same methods as in the Bay of Quinte. Results from these surveys are included in the appropriate sections for comparison purposes.

Brief field data collection descriptions are included in each section. Detailed methodologies for biotic community sampling are available in the Durham Region Coastal Wetland Monitoring Project: Methodology Handbook – Second Approximation. (Environment Canada and Central Lake Ontario Conservation Authority 2003).

Table 3. The number of data collection points for water quality (WQ), submerged aquatic vegetation (SAV), aquatic macroinvertebrates (Inverts), fish, and breeding marsh birds in each Bay of Quinte coastal wetland.

	Number of Stations Surveyed				
Site	WQ	SAV	Inverts	Fish	Birds
Parrott's Bay Marsh	3	20	3	-	-
Hay Bay South	3	20	3	7	9
Hay Bay North	3	20	3	8	15
Big Island Marsh East	3	20	3	8	13
Big Island Marsh West	3	20	3	-	13
Robinson's Cove Marsh	3	20	3	8	2
Blessington Creek Marsh	3	20	3	-	14
Sawguin Creek Marsh	3	20	3	8	18
Belleville Marsh	-	-	-	-	2

Robinson's Cove Marsh
Geomorphic Type: Open Bay
Size: 8.8 ha
Sub-watershed: Prince Edward County Watershed
Selection Rationale: One of the smaller coastal wetlands in the Bay of Quinte. EC-CWS previously collected data on surrounding land use, water quality, marsh birds, amphibians, aquatic macroinvertebrates, and submerged aquatic vegetation at this site.

In the past, much of the surrounding land at this site was agricultural (row crop). As of 2004, the property had exchanged ownership. The new owners of the adjacent land have planted hundreds of trees along the upland perimeter of the wetland and have indicated they plan to reduce the intensity of the agricultural activities on the adjacent land.

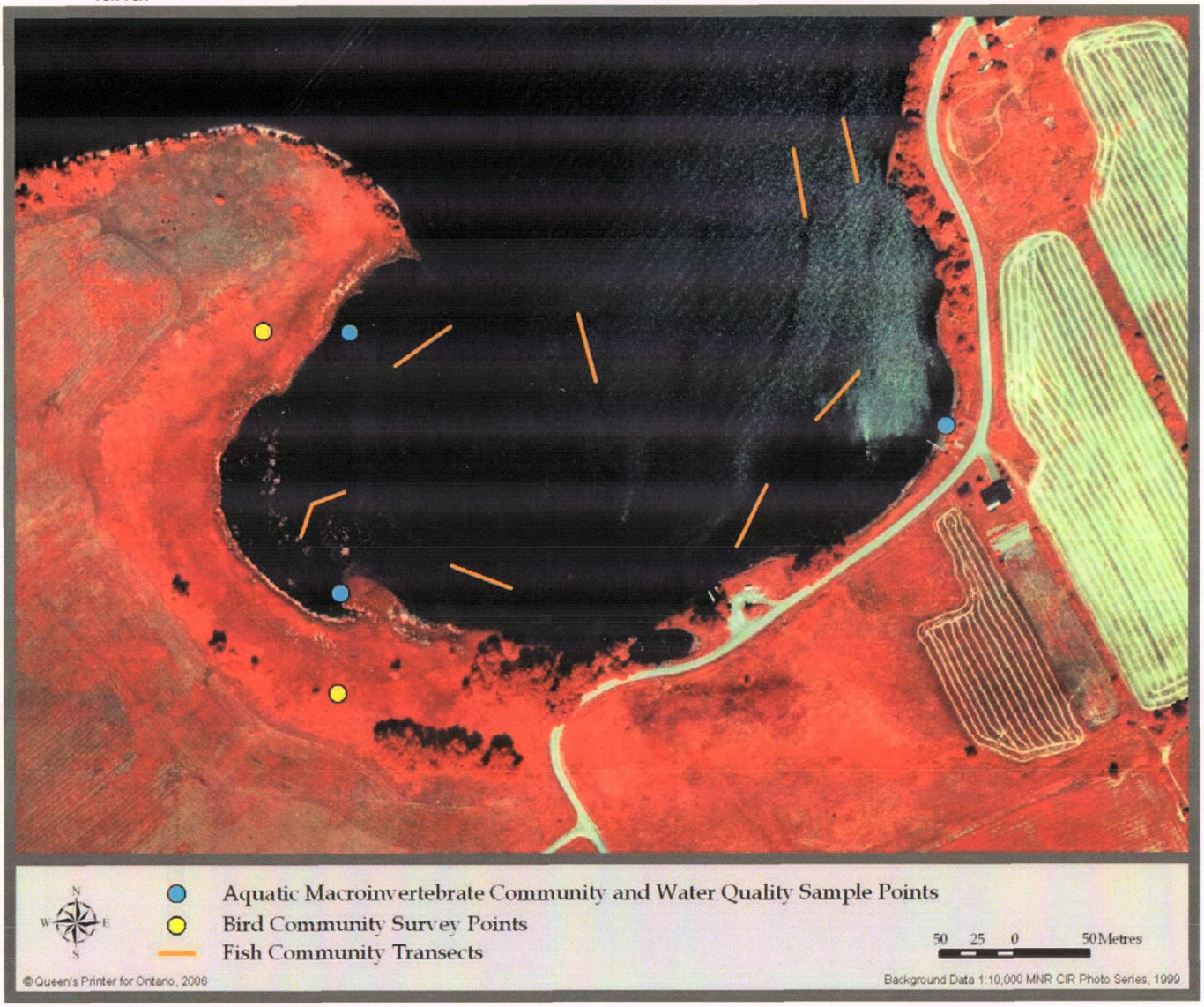

Figure 2. A colour infrared aerial photograph of Robinson's Cove Marsh showing various field sampling locations.

Hay Bay North Marsh
Geomorphic Type: Open Drowned Rivermouth
Size: 307.2 ha
Sub-watershed: Hay Bay Watershed
Selection Rationale: Located at the confluence of Little and Wilton creeks at the northeast end of Hay Bay, this site represents a large riverine coastal wetland. EC-CWS previously collected data on surrounding land use, water quality, aquatic macroinvertebrates, and submerged aquatic vegetation at this site. This site is popular for recreational fishing and waterfowl hunting.

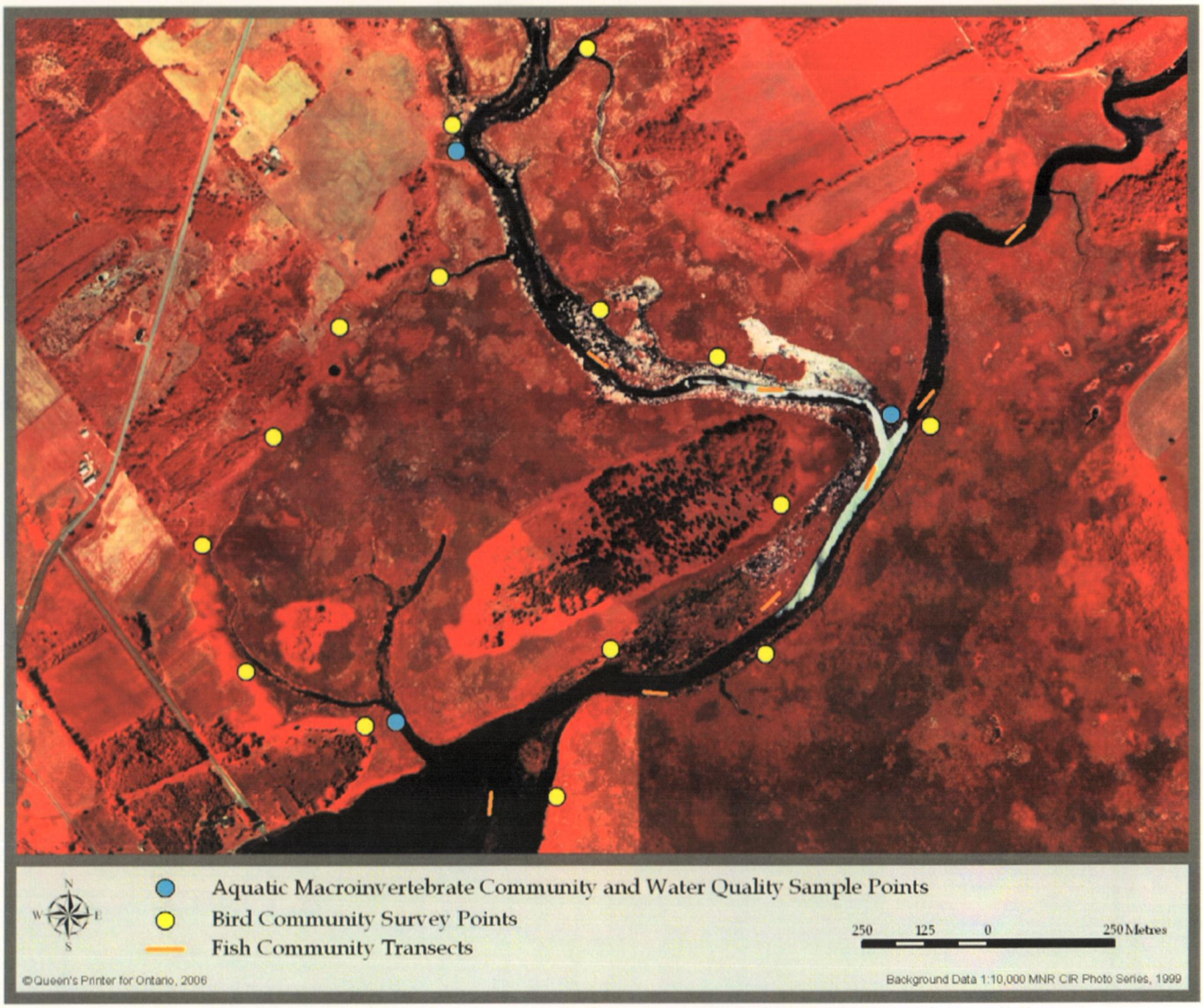

Figure 3. A colour infrared aerial photograph of Hay Bay North Marsh showing various field sampling locations.

Hay Bay South Marsh
Geomorphic Type: Open Bay
Size: 122.0 ha
Sub-watershed: Hay Bay Watershed
Selection Rationale: At the southeast shore of Hay Bay, this wetland is located at the end of a long (more than five km) fetch and is regularly exposed to strong prevailing winds. EC-CWS previously collected data on surrounding land use, water quality, aquatic macroinvertebrates, marsh birds, amphibians, and submerged aquatic vegetation at this site.

