“TAKING STOCK IN STOCKING”

Stocking of American eel (*Anguilla rostrata*) in the Upper St. Lawrence River and Lake Ontario – 2006-2009

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TABLE OF CONTENTS

1.0 INTRODUCTION ........................................................................................................... 1-1
2.0 PREVIOUS STOCKING INITIATIVES ........................................................................ 2-1
3.0 ONTARIO POWER GENERATION EEL STOCKING PROGRAM, 2006 - 2009 .... 3-1
  3.1 Overview.............................................................................................................. 3-1
  3.2 Purchasing............................................................................................................ 3-1
  3.3 Holding and Quarantine ....................................................................................... 3-5
  3.4 Health Assessment............................................................................................... 3-6
    3.4.1 Health Assessment Statistical Design ...................................................... 3-6
    3.4.2 Virology ................................................................................................... 3-9
    3.4.3 Gross Parasitological Assessment .......................................................... 3-13
    3.4.4 Histologic Parasitological Assessment .................................................. 3-13
  3.5 Marking .............................................................................................................. 3-15
  3.6 Transportation and Delivery .............................................................................. 3-16
  3.7 Stocking ............................................................................................................. 3-17
4.0 EFFECTIVENESS MONITORING ................................................................................ 4-1
5.0 OTHER INFORMATION RELATING TO THE STOCKING PROGRAM ................. 5-1
  5.1 Presentation to Canadian East Coast Elver Advisory Committee (Fishers)
    OPG Stocking Program....................................................................................... 5-1
  5.2 2008 Experimental Conservation Licenses.......................................................... 5-1
6.0 REFERENCES ................................................................................................................ 6-1

LIST OF TABLES

Table 1. Summary of OPG Eel Stocking Program 2006–2009. ........................................... 3-4
Table 2. Summary of virology and bacteriology testing methodology and results. .......3-11
Table 3. OTC batch marking procedure for 52 kg of eels. .............................................3-16
LIST OF APPENDICES

Appendix I: Photographs

Appendix II: Maps and Figures
- Figure 1 - Study Area Location (Mallorytown Landing)
- Figure 2 - Study Area Location (Deseronto)
- Figure 3 - Transect Locations at Mallorytown Landing
- Figure 4 - Transect and Plot Locations at Mallorytown Landing (June 21, 2007)
- Figure 5 - Transect Locations at Mallorytown Landing (May 15, 2008)
- Figure 6 - Transect Locations at Mallorytown Landing (May 29, 2008)
- Figure 7 - Transect Locations at Deseronto (June 11, 2008)
- Figure 8 - Transect Locations at Deseronto (June 2, 2009)
- Figure 9 - Transect Locations at Mallorytown Landing (June 2, 2009)

Appendix III: Stocking Transect Coordinates and Data
ABSTRACT

In 2006, Ontario Power Generation initiated an American eel (Anguilla rostrata) stocking research program, and to date, more than 3.9 million eels have been trapped in the Canadian maritimes and released into the Upper St. Lawrence River/Lake Ontario system. This program is one effort being utilized to offset turbine passage mortality of downstream migrating adult eels at the R. H. Saunders Generating Station on the St. Lawrence River. Stocking was one of the alternatives recommended for implementation by the Decision Analysis process conducted during 2005 (Greig et al., 2006). The stocking program was developed based on input from several workshops and conferences attended by regulatory agencies, research institutes, power utilities, commercial fishers, and interested parties from the private sector.

In 2006, glass eels were captured in spring and raised in captivity until October when an estimated 166,774 elvers were stocked. In subsequent years, 2007 - 2009, all stocking was done in the spring using glass eels. The total number of glass eels stocked in 2007 was estimated to be 436,907, followed by 2,001,561 in 2008, and 1,303,042 in 2009.

Prior to stocking, fish were held in quarantine until results from health assessments, including gross examination, virology, parasitology, histopathology, and bacteriology, were completed, as stipulated by both Canadian and United States government regulations. Health assessment results from all years did not identify any regulated pathogens with two exceptions. In 2007, a stocking lot of eels collected in July was rejected based on indications that infection by Anguillicoloides crassus larvae was likely. In 2009, one lot was diagnosed with Enteric red mouth (Yersinia ruckeri) which precluded their use in the stocking program.

Prior to release, fish were marked via immersion in a solution of oxytetracycline hydrochloride. Fish meeting all fish health criteria for stocking were transported to the release locations near Mallorytown Landing and Deseronto, Ontario in water filled oxygenated plastic bags. The fish were scattered stocked in daylight hours from a boat that traversed transects located in traditionally good commercial eel harvest areas.
Monitoring to determine the effectiveness of the stocking program was initiated in 2009 and preliminary results indicate that: 1) the stocked population appears to disperse from the release locations; and 2) eels sampled in the stocking locations are growing rapidly. The stocking program, as well as effectiveness monitoring, is planned to continue through 2011.
ACKNOWLEDGEMENTS

The successful execution to date of the American eel (*Anguilla rostrata*) stocking program was the result of collaborative effort between government agencies, the fishers and industry dedicated to the recovery of the American eel in Upper St. Lawrence/Lake Ontario, including:

Aquatic Diagnostic Services at the Atlantic Veterinary College, University of Prince Edward Island
Dr. David Groman and staff

Aquaculture Veterinary Services International
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Fish Harvesters and Aquaculture Facilities
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Mike Campbell
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Tom Pratt
Greg Stevens

Hydro Québec
Richard Verdon

Kleinschmidt Associates
Tracy Maynard
Scott Ault

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Pierre Dumont

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Bill Fleming
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1.0 INTRODUCTION

The American eel (*Anguilla rostrata*) historically had the largest range of any fish species in the western hemisphere, dominating most systems it inhabited, thus playing an ecologically significant role in those systems (Committee on the Status of Endangered Wildlife in Canada, 2006; A. Mathers, OMNR, pers. comm.). The panmictic and catadromous species is widely distributed along the entire North American east coast and is found in all Canadian freshwater systems that are accessible to the Atlantic Ocean (Fisheries and Oceans Canada, 2006).