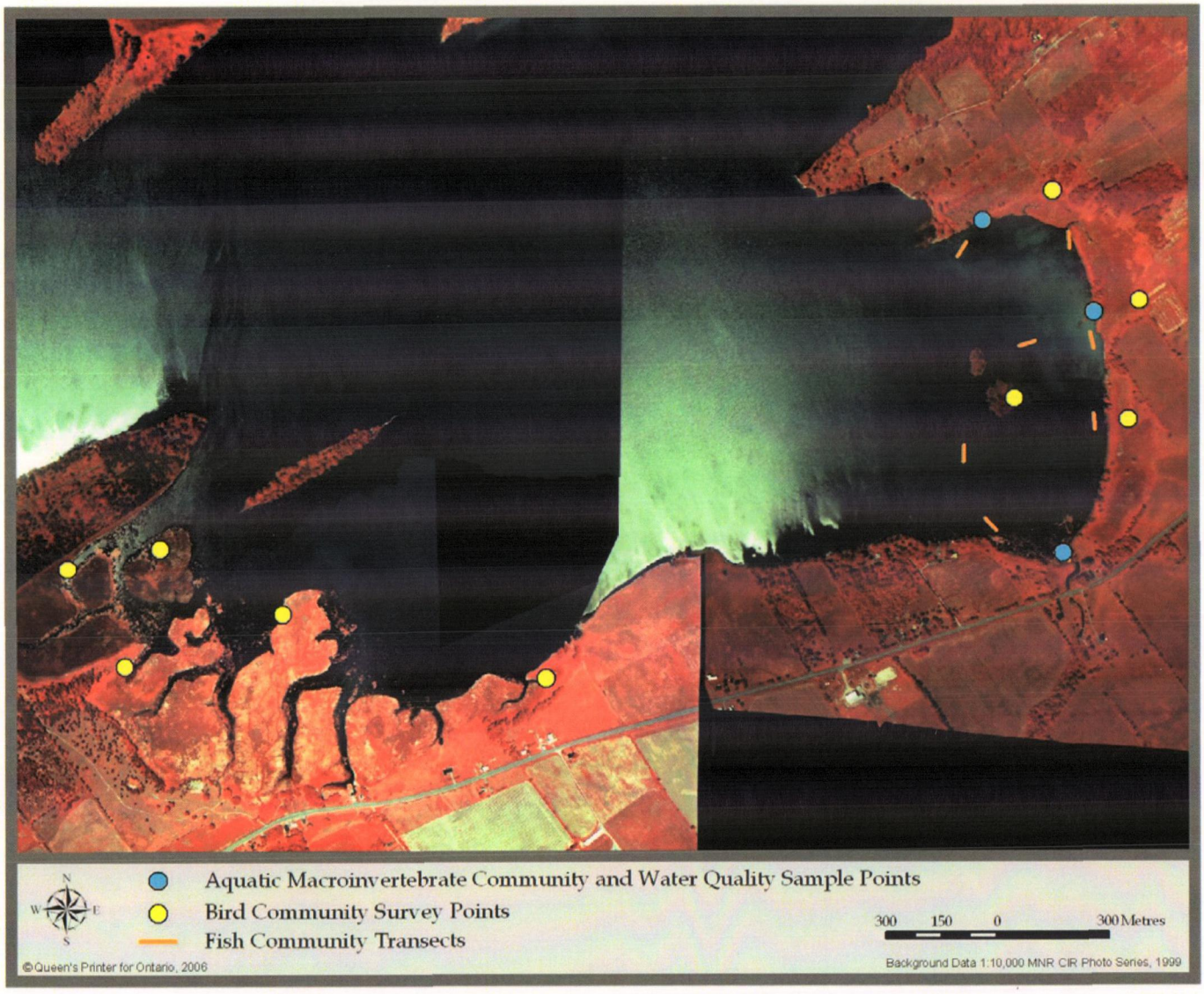

Figure 4. A colour infrared aerial photograph of Hay Bay South Marsh showing various field sampling locations.

Parrott's Bay Marsh
Geomorphic Type: Protected Bay
Size: 29.7 ha
Sub-watershed: Hay Bay Watershed
Selection Rationale: This is the easternmost mainland coastal wetland in the Bay of Quinte. This wetland is exposed to relatively little disturbance compared to other Lake Ontario coastal wetlands and is part of the Parrott's Bay Conservation Area. The wetland is surrounded by forested area – most of which is owned by the Cataraqui Region Conservation Authority. EC-CWS previously collected data on surrounding land use, water quality, aquatic macroinvertebrates, marsh birds, amphibians, fish, and submerged aquatic vegetation at this site.

Figure 5. A colour infrared aerial photograph of Parrott's Bay Marsh showing various field sampling locations.

Blessington Creek Marsh
Geomorphic Types: Protected Bay (96%), Open Drowned Rivermouth (4%)
Size: 113.9 ha
Sub-watershed: Blessington Creek
Selection Rationale: This site was recommended for study by the Bay of Quinte RAP Restoration Council because of the watershed's proximity to Belleville. Located at the east end of the city of Belleville, the majority of the wetland's watershed extends north and east of the city. Currently, the most common land use in the watershed is agriculture, but increasing development pressures are expected.

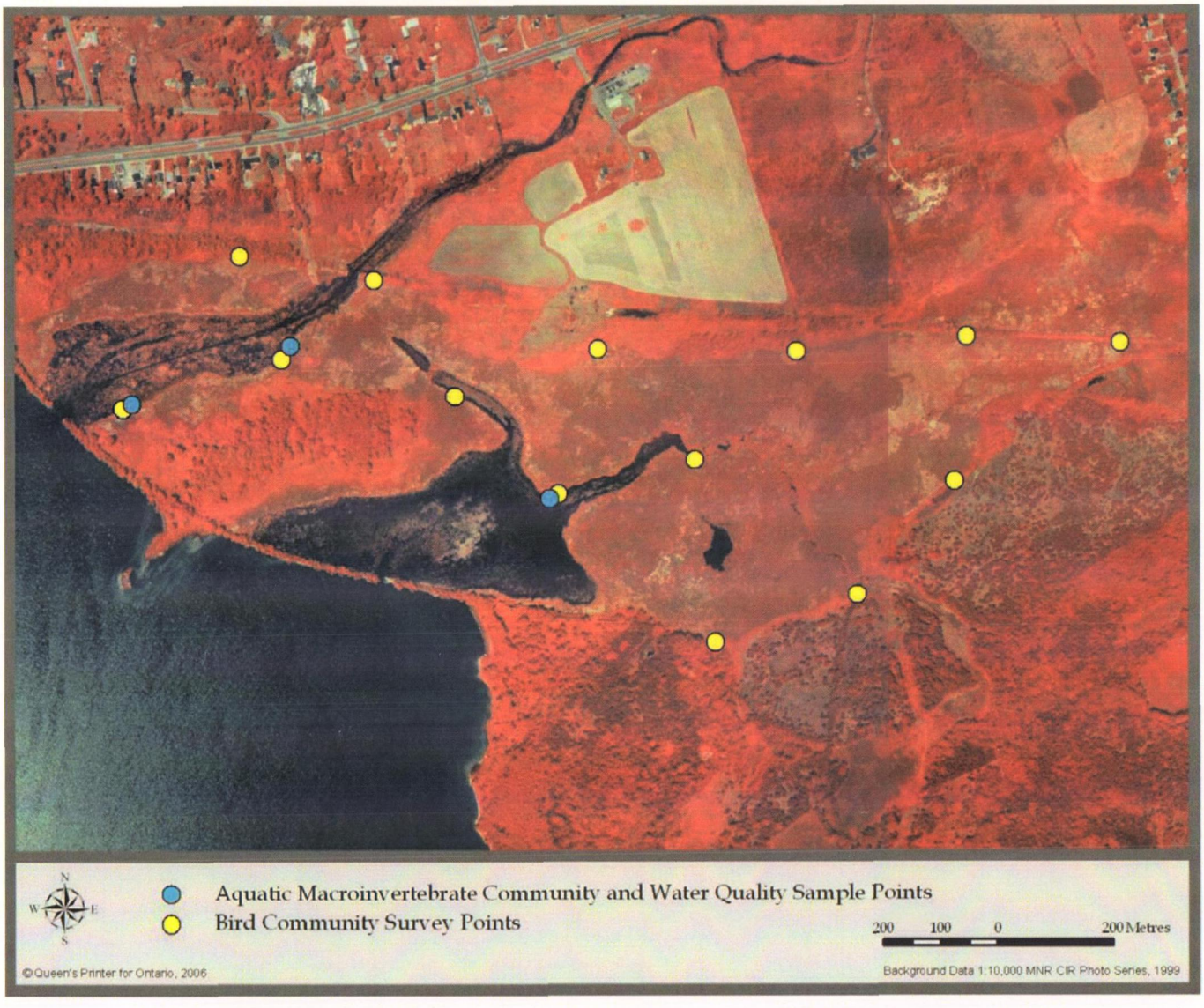

Figure 6. A colour infrared aerial photograph of Blessington Creek Marsh showing various field sampling locations.

Big Island Marsh (East and West)
Geomorphic Type: Protected Bay
Size: 685.4 ha
Sub-watershed: Prince Edward County Watershed
Selection Rationale: Big Island Marsh is another large Bay of Quinte coastal wetland. It has formed between Big Island and the Prince Edward County mainland. Local observations note that the open water area between the island and mainland has been filling in with vegetation and the marsh has been expanding towards the lake at an increased rate since the building of the causeway connecting the mainland to Big Island. Much of this marsh expansion involves cattail (*Typha* spp.) stands advancing toward open water. Habitat restoration through level-ditching has been raised as a potential option for this site. Collecting data before any restoration project is implemented within the marsh gives an excellent opportunity to measure the effect of the project.

Due to its size, Big Island Marsh was separated into sections east and west of the causeway. Although these are not considered separate wetlands, the full suite of sampling was done in each section to give a better representation of the site condition. The two sections are reported upon separately throughout most of this document.

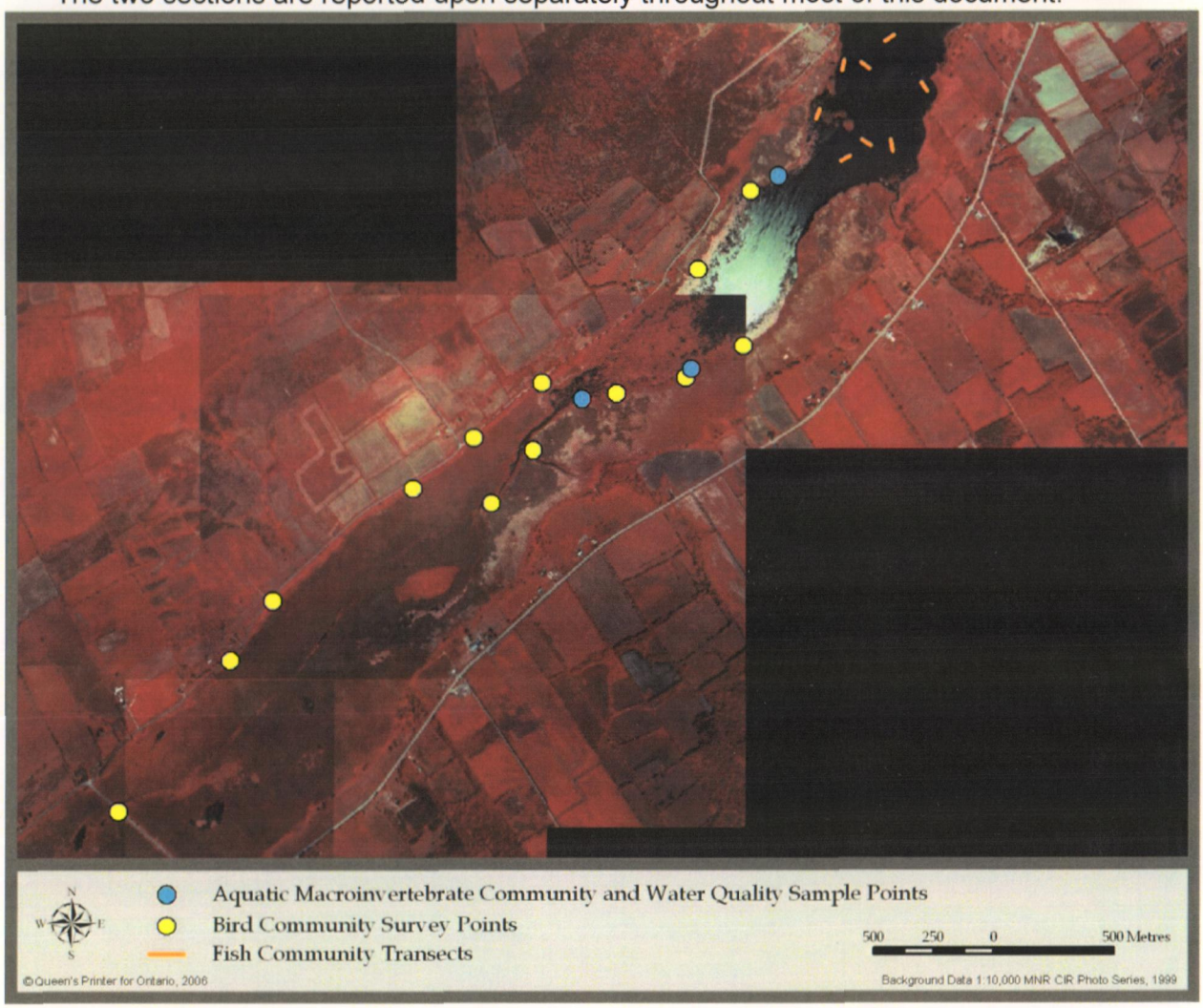

Figure 7. A colour infrared aerial photograph of Big Island Marsh East showing various field sampling locations.

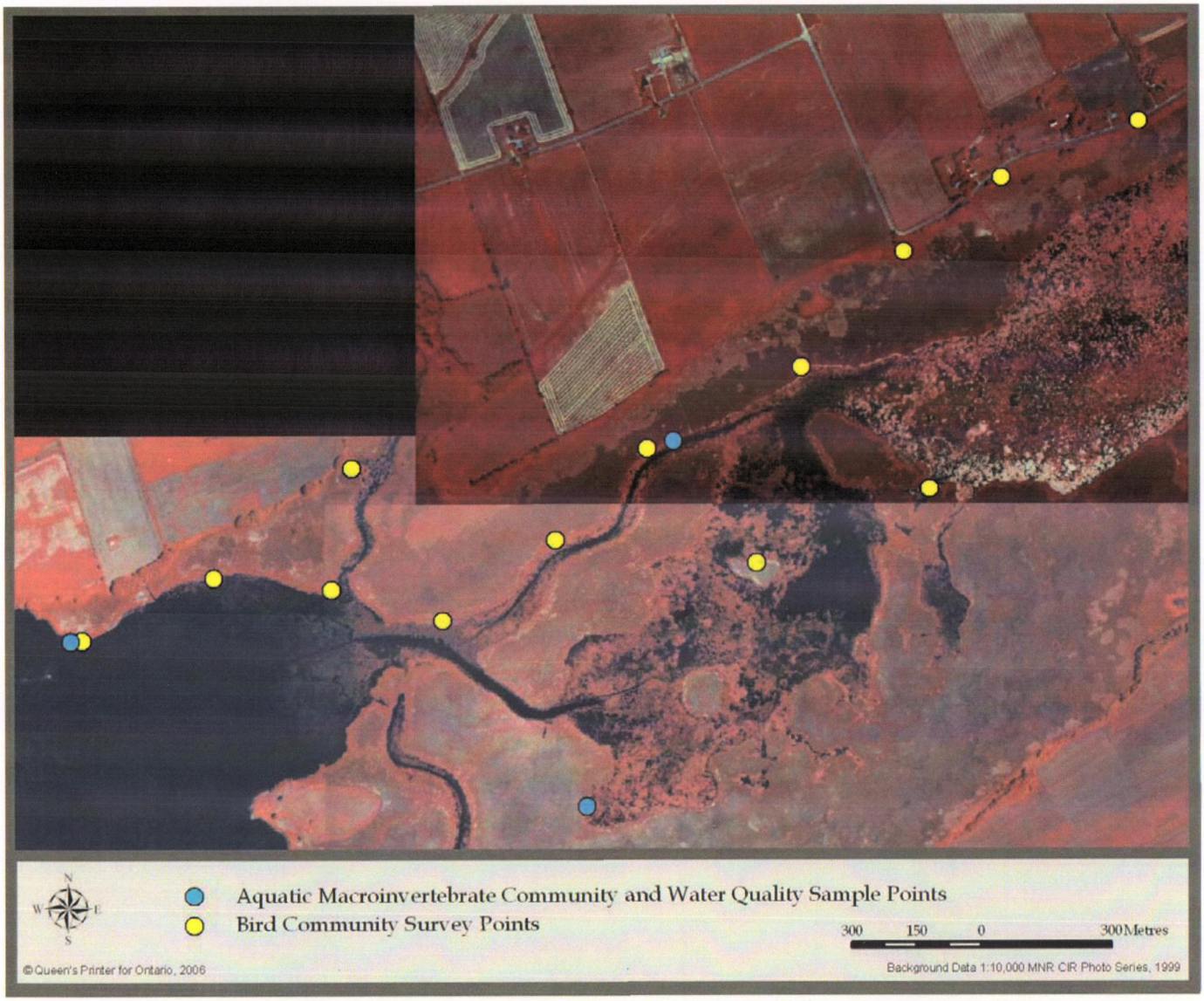

Figure 8. A colour infrared aerial photograph of Big Island Marsh West showing various field sampling locations.

Sawguin Creek Marsh
Geomorphic Types: Open Drowned Rivermouth (54%), Protected Embayment (31%), Open Embayment (10%), Open Shoreline (5%)
Size: 2180 ha
Sub-watershed: Prince Edward County Watershed
Selection Rationale: This wetland has several geomorphic types and is the largest coastal wetland in the Bay of Quinte. During the winter of 1998, a habitat enhancement project was undertaken in the marsh south of Huff's Island. The project involved creating 5.6 kilometres of level ditching within a 98-hectare section of the marsh.

For the 2005/06 pilot, EC-CWS intended to sample the enhanced section of the marsh. However, many of the property owners surrounding this section of the marsh denied access to the marsh through their land. Accessing this section of the marsh through navigable water was possible but intensive and deemed not practical. Access to the marsh, and the subsequent study area, were limited to sections north of Huff's Island using the causeway on Marsh Road for access.

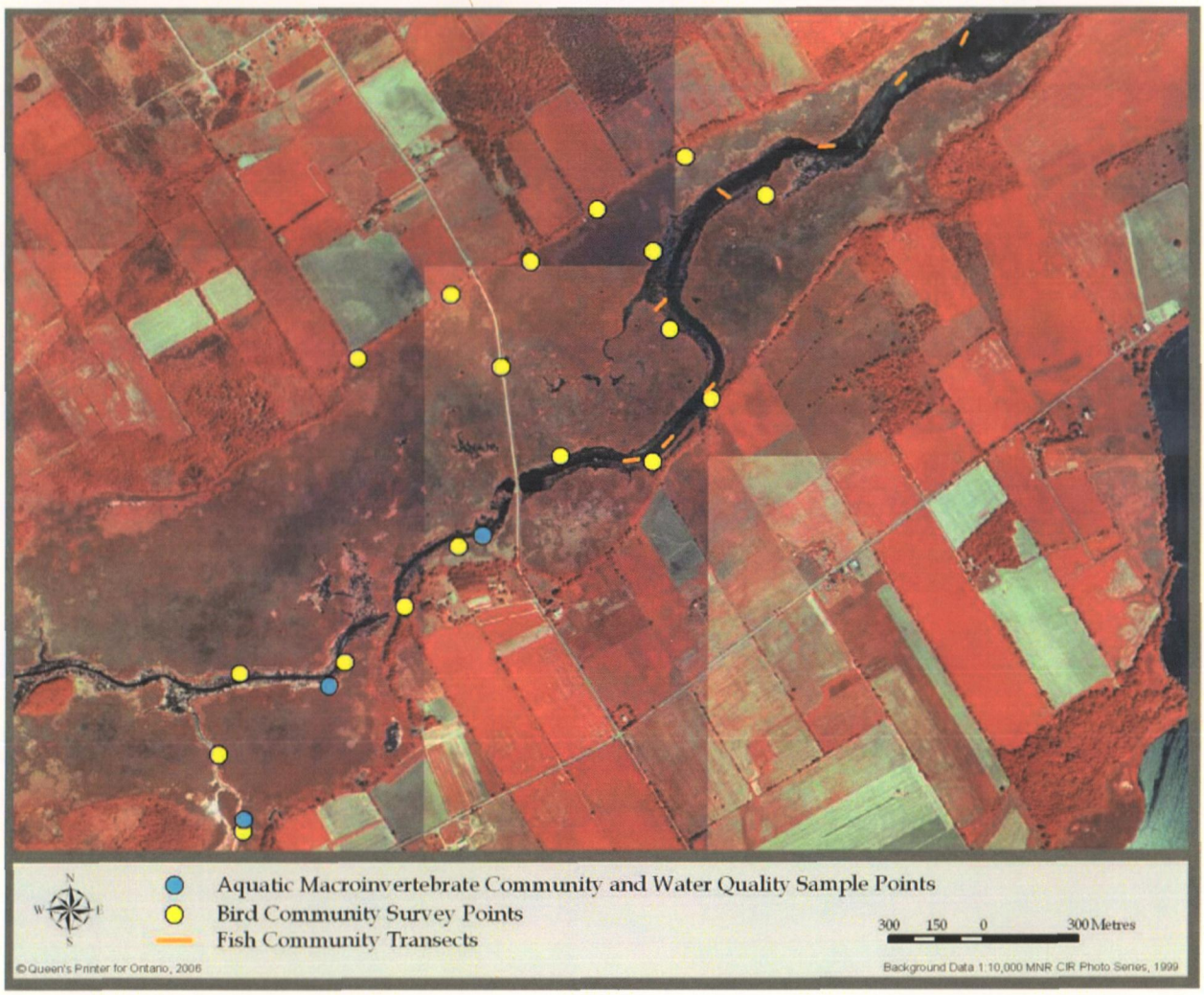

Figure 9. A colour infrared aerial photograph of Sawguin Creek Marsh showing various field sampling locations.

Assessing Coastal Wetland Condition

Wetland Health Versus Integrity

Karr (1996) and Karr and Chu (1999) discuss the definition and use of the terms "health" and "integrity" to describe biological systems. The following discussion summarizes and simplifies the points made in these two papers and outlines the applicability of "health" and "integrity" in this report.

Karr and Chu (1999) note that:

> *Webster's dictionaries define health as a flourishing condition, well being, vitality, or prosperity. A healthy person is free from physical disease or pain; a healthy person is sound in mind, body and spirit. An organism is healthy when it performs all its vital functions normally and properly, when it is able to recover from stresses, when it requires minimal outside care. A country is healthy when a robust economy provides for the well-being of its citizens. An environment is healthy when the supply of goods and services required by both human and nonhuman residents is sustained. To be healthy is to be in good condition.* [p. 16]

It is clear that health is a subjective term. For coastal wetlands, one person may define a healthy wetland as one that affords ample opportunities for observing different bird species. Another person may define it as one that provides a good harvest of wild rice. Other definitions may be related to pike habitat, plant assemblage, or water quality.

For the DRCWMP, coastal wetland health is defined through the overall condition of biotic communities being monitored (e.g., fish, marsh birds, amphibians, vegetation). But how is the condition of a biotic community measured? A tool used to measure biotic community health is the community's biotic integrity. Karr (1996) defines biotic integrity as:

> *...the capacity to support and maintain a balanced, integrated, adaptive biological system having the full range of elements (genes, species, assemblages) and processes (mutation, demography, biotic interactions, nutrient and energy dynamics, and metapopulation processes) expected in the natural habitat of a region.* [p. 101]

Karr (1997) clarifies that:

> *Inherent in this definition is that: (1) living systems act over a variety of scales from individuals to landscapes; (2) a fully functioning living system includes items one can count (the elements of biodiversity) plus the processes that generate and maintain them; and (3) living systems are embedded in dynamic evolutionary and biogeographic contexts that influence and are influenced by their physical and chemical environments.* [p. 483]

So what range of biotic integrity is considered healthy or unhealthy? A healthy level of integrity can be subjective and must be defined by appropriate stakeholders. For Bay of Quinte coastal wetlands, the definition of a healthy wetland should be based on Lake Ontario coastal wetlands that experience the least disturbance (Figure 10). Using these

less disturbed wetlands, the stakeholders can objectively set thresholds of biotic integrity that reflect a healthy wetland.