At one time, the eel was one of the top three species in Ontario’s fishery, with a peak annual harvest value of $600,000 (Mathers and Stewart, 2009). In recent years, there have been serious concerns raised about the decline in American eel abundance (*e.g.* Haro *et al.*, 2000; Casselman and Cairns, 2003; MacGregor *et al.*, 2008). Two of the main reasons for concern identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) are the observed decline in the number of juvenile American eels ascending the R.H. Saunders Generating Station’s eel ladder and declining indices of eel abundance in Lake Ontario and the St. Lawrence River. The ladder has been in operation since 1974 and provides access to Lake Ontario and its watersheds above the R.H. Saunders Generating Station on the St. Lawrence River in Cornwall, Ontario. The abundance of eels ascending the ladder peaked in 1982-83, declined precipitously thereafter, and is currently three orders of magnitude below the peak level (McGregor *et al.*, 2008). In parallel, as indexed by the commercial catch record, the population of adult eels in the fishery also declined in the Upper St. Lawrence River/Lake Ontario (USLR/LO) system (Casselman, 2001). As a result of these declining population indicators, the American eel is recommended for listing as a “Species of Special Concern” by COSEWIC, the scientific body that advises the Canadian government on the status of species-at-risk. It has not yet been accepted for listing under the Canadian Species-At-Risk Act. However, the American
eel was listed as an “Endangered” species in Ontario under the Endangered Species Act promulgated on June 30, 2008.

The observed decline of the American eel is hypothesized to be a result of one or a combination of factors including (in no order of significance): exploitation of all life stages, toxicity from water contamination, obstruction of upstream migration, mortality during downstream passage at hydroelectric turbines, changes in oceanic currents, alteration and loss of habitat, and productivity and food web changes (Casselman, 2007). The appearance of the exotic swim bladder nematode parasite *Anguillicoloides crassus* in Canada, may also be having an effect on the eel population (Oliveira, Threader and Groman, pers. comm.).

In 2004, the Canadian Eel Steering Committee Relating to Passage and Associated Habitat Issues in the St. Lawrence (CESC) was formed to investigate potential mitigation measures for turbine mortality through the R.H. Saunders and the Beauharnois Generating Stations and associated habitat issues. The Canadian Eel Steering Committee includes membership from Ontario Power Generation (OPG), Ontario Ministry of Natural Resources (OMNR), Department of Fisheries and Oceans Canada (DFO), Environment Canada, Hydro Québec, and Ministère des Ressources naturelles et de la Faune du Quebéc (MRNF).

In February of 2005, in response to the observed decline, the first of a series of multi-government and hydroelectric industry facilitated workshops was held in Cornwall, Ontario to investigate methods to increase juvenile recruitment in the USLR/LO and provide safe downstream passage for adult American eels migrating from the USLR/LO. The workshop format facilitated choosing by environmental managers and scientists the “best” mitigation measures to address the issue of downstream passage mortality of eel in the St. Lawrence River. Later in 2005, the CESC hosted three decision analysis workshops to assist in developing an action plan for American eel recovery in the USLR/LO (Greig *et al.*, 2006).

Subsequent to the 2005 meetings, an OPG Action Plan was developed based on recommendations from the above mentioned workshops, results of the decision analysis process (Greig *et al.*, 2006), recommendations of the CESC, and discussions within the Planning and Implementation Group of the CESC. One component of the Action Plan was a stocking program
to introduce juvenile eels into the USLR/LO. The objectives of the stocking program are to:

- supplement the natural recruitment of juvenile eels into the USLR/LO;
- achieve a stocked eel abundance that can be monitored;
- promote a high proportion of females in the population; and,
- offset turbine mortality.

A small-scale preliminary program was initiated by OPG in 2006 to develop protocols and procedures for the purchasing, holding, and transport of juvenile eels. Prior to continuing a larger-scale program in 2007, an international workshop was convened in Montréal in March to address issues related to the stocking of eels (both glass and elver) from donor sites in the Canadian Maritimes to various locations in the St. Lawrence River system (Pratt et al., 2007; Williams and Thredder, 2007). The workshop was coordinated by OPG in partnership with the Great Lakes Fisheries Commission, MRNF, OMNR, and DFO. Interested parties from regulatory agencies, research institutes, power utilities, commercial fishers, and the private sector from Canada, the United States, and Europe also attended. The workshop was organized to address four key themes.

- How to reduce the risk of transferring pathogens and other “fellow travellers” through stocking.
- What technical steps are required to stock Lake Champlain/Upper St. Lawrence River/Lake Ontario.
- How to monitor stocked populations.
- What research questions need to be addressed for the long-term?