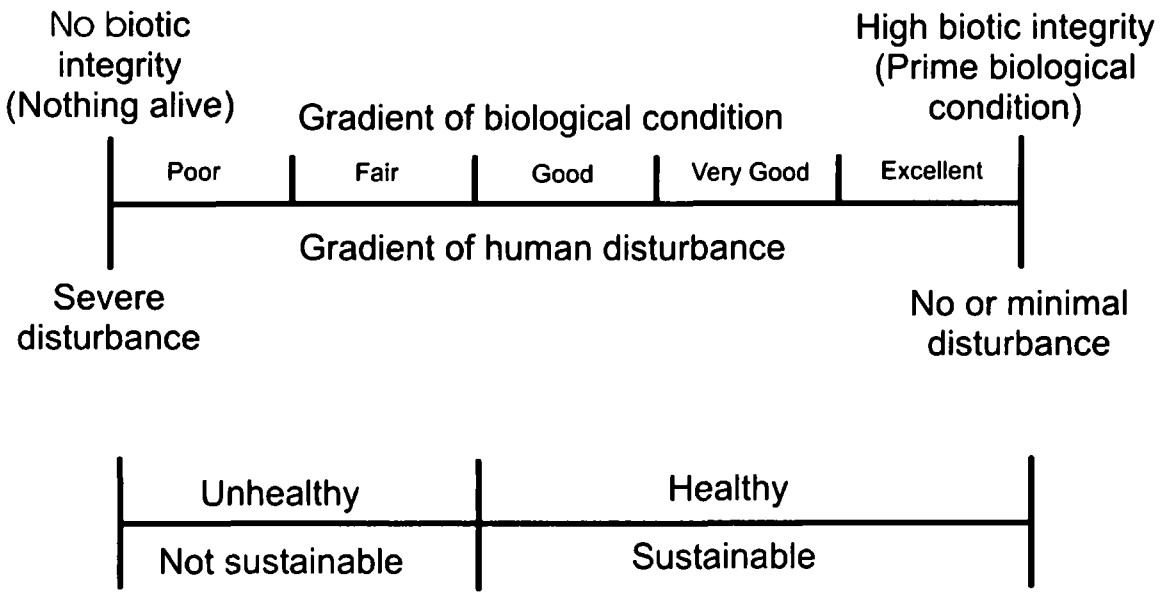

Figure 10. Gradient of biological condition in relation to gradient of human disturbance (top). By combining the condition of several biological communities, a parallel gradient (bottom) representing the health of the wetland can be determined. Subsequently, a specific range on the health gradient can be set as a goal for each wetland (adapted from Karr and Chu 1999).

Determining Biotic Integrity of Wetland Communities

A multimetric approach was used to determine biotic integrity of coastal wetland communities. Metrics are biological attributes that are known to respond in specific and predictable ways to changes in wetland disturbance (Figure 11). For example, coastal wetland biological community metrics for the submerged aquatic vegetation (SAV) community could be percent cover, exotic species richness, mean coverage of turbidity intolerant taxa, or overall floristic quality. In Figure 11, biological attribute A increases with increasing disturbance and is an appropriate metric for biological monitoring. Conversely, biological attribute B is robust within the range of disturbances experienced and does not respond predictably to wetland disturbance. Biological attributes that do not have a constant and predictable relationship within the range of disturbance are not suitable metrics.

Once a suite of suitable metrics is defined for a biotic community, the metrics are scored, standardized and combined. This creates an Index of Biotic Integrity (IBI) for the particular community. The multimetric IBI incorporates several suitable biological attributes to increase the accuracy of describing the condition of the particular biological community. IBIs are scored out of 100. Details of the scoring, standardizing, and combining metrics are described in Section 3 of the Durham Region Coastal Wetland Monitoring Project: Year 2 Technical Report (Environment Canada and Central Lake Ontario Conservation Authority 2004; herein EC and CLOCA 2004).

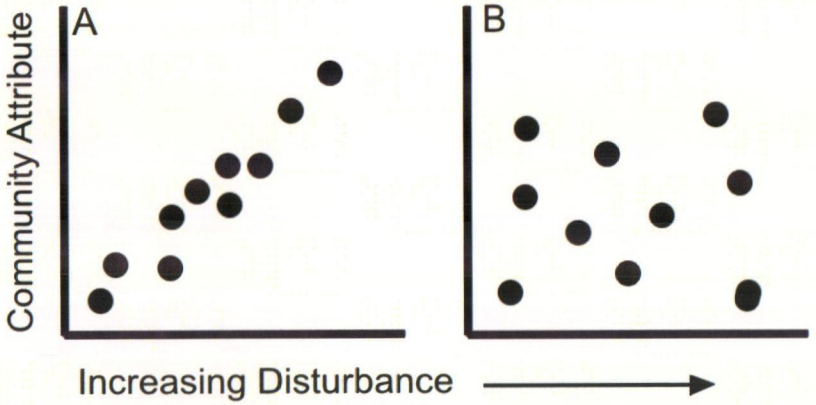

Figure 11. The theoretical response of biological community attributes A and B to increasing disturbance.

Water Quality

Wetland water quality is not a direct measure of biotic community condition. For the Durham Region Coastal Wetland Monitoring Project, water quality parameters were collected to help create disturbance measurements for individual Canadian Lake Ontario coastal wetlands. Water quality parameters were examined in Bay of Quinte coastal wetlands for two reasons. First, the overall water quality can be an indication of the exposure level of aquatic communities to disturbance. Second, water quality data can help provide insight into observations linked to the abundance or richness of certain biotic guilds (e.g., lack of turbidity intolerant fish or plant species; presence of exotic marine amphipods (*Gammarus tigrinus*) in parts of the Great Lakes; see Grigorovich et al. 2005).

Method Summary

Sample Collection and Analysis

Wetland water quality assessment does not appear in the most recent approximation of the DRCWMP Methodology Handbook – Second Approximation (EC and CLOCA 2003). Therefore, the summary in this section includes extended, but not thorough, methodology descriptions.

Water quality sampling stations were established within each wetland along the edge of the emergent vegetation and open water (Figures 2-9). A Quanta Hydrolab unit was used to measure dissolved oxygen (mg L^{-1}), pH, water temperature (°C), conductivity (µS cm^{-1}), redox potential (mΩ), and turbidity (NTU). The meter probe was positioned at mid-depth in the water column. A propeller fixed to the unit was turned on to ensure ambient water continually circulated over the sensors. Water depth (m) was collected at each replicate location using a calibrated Secchi disk or sounding pole.

Water samples for ammonia nitrogen (NH_4) and nitrate nitrogen (NO_3) were collected from the surface in clean, deionized-rinsed, plastic centrifuge tubes and analyzed using a DR890 colorimeter. The Hach reagents used in the analysis meet USEPA protocols for the analysis of surface water as they are generated from Standard Methods. A cadmium reduction method was used for the analysis of nitrate nitrogen and salicylate for ammonia. Samples were stored in the dark at 4°C until analysis. The storage period for the samples did not exceed 6 hours.

Water samples for analysis of total phosphorus (TP) were collected in 125-mL flint glass bottles that had been filled with 0.5% H_2SO_4 for three days and triple-rinsed with both deionized water and sample water prior to collection. These samples were preserved with one mL of 30% H_2SO_4, stored in the dark, and sent to the National Laboratory of Environmental Testing (NLET) in Burlington, Ontario for analysis. Chlorophyll *a* samples were collected at all locations. Using a one-litre polypropylene bottle, a sample of 500-1,000 mL of water was collected and filtered through a 0.45-µm glass fibre filter. The samples were stabilized with 0.8 mL of 1% w/v $CaCO_3$ suspension stored in plastic petri dishes and stored below 0°C until analysis at the NLET.

Information on the location and surrounding vegetation was collected at each replicate location within the vegetation zone. The dominant vegetation was recorded for each sampling location, along with observations of incidental macrophyte species within three

metres of the sampling location. A Trimble GEO XT global positioning system was used to record each sampling location.

Ranking Water Quality

Six water quality parameters were combined into an overall water quality ranking for each site. Parameters used were: total phosphorus, ammonia, nitrate, turbidity, chlorophyll *a*, and conductivity. For each of these parameters, higher measured field values indicate increased disturbance at the site (Table 4).

Each parameter within a site was assigned an ordinal score of 1, 3, or 5. This was done by calculating the 25th and 75th percentiles were calculated from water quality data from 23 Lake Ontario coastal wetlands in 2005 – eight Bay of Quinte Sites and 15 Durham Region sites (Table 6).

Table 4. Descriptions of water quality parameters used to score and rank water quality.

Disturbance Variable	Description
Total Phosphorus	The concentration (mgL^{-1}) of all forms of phosphorus dissolved in the sample. This is an important indicator of enrichment in surface waters.
Ammonia	The concentration (mgL^{-1}) of ammonia nitrogen in the sample. Ammonia can be toxic to aquatic organisms and is released into waterways by many industries, primarily municipal wastewater treatment plants.
Nitrate	The concentration of nitrate nitrogen (mgL^{-1}) in the sample. The greatest sources of nitrates in the environment are sewage, fertilizer, and manure.
Turbidity	A measure of the degree to which light traveling through a water column is scattered by the suspended organic (including algae) and inorganic particles measured in Nephelometric Turbidity Units (NTU).
Chlorophyll *a*	A measurable parameter for all phytoplanktonic production. On average, 1.5 percent of algal organic matter is chlorophyll-*a*. Thus, if chlorophyll-*a* levels are known, the phytoplankton biomass in the water body can be estimated.
Conductivity	A measure of the dissolved ions in water measured in milliseimens per centimetre ($mScm^{-1}$). Conductivity is a good indicator of urban run-off – especially from road salt.

If the mean parameter value at each site was above the 75th percentile, the parameter was considered impacted and received a score of 1. If the mean parameter value was below the 25th percentile, the parameter was considered to be far less impacted and scored a 5. Mean values between the 25th and 75th percentile scored a 3. After each parameter within the site was scored, a mean score was calculated for water quality at

the wetland; higher scores indicate better water quality. Mean scores were converted to a qualitative rank according to Table 5.

Table 5. Corresponding mean water quality parameter score and qualitative rank.

Mean Score	Qualitative Rank
1- 2	Poor
2- 3	Fair
3- 4	Good
4- 5	Excellent

Results

All Bay of Quinte sites had mean water quality parameter scores between 3 and 5 and were ranked good to excellent relative to other sites sampled on Lake Ontario. Of the Bay of Quinte sites, the Hay Bay South scored the lowest and Robinson's Cove Marsh and Big Island Marsh West scored the highest. There were no consistent patterns in parameters among Bay of Quinte sites – except for the nitrate parameter – which scored less than 5 at all sites.

Discussion and Delisting Criteria Recommendations

Water quality in Lake Ontario coastal wetlands is influenced by water inputs from both the watershed and Lake Ontario. In general, water quality in open bay and protected bay sites is highly influenced by Lake Ontario. Conversely, sites that are periodically isolated from the lake by barrier beach formations have larger watershed influences. Drowned rivermouth water quality can have variable extents of watershed and lake influence depending environmental factors (e.g., wind, seiche, precipitation, tributary inflow).

Water quality in sampled Bay of Quinte coastal wetlands is relatively good compared to Durham Region coastal wetlands. This is likely a result of less urbanization in the watersheds. The majority of Durham Region coastal wetlands are often closed to the lake, thus heavily watershed influenced. In addition, the water received in Durham is generally from heavily urbanized watersheds. In contrast, Bay of Quinte coastal wetlands in this pilot generally receive water from less urbanized watersheds; most were on the Prince Edward County side of the bay.

Water is a critical habitat component in Great Lakes coastal wetlands and the quality of the water has a strong influence on the overall aquatic habitat quality in these environments. Poor water quality compromises fish and wildlife habitat in several ways. First, and most obvious, water is the medium in which fish exist (respire, spawn, feed, etc.). Poor water quality can affect the behaviour and physiology of fish and hence their ability to survive in environments with poor water quality.

Table 6. Water quality parameter means (M), score (S), mean score, and rank for eight Bay of Quinte (shaded) and 15 Durham Region coastal wetland sites. Wetlands are ordered vertically from east to west.

Site	Conductivity (mS cm^{-1})		Turbidity (NTU)		NH_4 (mg L^{-1})		NO_3 (mg L^{-1})		Phosphorus (mg L^{-1})		Chlorophyll *a* (µg L^{-1})		Mean Score	Rank
	M	S	M	S	M	S	M	S	M	S	M	S		
Parrott's Bay Marsh	0.36	3	15.23	5	0.01	5	0.43	3	0.04	3	1.07	5	**4.00**	**Excellent**
Hay Bay South	0.25	5	23.00	3	0.05	1	0.80	1	0.03	5	0.83	5	**3.33**	**Good**
Hay Bay North	0.44	3	20.33	3	0.02	3	0.60	3	0.03	5	0.57	5	**3.67**	**Good**
Big Island Marsh East	0.34	5	14.67	5	0.02	3	0.60	3	0.04	5	2.13	3	**4.00**	**Excellent**
Big Island Marsh West	0.27	5	17.43	5	0.01	5	0.37	3	0.03	5	0.80	5	**4.67**	**Excellent**
Robinson's Cove Marsh	0.24	5	16.80	5	0.01	5	0.60	3	0.03	5	0.80	5	**4.67**	**Excellent**
Blessington Creek Marsh	0.34	5	26.40	3	0.02	5	0.37	3	0.04	3	1.60	3	**3.67**	**Good**
Sawguin Creek Marsh	0.34	5	25.70	3	0.03	3	0.47	3	0.03	5	2.87	3	**3.67**	**Good**
Port Newcastle Marsh	0.54	3	16.97	5	0.01	5	0.80	1	0.07	3	4.33	3	**3.33**	**Good**
Wilmot Creek Marsh	0.66	3	31.73	3	0.05	3	3.20	1	0.09	3	1.00	5	**3.00**	**Good**
Bowmanville Marsh	0.57	3	28.22	3	0.02	5	0.28	3	0.17	1	5.47	3	**3.00**	**Good**
Westside Marsh	1.53	1	32.52	3	0.02	3	0.20	3	0.08	3	2.77	3	**2.67**	**Fair**
McLaughlin Bay Marsh	0.56	3	71.30	1	0.09	1	0.23	3	0.24	1	12.05	1	**1.67**	**Poor**
Oshawa Second Marsh	0.90	3	17.28	5	0.06	1	0.70	1	0.08	3	1.90	3	**2.67**	**Fair**
Corbett Creek Marsh	2.67	1	23.47	3	0.03	3	0.07	3	0.09	3	13.30	1	**2.33**	**Fair**
Pumphouse Marsh	1.73	1	34.83	1	0.29	1	0.03	5	0.22	1	18.63	1	**1.67**	**Poor**
Lynde Creek Marsh	0.90	3	37.93	1	0.07	1	0.20	3	0.13	1	7.90	1	**1.67**	**Poor**
Cranberry Marsh	0.62	3	71.23	1	0.16	1	0.07	3	0.89	1	3.10	3	**2.00**	**Fair**
Carruthers Creek Marsh	0.79	3	35.53	1	0.02	3	0.03	5	0.10	3	1.87	3	**3.00**	**Good**
Duffins Creek Marsh	0.91	1	30.43	3	0.02	3	0.00	5	0.13	3	4.13	3	**3.00**	**Good**
Hydro Marsh	1.01	1	35.10	1	0.03	3	0.03	5	0.16	1	5.63	1	**2.00**	**Fair**
Frenchman's Bay Marsh	0.58	3	26.93	3	0.03	3	0.00	5	0.10	3	6.13	1	**3.00**	**Good**
Rouge River Marsh	1.17	1	25.67	3	0.02	3	0.07	3	0.13	3	1.23	3	**2.67**	**Fair**

Second, water quality affects food sources for fish and wildlife. Aquatic macroinvertebrates (also considered wildlife) and submerged aquatic vegetation are impacted by poor water quality. Furthermore, submerged aquatic vegetation also provides habitat for fish and wildlife by providing cover and shelter.

Water quality in some littoral and off-shore zones has been evaluated in the Bay of Quinte for decades. The addition of standardized coastal wetland water quality assessments can contribute to the understanding of the overall aquatic habitat quality in the Bay of Quinte AOC. Coastal wetland water quality assessments can be an important part of fish and wildlife habitat IBUs 14.1 and 14.2 (Table 2). Assessments in Bay of Quinte coastal wetlands in this pilot suggest that the water quality components of these habitats are not highly impacted. In addition, the water quality at these sites does not appear to be impairing fish, marsh bird, aquatic macroinvertebrate, and submerged aquatic vegetation communities (see following section).

In this pilot, it is recognized that although water quality can be an indicator of aquatic habitat quality, there are many other factors that contribute to the overall quality of aquatic habitats in coastal wetlands (e.g., substrate characteristics, water depth, temperature, dissolved oxygen, emergent vegetation). Although these variables are not used in the assessment of aquatic habitat quality in this pilot, many are collected as ancillary data in biotic community sampling (i.e., fish, SAV, macroinvertebrate, and breeding birds). These additional data could be used to better characterize the aquatic environment in Bay of Quinte AOC coastal wetlands. However, methods to summarize these data to report on coastal wetland habitats have not been developed. The BQ-RAPRC may want to investigate the application of these data to provide a more robust description of aquatic habitat in Bay of Quinte AOC coastal wetlands.

BQ-RAPRC (2003; see Table 2 in this report) recommends that as part of delisting IBU 14.1 and 14.2, fish and wildlife habitat in the Bay of Quinte should be protected and restored to the greatest extent possible. Part of protecting these habitats is ensuring that their quality, including water quality, is not reduced. It is recommended that the maintenance of water quality be part of the delisting criteria for IBU 14.1 and 14.2 in Bay of Quinte coastal wetlands. Specific delisting criteria should be specified by the BQ-RAPRC. These criteria could include targets for specific water quality parameters, scores, mean scores, or ranks. Maintaining coastal wetland water quality at the current (2005) rank of good or excellent based on the six water quality parameters measured is recommended.

It is important to note that, although this water quality ranking was developed for the Bay of Quinte, other Great Lake coastal wetland water quality assessment methods are also being developed (Chow-Fraser 2005). BQ-RAPRC may wish to also explore these methods for use as delisting criteria.

Submerged Aquatic Vegetation Community

Method Summary

Sampling was completed by randomly placing 20 one-metre-square quadrats in the open water basin of each wetland. Within each quadrat, the percent coverage of each submerged and floating-leaved species was recorded.

Results

Submerged aquatic vegetation (SAV) indices of biotic integrity in Bay of Quinte coastal wetlands ranged from 60.4 (Big Island West Marsh) to 97.8 (Hay Bay South; Table 7) and, within sites, were quite consistent among the two years sampled. Indices of biotic integrity were comparable to past scores of some other Lake Ontario coastal wetlands (e.g., Bayfield Bay, Presqu'ile Bay, and South Bay marshes), and higher than Durham Region sites in all cases.

All Bay of Quinte sites scored well on floristic quality (FQI), total cover (PCOV), and native species richness (SNAT) metrics. Turbidity intolerant species richness and percent cover metric scores (SINT and PINT) were variable among the sites. Hay Bay South and Robinson's Cove marshes, which had the highest IBIs (97.8 and 88.3), also scored relatively high (between 6.85 and 10) on turbidity intolerant metrics. All other sites generally scored below five on the same metrics. Low scores on turbidity intolerant metrics affected the IBI particularly at Sawguin Creek Marsh.

Discussion and Delisting Criteria Recommendations

Submerged aquatic vegetation provides important habitat for fish, amphibians, and macroinvertebrates and is a valuable food source for some wetland birds. Most Bay of Quinte coastal wetlands include substantial flooded areas capable of supporting SAV. As such, the SAV community is an important factor in fish and wildlife habitat provision in the Bay of Quinte Area of Concern. There are several variables that affect the quality of aquatic habitats used by fish and wildlife in coastal wetlands. This report uses the SAV community condition as an indicator of aquatic habitat quality in Bay of Quinte AOC coastal wetlands.

Bay of Quinte coastal wetlands surveyed in this pilot study have scored some of the best IBIs in surveyed Lake Ontario coastal wetlands. However, some of the wetlands appear to have lower richness and abundance of turbidity intolerant species. Although water quality rankings indicate good and excellent water quality at these sites, the lower turbidity intolerant species metrics indicate periods of high turbidity may be impacting the presence and abundance of these species.

Most Bay of Quinte coastal wetlands have a permanent connection to Lake Ontario; an advantage for SAV communities. Seiches, wind tides, and lake currents may facilitate flushing within these sites thus maintaining high water quality and suitable conditions for SAV establishment and growth. In addition, Bay of Quinte wetlands that receive water from large watersheds are generally not as impacted as other Lake Ontario sites with more urbanized watersheds.

EC and CLOCA (2004) give qualitative condition ranks to SAV communities in Lake Ontario coastal wetlands based on the sensitivity of the IBI. These rankings have been applied to Bay of Quinte SAV communities (Table 8)

Table 7. Submerged aquatic vegetation community metrics (scored out of 10) and IBIs (scored out of 100) for eight Bay of Quinte (shaded) and 15 Durham Region coastal wetland sites in 2005. Recent IBIs for other Lake Ontario coastal wetlands are also included. Wetlands are ordered vertically from east to west.