Existing literature regarding eel migration, sex determination, and mortality raised questions about whether the objectives of the stocking program were feasible. Such questions included, would stocked eels find appropriate migration pathways south to the spawning grounds in the Sargasso Sea if adult migratory behavior is dependent on the memory from earlier life stages (Feunteun, 2002). In addition, although Vladykov and Liew (1982) report that sex of *Anguilla rostrata* is determined at fertilization, other literature suggests that environmental conditions are responsible for determining sex (Krueger and Oliveira, 1999). Given that previous studies indicate that too high of a density of stocked eels may result in a higher proportion of males in the population, stocking density was another potential consideration since
an objective of the program was to promote a higher proportion of females in the USLR/LO. It was also unknown whether translocation of eels would increase mortality compared to eels that migrate naturally (COSEWIC, 2006). Although eel stocking has been performed successfully in Europe to support fisheries, stocking has been confined to rivers and lakes of much smaller size than the USLR/LO. Overall, it was determined that knowledge, skills and research surrounding disease/fellow traveller risks and stocking methodology were adequate enough to enable decisions on many of the presented issues. The outcomes from this workshop were addressed, where possible, during the planning and execution of the 2007, 2008, and 2009 stocking program.
2.0 **PREVIOUS STOCKING INITIATIVES**

Stocking of elvers into upstream freshwater systems was proposed as a method of improving recruitment into the USLR/LO and ultimately increasing spawner escapement to the Sargasso Sea (Greig *et al.*, 2006). Stocking generally consists of collecting glass eels or early elvers from the coastal estuaries and releasing them upstream into freshwater habitats, thereby artificially boosting recruitment of juveniles into the upper reaches of the system. Such practices have been implemented in Europe in an attempt to boost declining numbers of European eel (*Anguilla anguilla*) since at least the 19th century (Haro *et al.*, 2000). Stocking of European eel elvers has often proven successful and has sustained fisheries for yellow and silver phase eels in a number of river systems. Recent stocking of American eels has been undertaken in North America, but it is too early to determine if the practice will prove successful in the long-term (Pratt *et al.*, 2010). It has been shown that individuals are surviving the initial stocking process and growing well, but the percentage survival requires further study. Also, it is not yet certain whether they disperse from the stocking areas, whether they differentiate sexually into female, and whether they survive to adulthood and successfully migrate to the Sargasso Sea and reproduce (Williams and Threader, 2007; Pratt *et al.*, 2010).

In 2005, the MRNF and Hydro-Québec initiated the first large-scale eel stocking program in the Richelieu River, Quebec (Lake Champlain) in an effort to increase American eel recruitment. This watershed was selected because historically it supported a viable eel fishery and it has no barriers for outmigrating silvering phased eels. In fall 2009, six migrating silver American eels were collected in the brackish waters of the St. Lawrence estuary and it was determined that these eels were released in the Richelieu River, four years earlier as part of the stocking program. This direct observation is the first evidence that American eels stocked as glass eels can migrate seaward at least as far as the estuary in synchrony with naturally recruited female silver eels en route to their spawning grounds in the Sargasso Sea (Verreault *et al.*, *in review*).

In the late spring of 2006, OPG initiated a similar stocking study program involving the release of glass eels in the Upper St. Lawrence for population enhancement (Cowx, 1998; Williams and Threader, 2007). Stocking continued in 2007, 2008, and 2009, and to date, about
3,900,000 glass eels have been released to the USLR/LO by OPG. The following sections of this report provide details related to each of the stocking years of this program. The format of this report has been developed to allow for the addition of subsequent years’ data as the stocking programs continue in the future.
3.0 ONTARIO POWER GENERATION EEL STOCKING PROGRAM, 2006 - 2009

3.1 Overview

In October of 2006, OPG, initiated a stocking program involving the release of juvenile eels into the USLR/LO. This program was undertaken as one component of OPG’s “Action Plan for Offsetting Turbine Mortality of American Eel at the R.H. Saunders Generating Station, 2006”, which is based in part on recommendations from the CESC as a result of the decision analysis process (Greig et al., 2006). The program has continued each year through 2009 and is planned to extend through 2011. The Action Plan focuses on Lake Ontario and the Ontario portions of the St. Lawrence River and is coordinated with a similar program in Quebec. The stocking occurs under a license issued by the OMNR under the Fish and Wildlife Conservation Act. Prior to issuing the license, the advice of the Ontario Introductions and Transfers Committee was obtained. Given that the USLR/LO systems extend into portions of the U.S.A., collaboration with the New York State Department of Environmental Conservation (NYSDEC), and to a lesser degree the Great Lakes Fishery Commission (GLFC) was maintained since the beginning of the program and will continue in subsequent years.

As part of this program, OPG conducts the coordination of eel procurement, health assessments, hiring provincial veterinarians to oversee some components of the program, marking eels prior to release, transportation, and acquisition of all necessary permits for fish collection, and stocking.

3.2 Purchasing

Eels used for this program were purchased by OPG from commercial fishing companies and individual fishers along the east coast of Canada. Collection of eels is regulated by the federal government through the issuance of licenses. Presently there are nine federal fishing licenses permitting the collection of glass eels on the east coast of Canada, however not all license holders actively participate in the fishery. Two of the nine licenses allow the acquisition of glass eels for aquaculture purposes (grow-out operations) with a maximum retention time as specified in the license. The remaining seven licenses have limits of 900 kg of eels for general commercial sales, typically to Asian markets (i.e., China, Korea). In addition to the 900 kg limit, each of these seven
license holders is permitted to collect and sell an additional 100 kg of eels for conservation purposes (“conservation quota”), such as stocking.