	2005 Metrics						IBI		
Wetland Name	SINT	PINT	FQI	PCOV	SNAT	2005	2004	2003	2002
Hill Island East Marsh								**89.6**	
Little Cataraqui Marsh								**73.3**	
Bayfield Bay Marsh								**96.8**	
Button Bay Marsh								**79.7**	
Parrott's Bay Marsh	4.84	3.60	8.88	9.51	8.78	**71.2**		**71.9**	
Hay Bay South Marsh	10	10	10	9.10	9.79	**97.8**		**90.0**	
Hay Bay North Marsh	4.03	2.43	9.60	10	10	**72.1**		**82.7**	
Big Sand Bay Marsh								**62.1**	
South Bay Marsh								**71.1**	
Big Island East Marsh	6.85	2.67	9.52	9.81	10	**77.7**			
Big Island West Marsh	3.22	1.84	9.26	7.52	8.35	**60.4**			
Robinson's Cove Marsh	8.06	6.85	10	9.26	10	**88.3**		**89.6**	
Blessington Creek Marsh	4.03	0.99	10	10	10	**70.0**			
Sawguin Creek Marsh	4.03	1.31	10	8.26	10	**67.2**			
Huyck's Bay Marsh								**55.0**	
Presqu'ile Bay Marsh								**72.9**	
Port Britain Marsh								**19.4**	
Port Newcastle Marsh	0	0	2.72	2.32	2.59	**15.3**	**33.6**		
Wilmot Creek Marsh	0	0	4.34	5.68	2.59	**25.2**	**20.2**	**15.4**	
Bowmanville Marsh	0.54	0.49	3.51	2.29	2.62	**18.89**	**22.4**	**14.6**	**27.4**
Westside Marsh	0	0	1.47	0.61	1.31	**6.8**	**0.0**		
McLaughlin Bay Marsh	0	0	0	0	0	**0.0**	**0.0**	**1.0**	
Oshawa Second Marsh	3.22	2.56	8.44	4.72	9.07	**56.0**		**40.2**	**31.4**
Corbett Creek Marsh	1.21	0.47	8.16	3.80	10	**47.3**	**52.2**	**31.3**	
Pumphouse Marsh	0	0	2.37	0.25	2.02	**9.3**	**26.6**	**56.3**	
Lynde Creek Marsh	0	0	1.08	0.56	0.86	**5.0**	**9.4**	**22.4**	**14.5**
Cranberry Marsh	0	0	6.08	2.14	7.06	**30.5**	**41.0**	**35.9**	
Carruthers Creek Marsh	0	0	0	0	0	**0.0**	**0.0**		**0.0**
Duffins Creek Marsh	0	0	1.80	0.25	1.15	**6.4**	**0.8**		**0.8**
Hydro Marsh	0	0	0.37	0.02	0.43	**1.6**	**0.6**		**0.5**
Frenchman's Bay Marsh	0.40	0	1.09	0.05	0.86	**4.8**	**2.7**		**15.0**
Rouge River Marsh	0	0	2.22	0.03	1.30	**7.1**	**10.5**		
Jordan Station Marsh								**19.6**	

SINT	Number of turbidity-intolerant species
PINT	Relative % cover of turbidity-intolerant species
FQI	Floristic Quality Index
PCOV	Total coverage
SNAT	Total number of native species

Table 8. Qualitative rankings of submerged aquatic vegetation community condition in eight Bay of Quinte coastal wetlands.

Site	2005 IBI	Rank
Parrott's Bay Marsh	71.2	Very Good
Hay Bay South Marsh	97.8	Excellent
Hay Bay North Marsh	72.1	Very Good
Big Island East Marsh	77.7	Very Good
Big Island West Marsh	60.4	Very Good
Robinson's Cove Marsh	88.3	Excellent
Blessington Creek Marsh	70.0	Very Good
Sawguin Creek Marsh	67.2	Very Good

BQ-RAPRC (2003; see Table 2 in this report) recommends that as part of delisting IBU 14.1 and 14.2, fish and wildlife habitat in the Bay of Quinte should be protected and restored to the greatest extent possible. This should include protecting the condition of the SAV community in Bay of Quinte coastal wetlands and ensuring that it is not reduced. The maintenance of coastal wetland SAV community condition can be a valuable part of refining delisting criteria for IBUs 14.1 and 14.2, because SAV is such an important habitat component. Specific delisting criteria should be agreed upon by the BQ-RAPRC. These criteria could include goals for specific coastal wetland SAV community metrics – particularly those involving turbidity intolerant species (SINT and PINT) – or IBIs. Maintaining coastal wetland SAV community condition at the current (2005) rank of very good or excellent based on IBIs is recommended.

Submerged aquatic vegetation community evaluations have been completed for many years in near- and off-shore zones in the Bay of Quinte. Coastal wetland SAV assessments combined with continued assessments in other zones of the bay can provide a more complete representation of overall SAV community condition on the Bay of Quinte AOC.

Aquatic Macroinvertebrate Community

(nektonic and epiphytic)

Method Summary

Methods were based on Burton et al. (1999), which were the methods used in the recent Great Lakes Coastal Wetland Consortium indicators research. For each wetland, three replicate sub-samples of approximately 150 aquatic macroinvertebrates (≥500μm) were taken by sweep-netting through the water column in the cattail (*Typha* spp.) dominated emergent communities. These samples represent a combination of primarily nektonic (free-swimming) and epiphytic (plant-dwelling) species assemblages – not benthic. Macroinvertebrates were identified to the lowest taxonomic group possible.

Results

Bay of Quinte sites scored IBIs between 56.9 and 81.5 (Big Island East and Hay Bay South marshes) and generally scored better than Durham Region sites (Table 10). Of particular note is that aquatic macroinvertebrate community condition appears to be declining within the easternmost wetlands surveyed (i.e., Parrott's Bay, Hay Bay North and South, and Robinson's Cove marshes) and increasing in the more westerly sites (i.e., Lynde Creek Marsh west to Rouge River Marsh).

Bay of Quinte sites scored well on most metrics. The number of Crustacea and Mollusca genera (NCMG) was below 5.10 at all Bay of Quinte sites. Scores were generally low for the abundance of Isopods (PISO) as well. Metric scores for the abundance of Trichoptera (PTRI) were extremely variable among Bay of Quinte sites and ranged from 0 (Parrott's Bay, Big Island East, and Robinson's Cove marshes) to10 (Hay Bay South and Sawguin Creek marshes). The abundance of Ephemeroptera (PEPH), a metric particularly sensitive to disturbance, scored well at Bay of Quinte sites compared to Durham Region sites.

Table 9. Metric codes used in Table 10

Metric Code	Description
NCMG	No. of Crustacea + Mollusca genera
NETG	No. of Ephemeroptera + Trichoptera genera
NODO	No. of Odonata genera
NFAM	Total no. of families
PAMP	% Amphipoda
PCRM	% Crustacea + Mollusca
PEPH	% Ephemeroptera
PISO	% Isopoda
PTRI	% Trichoptera
PDIP	% Diptera
PCRU	% Crustacea

Table 10. Aquatic macroinvertebrate community metrics (scored out of 10) and IBIs (scored out of 100) for eight Bay of Quinte (shaded) and 15 Durham Region coastal wetland sites in 2005. Recent IBIs for other Lake Ontario coastal wetlands are also included. Wetlands are ordered vertically from east to west. Metric codes are listed in the results section (Table 9).

	2005 Metrics											IBI		
Site	NCMG	NETG	NODO	NFAM	PAMP	PCRM	PEPH	PISO	PTRI	PDIP	PCRU	2005	2004	2003
Hill Island East Marsh														86.2
Little Cataraqui Creek Marsh														96.8
Bayfield Bay Marsh														86.2
Button Bay Marsh														58.9
Parrott's Bay Marsh	4.66	5.35	10	10	9.14	7.99	10	0.73	0	10	8.37	69.3	76.0	75.4
Amherst Island Diked Marsh													43.6	
Amherst Island Undiked Marsh													50.4	
Hay Bay North Marsh	4.23	7.13	10	9.60	7.49	7.56	10	7.50	2.20	10	7.62	75.8	82.1	91.7
Hay Bay South Marsh	4.23	10	10	8.00	9.92	7.19	9.77	0.76	10	10	9.83	81.5		92.5
Big Island East Marsh	3.39	5.35	10	9.40	4.28	4.37	10	1.78	0	10	4.03	56.9		
Big Island West Marsh	4.23	7.13	7.13	7.00	9.18	8.93	8.65	1.37	3.51	10	8.63	68.9		
Big Sand Bay Marsh													63.6	63.7
South Bay Marsh														77.1
Robinson Cove Marsh	5.08	5.35	4.28	5.80	10	10	5.39	6.92	0	10	10	66.2		92.1
Blessington Creek Marsh	4.66	7.13	7.13	7.80	9.91	8.41	10	0.95	1.02	10	9.20	69.3		
Sawguin Creek Marsh	3.39	8.92	10	8.60	6.56	5.82	6.30	1.73	10	10	6.18	70.4		
Huyck's Bay Marsh													67.0	61.3
Presqu'ile Bay Marsh														75.2
Port Britain Marsh														51.5
Port Newcastle Marsh	4.23	1.78	10	9.40	0.91	3.30	1.40	2.96	1.04	10	2.57	43.3	54.1	82.6
Wilmot Creek Marsh	5.50	0	7.13	8.60	3.16	8.71	0.99	5.80	0	10	3.50	48.5	69.0	70.9
Bowmanville Marsh	3.81	3.57	10	10	1.24	3.94	7.90	0.82	0	10	1.41	47.9	76.9	37.9
Westside Marsh	3.81	3.57	10	7.60	5.73	5.29	10	6.63	0	9.53	5.78	61.8	63.0	53.9
McLaughlin Bay Marsh	2.96	1.78	7.13	7.20	2.56	2.75	0.49	0	1.08	10	2.31	34.8	70.1	49.6
Oshawa Second Marsh	5.93	3.57	10	9.20	3.09	6.89	3.21	0.45	3.51	10	2.84	53.4		50.3
Corbett Creek Marsh	5.93	0	10	9.20	7.38	8.67	0	10	0	10	8.05	62.9	72.5	62.5
Pumphouse Marsh	2.96	0	7.13	7.40	1.72	1.97	2.63	0	0	10	1.55	32.1	69.9	68.2
Lynde Creek Marsh	4.66	1.78	10	10	6.82	8.03	0.52	0	1.11	10	6.31	53.8	62.8	34.2
Cranberry Marsh	2.54	1.78	10	8.80	6.75	6.18	3.82	0	0	10	6.15	50.9	67.4	47.9
Carruthers Creek Marsh	5.50	1.78	7.13	10	7.43	7.70	1.70	7.49	1.04	10	7.60	61.2	66.0	48.3
Duffins Creek Marsh	5.93	3.57	10	10	2.32	8.89	1.51	10	4.14	10	4.06	64.0	60.4	22.9
Hydro Marsh	3.39	0	7.13	9.00	4.38	5.03	6.08	7.25	0	9.14	4.77	51.1	42.1	17.5
Frenchman's Bay Marsh	5.93	1.78	0	6.00	8.49	8.55	4.33	10	2.28	10	9.55	60.8	49.6	28.8
Rouge River Marsh	5.08	5.35	10	10	1.94	5.59	10	10	1.16	10	2.86	65.4	76.8	49.3
Jordan Station Marsh														38.0

Discussion and Delisting Criteria Recommendations

BQ-RAPRC (2005) uses the Wildlife Ministers Council of Canada (Environment Canada 1990) definition of wildlife. By the definition, wildlife includes all non-domestic organisms – mammals, birds, fish, amphibians, reptiles, vascular plants, etc. – which also includes aquatic macroinvertebrates. As such, IBU 3.2 - Degradation of wildlife populations includes degradation of aquatic macroinvertebrate communities. Much work has been done in the Bay of Quinte AOC with respect to the condition of benthic invertebrate communities occupying open water zones of the bay, but few data are available to evaluate macroinvertebrate communities in coastal wetlands. However, there currently appears to be little interest and value in evaluating coastal wetland aquatic macroinvertebrates as a direct measure of wildlife population degradation in the Bay of Quinte and other Canadian AOCs. This is likely because nektonic and epiphytic macroinvertebrate communities do not provided the same direct economic and social value as other faunal communities such as birds and fish.

Nonetheless, coastal wetland macroinvertebrate communities are important in nutrient cycling and provide food for fauna. Aquatic macroinvertebrates are the primary food source for many fish species. In addition, species that emerge as flying insects provide many species of wetland dependent birds with a forage base.

Aquatic macroinvertebrate community structure is also known to reflect current or recent water quality in Great Lakes coastal wetlands (Gathman et al. 1999). Through the development of a coastal wetland aquatic macroinvertebrate IBI, EC and CLOCA (2004) have demonstrated that the aquatic macroinvertebrate community structure in Lake Ontario coastal wetlands is affected by anthropogenic disturbance. The disturbance estimates used in the IBI development rely heavily on integration of water quality parameters.