Overall costs incurred by OPG for the stocking program included purchasing of eels, shipping to the aquaculture facility, holding and quarantine during health assessments, performing health assessments, compensation for veterinarians, equipment and staff for marking and stocking, and effectiveness monitoring. Excluding the issues around conservation quotas and health assessment protocols, the supply of eels for the stocking program is dictated by market prices and availability of eels along Canada’s east coast. In years when market prices are high, purchases by OPG are limited since the program is managed on an annual budget. Further, the fisher’s success in collecting eels impacts the amount that can be purchased for stocking. A summary of the purchasing of eels for use in the stocking program is provided below and in Table 1.

In May 2006, OPG purchased approximately 102.07 kg of glass eels from South Shore Trading Limited (SST) in Port Elgin, New Brunswick. These eels originated from the Jordan River (Shelburne County) and the Salmon River (Yarmouth County), both located on the gulf side of Nova Scotia, and the Annapolis River (Annapolis County) located on the Bay of Fundy side of Nova Scotia. The glass eels were then "grown out" in holding facilities at SST (Port Elgin, New Brunswick) until the time of stocking in October. Based on laboratory grab samples at the time of stocking, 102.07 kg of elvers resulted in approximately 1,633 elvers per kg or a total of 166,744 elvers stocked. Cost was approximately $0.39/elver.

In 2007, OPG acquired a total of approximately 151 kg of glass eels (estimated 436,907 glass eels) from two suppliers in New Brunswick; SST and Brunswick Aquaculture. Prices ranged from $1,310/kg to $1,415/kg, which included holding and quarantine, assistance with marking, and transportation of the fish to Ontario. The glass eels were collected from the Magaguadavic River (6,700 eels/kg) in Charlotte County (southern New Brunswick) and the Mersey River (5,166 eels/kg) in Queens and Lunenburg Counties (Nova Scotia).
In 2008, OPG purchased approximately 370 kg of glass eels (a total of 2,001,561 glass eels) from three suppliers; SST, Brunswick Aquaculture, and Atlantic Eel Canada. Prices ranged from $630/kg to $805/kg, which again included holding and quarantine, assistance with marking and transportation services provided by SST. About 255.75 kg (5,145 eels/kg) of eels were collected from the Mersey River, and 114.25 kg (6,002 eels/kg) were collected from the Magaguadavic River and the Salmon River combined.

In 2009, based on experience gained in the previous seasons, negotiations with the fishers to purchase eels for the stocking program began in March. OPG facilitates the program on an annual budget, so it was important to negotiate terms such as price and source location early in order to maximize the number of eels purchased for stocking. In April 2009, OPG and SST formed a contract in which SST would provide 450 kg of eels to OPG for a purchase price of $500/kg eels, and an additional $130/kg for holding and transportation. The contract stipulated that the eels would be collected from no more than two river sources in the same county in order to minimize quarantine and health assessment costs. Additional terms were provided to reduce risk to the fishers should the eels prove unsuitable for stocking due to health assessment results. Under such circumstances, SST agreed to accept the fish back from OPG and make its best effort to assist OPG in mitigating the cost that would have been incurred by OPG for these eels. However, not all fishers were willing to accept this contractual term. While the initial agreement was for SST to supply 450 kg of glass eels, they were only able to provide 299 kg in 2009. Approximately 211.5 kg (4,428 eels/kg) were collected in the Mersey River and the remaining 87.5 kg (4,287.5 eels/kg) were collected from the Ingram River. In 2009, statistical analyses of collection data were initiated. A paired t-test was performed on the data collected from the two rivers and indicated there was no significant difference (p>0.05) between the number of eels per kilogram from the two rivers. Therefore, combining the datasets from the two rivers (average of 4,358 eels/kg) indicates approximately 1,303,042 eels (+/- 94,538) were purchased and stocked in 2009.
Table 1. Summary of OPG Eel Stocking Program 2006–2009.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number kg Purchased</th>
<th>Purchase Price (per kg)</th>
<th>Stocking Date</th>
<th>Stocking Location</th>
<th>Number of Eels Stocked</th>
<th>Mean Length (mm)</th>
<th>Mean Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>102.07</td>
<td>$637</td>
<td>October 12, 2006</td>
<td>Mallorytown Landing</td>
<td>166,774&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.69 (n = 25)</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>151</td>
<td>$1,310 – $1,415</td>
<td>June 21, 2007</td>
<td>Mallorytown Landing</td>
<td>436,907</td>
<td>59.2 (n=49; ±0.5)</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>370</td>
<td>$630 - $805</td>
<td>May 15, 2008</td>
<td>Mallorytown Landing</td>
<td>797,475</td>
<td>60.9 (n=40; ±0.6)</td>
<td>0.17 (n=40; ±0.0006)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>May 29, 2008</td>
<td>Mallorytown Landing</td>
<td>518,358</td>
<td>60.4 (n=40; ±0.5)</td>
<td>0.14 (n=40; ±0.0004)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>June 11, 2008</td>
<td>Deseronto</td>
<td>685,728</td>
<td>56.5 (n=40; ±0.5)</td>
<td>0.14 (n=40; ±0.006)</td>
</tr>
<tr>
<td>2009</td>
<td>299</td>
<td>$630</td>
<td>June 2, 2009</td>
<td>Deseronto</td>
<td>651,521 (±47,269)</td>
<td>59.14 (n=246; ±4.0)</td>
<td>0.18 (n=246; ±4.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>June 2, 2009</td>
<td>Mallorytown Landing</td>
<td>651,521 (±47,269)</td>
<td>59.14 (n=246; ±4.0)</td>
<td>0.18 (n=246; ±0.04)</td>
</tr>
</tbody>
</table>

Estimated Total Number of Eels Stocked from 2006 - 2009: 3,908,284

<sup>1</sup> Eels in 2006 were captured in the spring as glass eels, grown out to elver size, and stocked in the fall. In 2007-2009, eels were stocked as glass eels following a brief holding period.
3.3 Holding and Quarantine

Transferring fish between different river systems potentially allows the introduction of diseases and/or parasites into areas in which the pathogens did not previously exist. Government regulations require health assessments to be performed on fish destined for stocking in order to reduce the likelihood of introducing new pathogens. Therefore, fish must often be held in quarantine until health assessment results are available. The eels stocked in 2006 were captured as glass eels in the spring, grown to elvers, and released in the fall. This time period in captivity provided ample time for health assessments to be performed and to obtain the results from the laboratory prior to release. In 2007, the stocking approach changed to releasing glass eels shortly after capture. These fish, however, needed to be quarantined while awaiting health assessment results. Further, based on input after the 2006 season from science workshops and with representatives from the Quebec, Ontario, and New York State Introductions and Transfers Committees (ITC), the 2007 approach was also changed to segregate collected eels by source County and hold them in tanks with their own water supply while awaiting results from health assessments. In 2008 the process was modified again, to further reduce the risk of spreading of pathogens or parasites. The new protocol prescribed that:

- fish be collected and segregated by river;
- each river’s holding tank be separate from all other tanks holding fish from other operations or rivers;
- each holding tank have a flow-through water design so that recirculation of water with other tanks could not occur;
- fish could be added to these tanks, from the same river, within a 14-day window. After the 14th day, no further fish could be added to the tank;
- for days 15 to 30 and so on, a separate quarantined tank would be used for which a second health assessment would be required;
- at day 14, about 400 live eels would be collected from the tanks using an opportune random net sample and shipped to the Aquatic Diagnostic Services of the Atlantic Veterinary College University of Prince Edward Island (AVC UPEI) for health assessments; and,
- a licensed aquaculture veterinarian would visit the holding facilities to assure that all relevant procedures were incorporated and that animal handling and care met established criteria.
A recommendation was also discussed for the disinfection of nets and shipping vehicles/containers in between uses in different river systems to reduce contamination and the potential spread of pathogens. However, the actual logistics of the field efforts for collection of glass eels have not permitted implementation of these recommendations to date.

The holding and quarantine protocol used in 2008 was implemented again in 2009. Further, at the beginning of the 2009 stocking program, early-caught glass eel body mass (i.e., condition) was monitored for a subsample of fish while the fish were being held in quarantine during the tissue culture testing period. These additional data were collected because some studies (Edeline et al., 2006) have indicated that a loss in body mass during early life history stages has the potential to affect migratory behavior. As such, the 2009 Health Assessment Protocol required that if glass eel body mass loss became significant (e.g. >20%) before the end of the tissue culture testing, OPG would immediately notify OMNR, NYSDEC, and the GLFC to collectively decide on the appropriate subsequent actions. Body mass loss of this magnitude was not observed in 2009 and glass eels were stocked as anticipated.

3.4 Health Assessment

Health assessments of the eels used in the 2006 - 2009 stocking program were primarily conducted by Aquatic Diagnostic Services at the AVC UPEI. In 2006 there was one exception, the DFO in Moncton, New Brunswick performed virology testing, and the University of Massachusetts (K. Oliveira) performed parasitological testing, primarily for A. crassus. The following sections of the report describe the evolution of testing protocols for viruses, bacteria, and parasites including a description of the testing techniques.

3.4.1 Health Assessment Statistical Design

Guidance for developing health assessment protocols was obtained from the AVC UPEI, with consideration of the Sea Grant Training Curriculum “Aquatic Invasive Species – Hazard Analysis and Critical Control Point” (2004).
A statistical design for testing was adopted in 2007, prescribing the sample size of 150 fish as suggested by the Canadian Fish Health Protection Regulation as presented at the 2008 ITC Workshop. In 2008, the question was raised whether the sample size of 150 individuals was adequate or was an increased number required to improve accuracy. The Aquatic Animal Health Division of the Canadian Food Inspection Agency (CFIA) was consulted and indicated that while a sample size of 150 individuals was statistically adequate; increasing the sample size to 170 individuals would increase accuracy. This suggestion was based on the current feral fish assessment strategy employed by CFIA for surveillance of Viral Hemorrhagic Septicemia Virus (VHSV) in Great Lakes watersheds. Negative test results for this sample size (n=170) would indicate with 95% certainty that less than 2% of the study population would be infected with the pathogen being screened (D. Groman, N. Bruneau pers. comm.). Based on this discussion, each of the glass eel lots tested in 2008 and 2009 included 170 individuals for virology and bacteriology assessments and a further 170 for parasitology and histology assessments.

In 2006 and 2007, health assessments were conducted on lots of pooled fish (i.e., they were not segregated by source river). For these years, a ‘lot’ was defined as fish caught from the same County within a 14-day window. In 2008, with the introduction of new holding and quarantine protocols (see Section 3.3 - Holding & Quarantine), eels were not pooled for health assessments and remained segregated by source river for testing, as was the case in 2009. For 2008 and 2009, a ‘lot’ was defined as fish collected from the same River within a 14-day period prior to June 1st of any given year.
In February 2009, a meeting was held between OPG, OMNR, MRNF, NYSDEC and the AVC UPEI to further address health assessment protocols. The NYSDEC initiated legislation to amend Part 188 of their Fish Health Inspection Requirements in June 2007 to include assessments of other pathogens in fish destined for stocking, including Spring Viremia of Carp Virus (SVCV), Infectious Hematopoietic Necrosis Virus (IHNV), Aeromonas salmonicida (Furunculosis) bacteria, and Yersinia ruckeri (Enteric red mouth) bacteria. An increased number of eels would need to be sacrificed and holding times would need to be increased to comply with these requirements. OPG agreed to test for these additional pathogens in 2009. Since the physical size of glass eels precludes testing individuals for A. salmonicida and Y. ruckeri, it was agreed that the same fish homogenates utilized for virus isolation would be used. It was, however, cautioned that bacterial contamination from whole fish could be a limiting factor for the bacteriological assessment when homogenate testing was used.