As a food source and water quality indicator in coastal wetlands, the nektonic and epiphytic aquatic macroinvertebrate community condition can be used, in combination with other factors such as SAV community condition and water quality, as an indicator of aquatic habitat quality. As such, assessing the condition of the macroinvertebrate community in Bay of Quinte coastal wetlands can contribute to the evaluation of IBU 14 – Loss of fish and wildlife habitat.

EC and CLOCA (2004) assigned qualitative ranks to aquatic macroinvertebrate communities in Lake Ontario coastal wetlands based on the sensitivity of the IBI. These rankings have been applied to Bay of Quinte aquatic macroinvertebrate communities (Table 11).

The monitoring approach developed through the DRCWMP framework defines the level of richness and abundance of key suites of species (metrics) that are representative of less disturbed Lake Ontario coastal wetlands. In addition, this method incorporates abundance and richness of several key taxa and expresses them as a community condition score (i.e., index of biotic integrity).

Table 11. Qualitative rankings of aquatic macroinvertebrate community condition in eight Bay of Quinte coastal wetlands.

Site	2005 IBI	Rank
Parrott's Bay Marsh	69.3	Very Good
Hay Bay South Marsh	75.8	Very Good
Hay Bay North Marsh	81.5	Excellent
Big Island East Marsh	56.9	Good
Big Island West Marsh	68.9	Very Good
Robinson's Cove Marsh	66.2	Very Good
Blessington Creek Marsh	69.3	Very Good
Sawguin Creek Marsh	70.4	Very Good

Since the community condition is affected by habitat quality, this approach can be used to help refine the delisting criteria for IBU 14. For example, the BQ-RAPRC could define a threshold or range of a certain metric (e.g., the abundance of Trichoptera (PTRI)) or the IBI among Bay of Quinte coastal wetlands that would contribute to a delisting of habitat impairments. It is recommended that the aquatic macroinvertebrate community condition be maintained at the rank of very good or excellent based on IBIs.

Fish Community

Method Summary

Fish were captured by boat electrofishing six points along 44-m transects, which were stratified by habitat types (e.g., emergent marsh, submerged aquatic vegetation, open water) within each wetland (Figures 2-9). Fork length and weight measurements were taken on all fish. When large numbers of conspecific fish were captured, 10 randomly chosen individuals in each of two age classes (i.e., young-of-year and juvenile/adult) were weighed and measured; then the remainder of each cohort was counted and batch weighed. Sampling occurred during mid-August to early September.

Results

In this pilot, all Bay of Quinte coastal wetlands scored high fish community IBIs relative to other Lake Ontario sites (Table 12). Of the Bay of Quinte sites sampled, Sawguin Creek Marsh was the lowest (70.4) and Big Island East Marsh scored almost 100.

In general, Bay of Quinte sites had high richness and abundances of sensitive and native fish species and low numbers of non-native species. Hay Bay North, Robinson's Cove, and Sawguin Creek marshes had somewhat low numbers of native fish (NNAT). Of particular note is the percentage of piscivore biomass (PPIS) metric. This metric is generally low in disturbed wetlands, and all Bay of Quinte sites scored well.

Discussion and Delisting Criteria Recommendations

It is well known that the Bay of Quinte recreational and commercial fisheries hold great economic and social value. Fish communities as a whole are an important part of the trophic structure in the Bay of Quinte. There has been much concern about and work done on the near-shore and deep water fish communities (e.g., walleye populations) in the bay, but relatively little regarding other species – especially warm water species strongly reliant on coastal wetland habitats (BQ-RAPRC 2003).

BQ-RAPRC (2003) indicates that part of meeting the delisting criteria for IBU 3.1 – Degradation of fish populations, includes demonstrating that key fish species are present in numbers consistent with an unimpaired ecosystem. This entails evaluating different fish communities. Near-shore and off-shore fish communities have been evaluated for a number of years through programs implemented by Fisheries and Oceans Canada and the Ontario Ministry of Natural Resources. Coastal wetland assessments completed through this pilot can add to the knowledge of Bay of Quinte fish communities and provide a more complete description of the overall fish community.

For coastal wetlands, to demonstrate that key fish species are present in numbers consistent with an unimpaired ecosystem, it is necessary to know what fish species and abundances are present in unimpaired ecosystems and compare those to the Bay of Quinte. All ecosystems have some degree of impairment. So, it may be more practical to compare fish communities that are representative of ecosystems with low impairment.

Throughout this process, it is important to maintain valid comparisons between fish communities. In the case of coastal wetlands, for example, Bay of Quinte coastal

wetland fish communities should be compared to other Great Lakes coastal wetlands with low impairment. In addition, the sites should be in the same geographical area to control for basin-specific fish assemblage variations. As such, the most effective method involves comparing Bay of Quinte coastal wetlands to other Lake Ontario coastal wetlands with low impairment.

The development of the fish community IBI reported here incorporates a suite of wetlands ranging from highly disturbed wetlands to less disturbed. According to Figure 10, these sites should also mirror a range in fish community impairment. The IBI was constructed such that sites with key taxa present in quantities (abundance, richness, and biomass) representative of sites with low disturbance (and impairment) scored best. Using this approach, a good measure of success for IBU 3.1 – Degradation of fish populations in coastal wetlands would be to: demonstrate that key fish taxa are present in abundances, richness, and biomass consistent with Lake Ontario coastal wetlands that experience low disturbance.

Table 12. Fish community metrics (scored out of 10) and IBIs (scored out of 100) for five Bay of Quinte (shaded) and 11 Durham Region coastal wetland sites in 2005. Recent IBIs for Durham Region sites are also included. Wetlands are ordered vertically from east to west.

	Metrics (2005)						IBI		
Wetland Name	**SNAT**	**SCEN**	**PPIS**	**NNAT**	**PBNI**	**BYPE**	**2005**	**2004**	**2003**
Parrott's Bay Marsh									**91.2**
Hay Bay South Marsh	10.0	10.0	10.0	5.4	6.4	5.4	**78.5**		
Hay Bay North Marsh	10.0	10.0	10.0	3.7	10.0	7.0	**84.5**		
Big Island East Marsh	10.0	10.0	10.0	10.0	10.0	9.9	**99.9**		
Robinson's Cove Marsh	9.9	10.0	10.0	3.9	10.0	7.0	**84.6**		
Sawguin Creek Marsh	8.4	10.0	5.7	3.4	10.0	4.7	**70.4**		
Huyck's Bay Marsh									**78.6**
Port Newcastle Marsh	6.9	6.5	0.1	10.0	7.0	0.7	**52.0**		**28.1**
Wilmot Creek Marsh								**45.1**	**60.5**
Westside Marsh	7.2	3.2	0.0	3.4	3.6	0.7	**30.1**		
Bowmanville Marsh	7.6	6.1	0.0	5.5	10.0	0.2	**49.0**	**35.9**	**46.2**
Oshawa Second Marsh	10.0	7.4	0.0	10.0	0.0	0.0	**45.6**		**43.9**
McLaughlin Bay Marsh	9.0	6.4	0.0	10.0	5.4	3.4	**57.1**		**35.8**
Pumphouse Marsh									**26.6**
Corbett Creek Marsh	10.0	10.0	7.4	5.7	6.0	0.5	**65.9**		**28.4**
Lynde Creek Marsh	7.5	6.4	10.0	3.6	6.8	1.6	**59.8**	**20.6**	**44.0**
Carruthers Creek Marsh									**32.5**
Duffins Creek Marsh	4.8	0.0	0.0	1.2	10.0	6.6	**37.6**	**32.1**	**28.2**
Hydro Marsh	6.1	7.4	10.0	1.4	3.2	0.3	**47.3**		**19.6**
Frenchman's Bay Marsh	7.0	8.0	2.2	3.2	7.4	6.1	**56.4**		**48.2**
Rouge River Marsh	7.5	8.3	3.2	3.3	6.6	1.0	**49.9**		**34.5**

SNAT	Number of native species
SCEN	Number of centrarchid species
PPIS	% piscivore biomass
NNAT	Number of native individuals
PBNI	% non-indigenous biomass
BYPE	Biomass of yellow perch

Using the EC and CLOCA (2004) method to assign qualitative ranks, coastal wetland fish communities in selected Bay of Quinte wetlands are good to excellent (Table 13). Applying the IBI approach to help refine the measure of success for IBU 3.1 in coastal wetlands, the BQ-RAPRC could monitor individual metrics (e.g., PPIS), the IBI score, or qualitative rankings.

Table 13. Qualitative rankings of fish community condition in six Bay of Quinte coastal wetlands.

Site	2005 IBI	Rank
Parrott's Bay Marsh	91.2*	Excellent
Hay Bay South Marsh	78.5	Very Good
Hay Bay North Marsh	84.5	Excellent
Big Island East Marsh	99.9	Excellent
Robinson's Cove Marsh	84.6	Excellent
Sawguin Creek Marsh	70.4	Very Good

*from 2003 data

The measure of success set out by BQ-RAPRC (2003) stipulates that key fish species in Bay of Quinte coastal wetlands should be present in numbers consistent with unimpaired systems – that fish communities be healthy and sustainable. To refine the measure of success, it is suggested that fish communities in coastal wetlands score IBIs between 60 and 100 giving them a qualitative rank of very good to excellent.

Fish community sampling for this pilot was performed by the Central Lake Ontario Conservation in partnership with Environment Canada. The electrofishing boat was specifically designed to access and navigate through Lake Ontario coastal wetlands (i.e., no boat ramp access, shallow water, dense submerged aquatic vegetation). In addition, survey crews must have specific training and qualifications to perform boat electrofishing. If the BQ-RAPRC sees value in the coastal wetland fish evaluations, partnership opportunities should be sought with agencies capable of performing the surveys (i.e., CLOCA, DFO).

Breeding Marsh Bird Community

Method Summary

The Marsh Monitoring Program (MMP) protocol, administered by Bird Studies Canada, was used to survey bird communities within various Lake Ontario coastal wetlands. Data from 2002 to 2005 were collected by volunteers and, in the absence of volunteers, conservation authority and Canadian Wildlife Service staff.

Results

Table 14. Bird community metrics (scored out of 10) and IBIs (scored out of 100) for seven Bay of Quinte (shaded) and 13 other Lake Ontario coastal wetland sites in 2005. Recent IBIs for Durham Region sites are also included. Wetlands are ordered vertically from east to west.

	Metrics (2005)				IBI			
Wetland Name	**SMAS**	**PMNO**	**PMUS**	**PMAS**	**2005**	**2004**	**2003**	**2002**
Bayfield Bay Marsh	6.43	10	10	10	**91.1**			**70.1**
Button Bay Marsh	2.50	4.94	7.78	1.50	**41.8**			**80.0**
Parrott's Bay								**80.1**
Hay Bay South Marsh	6.00	5.93	7.69	7.63	**68.1**			**60.5**
Hay Bay North Marsh	5.00	10	9.47	10	**86.2**			
Big Sand Bay Marsh	8.75	10	9.11	10	**94.7**			
South Bay Marsh	5.00	4.08	8.41	6.19	**59.2**			**42.2**
Big Island Marsh*	7.00	10	10	10	**92.5**			
Robinson's Cove Marsh	7.50	9.82	10	8.59	**89.8**		**11.7**	**63.1**
Belleville Marsh	2.50	1.21	8.80	2.00	**36.3**			
Blessington Creek Marsh	6.67	8.24	9.49	10	**86.0**			
Sawguin Creek Marsh	7.22	10	9.60	10	**92.1**			
Presqu'ile Bay Marsh	7.50	10	9.26	10	**91.9**			
Port Newcastle Marsh						**32.8**	**63.6**	
Wilmot Creek Marsh						**52.9**	**79.6**	**28.2**
Westside Beach Marsh	10	10	8.07	10	**95.1**	**91.7**	**86.6**	**89.2**
Bowmanville Marsh							**38.8**	**45.3**
McLaughlin Bay Marsh	5.00	6.04	8.71	10	**74.4**	**81.7**		
Oshawa Second Marsh						**74.9**	**75.9**	**66.8**
Pumphouse Marsh						**71.3**		
Corbett Creek Marsh						**78.3**	**30.4**	**54.7**
Lynde Creek Marsh	4.38	6.57	7.82	9.66	**71.1**	**67.6**	**37.0**	**57.9**
Cranberry Marsh						**94.0**	**72.1**	**49.4**
Carruthers Creek Marsh	7.50	5.68	8.3	8.65	**75.3**			
Duffins Creek Marsh	5.00	6.22	7.59	8.33	**67.9**		**18.3**	
Hydro Marsh	5.00	7.39	10	3.41	**64.5**			**14.1**
Frenchman's Bay Marsh	7.50	6.07	9.43	6.36	**73.4**		**23.1**	**14.6**
Rouge River Marsh	7.50	6.19	8.25	10	**79.8**	**89.5**	**54.4**	

SMAS	Marsh area-sensitive species richness
PMNO	% marsh-nesting obligates
PMUS	% marsh-users
PMAS	% marsh area-sensitive

* East and West

Bay of Quinte pilot sites scored IBIs from 36.3 (Belleville Marsh) to 92.5 (Big Island Marsh); five of seven Bay of Quinte IBIs were over 80.0 (Table 14). Sites with IBIs greater than 80.0 generally scored above 7.00 across all metrics. Belleville Marsh scored less than 2.50 on the richness and abundance of marsh area-sensitive species (SMAS and PMAS) and abundance of marsh-nesting obligates (PMNO).

Discussion and Delisting Criteria Recommendations

Most Bay of Quinte sites surveyed in 2005 scored high IBIs. This suggests that these sites provide high quality habitat for marsh nesting birds. Bay of Quinte sites generally scored well in the area-sensitive species metrics (PMAS and SMAS). This suggests these sites also provide sufficient areas of high-quality emergent marsh habitats to key species during the breeding season. Belleville Marsh was an exception. Low PMAS and SMAS scores indicate that the disturbance to this marsh has left it with a limited capacity to support these sensitive species.

The condition of Bay of Quinte coastal wetland breeding marsh bird communities has particular applicability to IBU 3.2 – Degradation of wildlife populations. The measure of success in BQ-RAPRC (2003) states that part of delisting involves demonstrating that key indicator species for coastal and upland wetlands and existing forests are present and in significant numbers to be self-sustaining. Population dynamics of marsh-nesting birds (i.e., their transient nature, locally and continentally, and the uncertainty of their annual survival) makes it very difficult to determine whether these species are present in self-sustaining numbers.

A more quantifiable and comparable approach to providing a measure of success for this IBU is achieved through the index of biotic integrity approach. This method is based on evaluating the abundance and richness of breeding bird species that are sensitive to disturbance (key species), and therefore complements the existing measure of success. This approach allows reporting on particular guilds of interest (e.g., area-sensitive species (PMAS and SMAS)), the entire breeding bird community (IBI out of 100), or a qualitative description of the bird community as in EC and CLOCA (2004; Table 15).

Table 15. Qualitative rankings of breeding marsh bird community condition in seven Bay of Quinte coastal wetlands.

Site	2005 IBI	Rank
Hay Bay South Marsh	68.1	Very Good
Hay Bay North Marsh	86.2	Excellent
Big Island Marsh*	92.5	Excellent
Robinson's Cove Marsh	89.8	Excellent
Belleville Marsh	36.3	Fair
Blessington Creek Marsh	86.0	Excellent
Sawguin Creek Marsh	92.1	Excellent

* East and West

In this pilot, data are being used to assess the current condition of the breeding marsh bird community at a site level. Administrators of the MMP recognize that their protocol may not be suitable for site-specific assessments and assert that these data are most applicable to monitoring long-term regional trends in marsh-breeding birds (Weeber and Vallianatos 2000). Within-year site variability and annual variability may be too high to

make reliable annual assessments of breeding marsh bird community condition, and longer-term trends are likely the only feasible method of reporting. Long-term trends may not suit the needs of decision makers and administrators involved wildlife management. The drawback of relying on long-term trends is that by the time a drop in population parameters (abundance, richness) is detected, the damage is done and it will likely take more resources and time to implement a recovery strategy.

To address this issue, the Canadian Wildlife Service, in consultation with Bird Studies Canada, has implemented a preliminary study to more accurately assess site-specific breeding marsh bird communities in Lake Ontario coastal wetlands on an annual basis. The study augments the existing MMP protocol with: 1) three survey visits to a survey station instead of two, 2) establishment of survey stations in the interior of the marsh as opposed to just the perimeter, and 3) an effort to survey as many stations as possible within each site (based on surveying constraints, logistics and safety). First year results and recommendations of the study are reported in "The Marsh Monitoring Program: Evaluating Marsh Bird Protocol Modifications to Assess Lake Ontario Coastal Wetlands at a Site Level" (Environment Canada 2006).

Preliminary results indicate that, in many cases, the extra visit and additional stations provide a better representation of the breeding marsh bird community. In particular, marsh-nesting obligates, a guild that requires quality marsh habitat for nesting, are better represented. Additional years of surveying using the augmented protocol are required to evaluate its ability to report on shorter-term or annual breeding marsh bird trends.

Long-term trend evaluation can also be difficult due to volunteer commitment over time. For example, high turnover of volunteers and inadequate wetland coverage within some AOCs can limit the ability to report on trends in marsh bird species. To maintain consistent evaluation, it is important for individuals and agencies with interests in breeding marsh bird community condition in the BQ AOC to ensure that MMP volunteer surveying is completed annually. This requires the participation of committed volunteers, paid staff, or a combination thereof. The Durham Region Coastal Wetland Monitoring Project is an example of a regional monitoring effort that relies on MMP data. Over the past four years it has become clear that the most effective method to ensure proper site-level data collection and submission is through the use of experienced paid staff. If the BQ-RAPRC sees value in the coastal wetland breeding marsh bird evaluations, it is essential that measures to ensure consistent data collection and submission be taken.

BQ-RAPRC (2003) states that part of delisting also includes demonstrating that key indicator species in existing forests are present and in significant numbers to be self-sustaining. The MMP does not provide data on forested areas. To obtain a more extensive representation of the overall breeding bird community in the Bay of Quinte AOC, results from existing bird survey programs should be incorporated into the delisting criteria of IBU 3.2 – Degradation of wildlife populations (e.g., Forest Bird Monitoring Program, Ontario Breeding Bird Atlas).

Next Steps

This report contains several recommendations with respect to refining delisting criteria for the following IBUs in the Bay of Quinte:

- 3.1 – Degradation of fish populations
- 3.2 – Degradation of wildlife populations
- 14.1 – Loss of Fish Habitat
- 14.2 – Loss of Wildlife Habitat.

In all cases, the recommendations revolve around assessing fish and wildlife habitats and populations in Bay of Quinte AOC wetlands in the context of other Lake Ontario coastal wetlands. For biotic communities, this involves monitoring the abundance and richness of key taxa and guilds that respond to disturbance.

It is now the responsibility of the BQ-RAPRC to consider these recommendations and the utility of the various indices in refining delisting criteria and defining measures of success.

If the BQ-RAPRC finds that the approach and recommendations in this document suit their needs, efforts should be made to implement a targeted assessment program in coastal wetlands deemed representative or of priority within the Bay of Quinte Area of Concern.

Summary

The purpose of this pilot study was two-fold. First, the current condition of habitat and fish and breeding bird communities in selected Bay of Quinte coastal wetlands were assessed. Results were expressed as indices of condition. Second, recommendations were made on how this monitoring framework could be used to refine delisting criteria and to complete status assessments for IBUs affecting coastal wetlands in the Bay of Quinte.

Preliminary results from Bay of Quinte AOC coastal wetlands showed good water quality and biotic communities that were in very good or excellent condition relative to other Lake Ontario coastal wetlands (Table 16).

Suggestions for possible refinements to delisting criteria and measures of success for IBUs relating to habitat and fish and wildlife populations were made using BQ-RAPRC (2003) as a guide.

For fish and breeding bird communities (IBU 3.1 and 3.2), it is recommended that the index of biotic integrity approach be used to monitor these populations. Pilot study results indicate that measures of success could include showing that richness and abundance of key taxa in these populations are among the best in Lake Ontario. These data should be used together with available data from existing programs (i.e., near- and off-shore fish community assessments, upland bird community surveys) to provide better representation Bay of Quinte fish and wildlife community condition.

Table 16. A summary of index scores and ranks (see shading key) for water quality (out of 5), submerged aquatic vegetation, aquatic macroinvertebrates (Inverts), fish, and marsh bird communities (out of 100) in nine Bay of Quinte AOC coastal wetlands.

Site	Water Quality Score	SAV	Inverts	Fish	Birds
		IBI			
Parrott's Bay Marsh	3.86	71.2	69.3	91.2	80.1*
Hay Bay South Marsh	3.29	97.8	75.8	78.5	68.1
Hay Bay North Marsh	3.29	72.1	81.5	84.5	86.2
Big Island Marsh East Marsh	3.86	77.7	56.9	99.9	92.5
Big Island Marsh West Marsh	4.43	60.4	68.9	-	
Robinson's Cove Marsh	4.71	88.3	66.2	84.6	89.8
Belleville Marsh	-	-	-	-	36.3
Blessington Creek Marsh	3.86	70.0	69.3		86.0
Sawguin Creek Marsh	3.57	67.2	70.4	70.4	92.1

Shading Key: Poor | Fair | Good | Very Good | Excellent

* IBI from 2002

For fish and wildlife habitats (IBU 14.1 and 14.2), it is recommended that indices be used to evaluate water quality, submerged aquatic vegetation, and aquatic macroinvertebrates as indicators of habitat quality in coastal wetlands. Although, other variables such as water temperature, depth, and dissolved oxygen contribute to overall aquatic habitat quality in coastal wetlands, this approach can provide a tool to monitor elements of habitat quality and determine whether the measures of success (i.e., no decrease in habitat condition) are met. These assessments can be used to augment

existing near- and off-shore water quality, aquatic invertebrate and SAV data for the purpose of refining delisting criteria of IBU 14 - Loss of fish and wildlife habitat.

The index approach used in this report provides a method for the BQ-RAPRC to monitor fish and wildlife populations and habitats in the Bay of Quinte AOC coastal wetlands. This approach can also be a useful tool for the BQ-RAPRC because it will provide quantitative data to monitor measures of success throughout the delisting process. Coastal wetland assessments, along with programs managed through other agencies (e.g., Lake Ontario Management Unit, Fisheries and Oceans Canada) can help provide a more complete description of factors affecting IBUs 3 and 14 in the Bay of Quinte.

Lastly, it is important to emphasize that this pilot study assessed water quality and biotic communities in selected Bay of Quinte AOC coastal wetlands in the context of other Canadian Lake Ontario coastal wetlands. These other coastal wetlands represent sites that are subject to a range of disturbance. In many cases, the assessments indicate that Bay of Quinte coastal wetlands are in better condition compared to these other coastal wetlands. It is recognized that the listing of fish and wildlife habitat and population IBUs in the Bay of Quinte was driven by the impairment of the beneficial uses compared to their historical state and not in the context of other Lake Ontario coastal wetlands. For the purposes of evaluating IBUs 3 and 14, the BQ-RAPRC may wish to investigate the possibility of assessing Bay of Quinte coastal wetlands in the context of their historical condition. In the absence of suitable historical data, assessments could be made in comparison to expected or theoretical historical conditions. The historical comparisons could be done using the same general framework and indices used in this report.

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