Although it has yet to be accepted as a stand-alone diagnostic tool, Polymerase Chain Reaction (PCR) is used to determine the presence of viral genetic material and further verify results of tissue cultures. In 2006 through 2008, both PCR and tissue culture were used to assess virology of the eels destined for stocking; however fish were released for stocking based upon the results of PCR while tissue culture continued. PCR testing is advantageous for reducing fish holding periods and expediting stocking since results are typically available in five to seven days. Tissue culture testing requires about 21 days for results, and therefore nearly quadruples eel holding time. Fish condition (i.e., body mass) could potentially deteriorate over the health assessment testing period since the fish are not fed in the quarantine tanks. Further, there has been limited success feeding glass eels in captivity (P. Dumont, pers. comm.; M. Campbell pers. comm.). Feeding may also increase the risk of parasitism, and in particular A. crassus prevalence. In a unique feeding experiment in Europe, feeding glass eels in captivity decreased survival after transfer in a river (P. Dumont, pers. comm.). This being the case, feeding was not considered a viable option to reduce holding stress. In 2009 the NYSDEC indicated they
would no longer accept PCR testing as a rapid diagnostic tool to determine the presence of viral genetic material in the eels destined for stocking, and release to stocking locations could not occur until results of tissue culture testing were available \(i.e.,\) after 21 days.

### 3.4.2 Virology

For virus isolation testing, the sample population was assessed in 2006 – 2008 using 15 fish sub-lots of 10 fish homogenates per sub-lot \(i.e.,\) 150 fish. In 2009, 17 sub-lots, each comprised of 10 fish homogenates, were submitted for virology testing. As indicated previously, the sub-lots contained homogenized fish and virus isolation was completed by the culturing of tissue homogenate samples on the following cell lines: Salmon Head Kidney (SHK), Fathead Minnow (FHM), Chinook Salmon Embryo (CHSE) and Eel Kidney (EK-1). These full-tissue cultures require approximately three weeks for completion. Molecular testing with the use of Reverse Transcription Polymerase Chain Reaction (RT-PCR) techniques was also undertaken on each of these tissue homogenates to determine the presence or absence of genomic material from the following viruses: \textit{i.e.} European Eel Herpesvirus (EEHV), Viral Hemorrhagic Septicemia Virus (VHSV), Infectious Salmon Anemia Virus (ISAV) and Infectious Pancreatic Necrosis Virus (IPNV).

In 2009, it was agreed that the eels would be tested for the same four viruses as previous years, with the addition of the SVCV and IHNV, as well as the bacteria \textit{A. salmonicida} and \textit{Y. ruckeri}, the latter being requirements of NYSDEC. Tissue culture was conducted in accordance with AFS FHS Blue Book (2007) and the World Organization for Animals guidelines. Sample sizes per lot remained at 170 fish as recommended by the CFIA. PCR was not used in 2009, except to confirm viral CPE as required or to add to the scientific database as a future diagnostic tool. Testing for \textit{A. salmonicida} and \textit{Y. ruckeri} required 96 hours and therefore did not impact holding time.
A summary of virology and bacteriology testing procedures and results is presented in Table 2. The selection of viruses for screening was based on the reduced likelihood of contact with these agents for eels entering freshwater for the first time. All viruses listed in Table 2 have been identified in North Atlantic Waters, and there is a remote possibility that transiting elvers could be carriers of these viruses of concern to the Great Lake watersheds.
Table 2. Summary of virology and bacteriology testing methodology and results.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Detection Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>European Eel Herpesvirus (EEHV)</strong></td>
<td>Manifests in dermal hemorrhagic lesions mainly in the pectoral fin and opercular regions, and by congestion and destruction of gill filaments.</td>
<td>Polymerase chain reaction (PCR) - uses DNA polymerase enzyme to replicate a DNA template, potentially generating millions of copies of the original template and enabling analysis of extremely small amounts of sample.</td>
<td>All sample pools negative for EEHV.</td>
</tr>
<tr>
<td><strong>Viral Hemorrhagic Septicemia (VHS)</strong></td>
<td>Infection characterized by bulging eyes, bloated abdomen, erratic behavior and hemorrhaging of the eyes, skin, gills and fin bases. Increasingly widespread in the Great Lakes/St. Lawrence system, resulting in some massive die-offs.</td>
<td>Nested PCR - modified procedure to reduce contamination from unwanted end-product DNA; uses two successive runs of PCR to amplify a secondary target within the first-run target.</td>
<td>All sample pools negative for VHS.</td>
</tr>
<tr>
<td><strong>Infectious salmon anemia virus (ISAV)</strong></td>
<td>Highly infectious disease of Atlantic salmon which may also be carried by several trout species. Symptoms include paling of gills, liver congestion, and severe anemia.</td>
<td>Reverse Transcription (RT) PCR - amplifies a piece of RNA by first reverse transcribing it to its DNA complement, which is then amplified using PCR.</td>
<td>All sample pools negative for ISAV.</td>
</tr>
<tr>
<td><strong>Infectious pancreatic necrosis virus (IPNV)</strong></td>
<td>Widespread disease causing characteristic “corkscrew” swimming behavior and sudden increase in mortality.</td>
<td>RT-PCR - as above.</td>
<td>All sample pools negative for IPNV.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
<td>Detection Method</td>
<td>Results</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td><strong>Infectious Hematopoietic Necrosis Virus (IHNV)</strong></td>
<td>Infection characterized by abdominal distension, bulging eyes, skin darkening, anemia, fading of gills, and hemorrhaging. Necrosis common in kidney and spleen.</td>
<td>RT-PCR - as above.</td>
<td>All sample pools negative for IHNV.</td>
</tr>
<tr>
<td><strong>Spring Viremia of Carp Virus (SVCV)</strong></td>
<td>Infection characterized by darkening of skin, exophthalmia, ascites, pale gills, protruding vent with a thick mucoid fecal cast. Internally, edema, inflammation and pinpoint hemorrhages in organs, including swim bladder.</td>
<td>RT-PCR - as above.</td>
<td>All sample pools negative for SVCV.</td>
</tr>
<tr>
<td><strong>Virus Isolation</strong></td>
<td>All virus strains (HPA, VHS, ISA, and IPN) tested.</td>
<td>CHSE/SHK/FHM cell lines: tissue sample incubation occurred at 15-16°C for 28 days. EK-1 cell line: samples were done in three passes of 7 days each, and were incubated at 26°C.</td>
<td>No virus isolated in any cell line.</td>
</tr>
<tr>
<td><strong>Furunculosis</strong></td>
<td>Infection characterized by internal and external hemorrhaging; welling of vents and kidneys; boils; ulcers; liquefaction; and gastroenteritis.</td>
<td>Standard plate culture with biochemical identification of isolates for sugar metabolism. Positives confirmed by slide agglutination with specific antibodies and mass spectrophotometer.</td>
<td>All sample pools negative.</td>
</tr>
<tr>
<td><strong>Enteric Red Mouth</strong></td>
<td>Infection characterized by reddening of mouth; subcutaneous hemorrhaging of mouth, fins, and eyes; and internal organ hemorrhaging.</td>
<td>Standard plate culture with biochemical identification of isolates for sugar metabolism. Positives confirmed by slide agglutination with specific antibodies and mass spectrophotometer.</td>
<td>One lot infected in 2009; all other lots negative.</td>
</tr>
</tbody>
</table>
3.4.3 **Gross Parasitological Assessment**

In 2006, gross parasitology of elver samples was completed by K. Oliveira of the University of Massachusetts on a sample of 126 eels. No parasites were observed. In 2007, AVC completed gross parasitological examination on samples of 150 eels. The 2007 samples were pooled from the three initial geographic sources (*i.e.* counties). In 2008 and 2009, sample size increased to 170 eels per test group, with testing completed for the individual (non-pooled) rivers from which fish were obtained. In 2007, 2008, and 2009, testing was performed with the use of gross macroscopic examination of live specimens. For these three years, the results of the parasitological evaluation indicated no gross evidence of an internal infection by the swim bladder parasite *A. crassus* and no presence of external infections by other copepod or metazoan parasites.

3.4.4 **Histologic Parasitological Assessment**

In 2006, three batches of eels, for a total of 210 individuals, were assessed at the AVC by histological techniques. A single intramural swim bladder larval nematode was found in one eel that was collected in August, and as a result, a further assessment was conducted to re-assess for the presence of swim bladder nematodes in another sample of eels. No nematodes were found and no inflammation to the swim bladder was observed in the additional sample (further confirmed by parasitological assessment conducted by K. Oliveira). While maturing myxosporean spores were observed in the urinary bladder, this parasite is considered to be common in eels from Nova Scotia and likely does not pose any threat (Melendy and Cone, 2001).

In 2007, health assessments were completed on four lots of pooled fish. Three lots consisted of eels collected in late May and early June 2007. No nematodes were found and no inflammation to the swim bladder was observed in any of these lots. The fourth lot was collected in Guysborough County, Nova Scotia, in late July for a proposed second stocking event. Histological examination of the Guysborough County eels collected in July did reveal nematode larvae in the wall of the pneumatic duct and swim bladder in a low
number of fish (Photos 1 – 2 Appendix I). Given this indication, a second sample of this lot was resubmitted two weeks later and both larval and pre-adult stages of nematode were identified in the wall and lumen of the swim bladder. The later pre-adult nematode contained eel blood within the digestive tract.

A review of literature provided collaborating evidence (Haenen et al., 1989) that the location and morphology of the nematode larva and pre-adults were in fact identical to that reported for experimentally induced infections of *A. crassus* in European eel. Since this parasite in the Guysborough County sample was in the correct location within the swim bladder, was morphologically similar in size, and was found to be feeding on eel blood, there was a high probability it was *A. crassus*. These observations further suggest that the parasite had matured during the interim between the two histological examination periods. The absence of the adult form of the parasite leaves some room for speculation on the identification of this parasite species.

Although not fully corroborated, this was likely the first report of natural infection of *A. crassus* in Nova Scotia waters (Rockwell et al., 2009; Aieta and Oliveira, 2009). As a result, the entire lot of fish from Guysborough County was rejected for stocking. This finding may provide evidence to support the premise of not stocking late season elvers from this region of Atlantic Canada. As a result, in 2008 and 2009, during purchase negotiations, it was stipulated that only fish caught prior to June 1 would be purchased by OPG. This date was selected in an attempt to reduce potential freshwater impacts on the health of eels selected for stocking and the likelihood of infection with *A. crassus*. Since the duration of freshwater feeding at this time is minimal, and water temperatures are still relatively low, exposure to the intermediate freshwater copepod host species is less likely.
No observations were made to indicate the presence of parasites in the fish examined by AVC in 2008 and 2009. Health assessment documentation for 2006 through 2009 is retained by OPG.

3.5 Marking

Conventional external fish marking and tagging techniques cannot be used on glass eels due to their small size (Photo 3), so chemical markers are often used. A review of marking eels through a variety of methods is provided by Casselman (2007). Mortality from such methods was found to be negligible when used on European eels (Simon and Dörner, 2005).

The marking of eels stocked by OPG was achieved with the use of oxytetracycline hydrochloride (OTC-HCL), an antibiotic which may be used in solution for the marking of juvenile fish via immersion (Simon and Dörner, 2005). OTC-HCL is incorporated into the calcifying tissues of fish as they grow, and will fluoresce under ultraviolet light, creating an identifiable and relatively long-term mark on hard tissue such as the otoliths of the fish (Nagiec et al., 1995; Younk and Cook, 1991; Nielsen, 1992; Casselman, 2007).

The marked eels were monitored for a recovery period of 48 hours in 2006 and 2007 and 24 hours in 2008 and 2009. During this period, the water quality in the holding tank was monitored. Dissolved oxygen ranged between 8.0 and 10.1 mg/L, with a water temperature of 9.0°C and a range of pH between 3.2 and 5.1. Although buffering has been recommended as part of this procedure, it was not performed during marking. No marking-induced mortality was observed in any of the years.

Since the initiation of the eel stocking program in 2006, marking of the eels has been performed at the SST aquaculture facility in Port Elgin, New Brunswick. When suppliers in addition to SST were involved, as in 2007 and 2008, the eels were transported by SST to SST’s facility for marking. The prescriptions for OTC-HCL were provided by local veterinary groups.
Eels were marked by immersion in a solution composed of 50 L of water, 2.5 kg of marine salt and 500 g of OTC-HCL (Simon and Dörner, 2005). Initially, 1 kg of fish was tested to assess the potential for mortality from the marking procedure through a 3.5-minute immersion in the solution followed by a 30-minute observation period. No mortalities were observed. Since OTC-HCL is absorbed by the eels from the solution, successive groups were immersed for longer durations because the concentration of OTC-HCL was diminished with each successive group immersed. Subsequent to the initial test, marking was conducted by placing 4 to 5-kg groups of eels into the solution for a designated period of time (Table 3). Each batch of OTC-HCL solution allowed for the marking of a total of 52 kg of eels based on the immersion times detailed in Table 3 (P. Dumont pers. comm.; Simon and Dörner, 2005).

Table 3. OTC batch marking procedure for 52 kg of eels.

<table>
<thead>
<tr>
<th>Batch Mass (kg)</th>
<th>Duration of Immersion in OTC-HCL Solution (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 kilograms (four, 5-kg groups)</td>
<td>3.5</td>
</tr>
<tr>
<td>12 kilograms (three, 4-kg groups)</td>
<td>4.0</td>
</tr>
<tr>
<td>12 kilograms (three, 4-kg groups)</td>
<td>4.5</td>
</tr>
<tr>
<td>8 kilograms (two, 4-kg groups)</td>
<td>5.0</td>
</tr>
</tbody>
</table>

A new solution of OTC-HCL was prepared for succeeding eel batches after each 52-kg batch was marked. Eels were double-marked in 2006 and single-marked in 2007, 2008, and 2009.

3.6 Transportation and Delivery

Immediately following the post-marking recovery period of 24 to 48 hours, the eels were shipped via truck to their respective destinations in Ontario. In 2006, the elvers were transported in 1-m³ “fish totes” (transport tanks) with ice packs, which are
commonly used for shipping fish. Due to the smaller size of the glass eels used for the stocking program in subsequent years, fish were packaged and shipped in plastic bags containing oxygenated well water at 8-9°C (Photo 4). Each bag was packaged in a Styrofoam cooler with ice packs. Upon arrival at stocking destinations, water temperature in the shipping containers ranged from 9°C to 12°C. No transport mortalities were observed in any of the years of the program.

3.7 Stocking

After the grow-out period in 2006 and the quarantine periods in 2007 - 2009, eels were stocked in various locations in the Upper St. Lawrence River and Lake Ontario following procedures and protocols described below.

In 2006, the eels were transferred from the transportation containers to containers with water from the St. Lawrence River prior to stocking. In subsequent years, the bags containing the eels were removed from the transport coolers and placed into shallow water along the shore to allow the eels to acclimatize to local water temperatures ranging from 13°C in May of each year to a high of 23°C in June 2008 (Photo 5). A single exception to this practice occurred during the stocking event on June 11, 2008. The refrigeration system in the SST truck failed, so acclimatization was done on board by transferring the fish directly from the truck to the boat.

To further reduce the risk of biological contamination of the stocking areas, in 2006, fish were transferred from the shipping holding tank to transport containers using a fine mesh dip net to minimize the transfer of water. In 2007 - 2009, eels were transferred with a fine mesh dip net (Photo 6) from the shipping bags to a dispersal bucket or “seeder” (Photo 7) containing River water (Photo 8). The seeders were fabricated by OPG based on a gravity flow design developed by Hydro Québec (Photo 9). The eels were drawn from the top bucket into a dispersal tube allowing for a controlled, consistent rate of dispersal to the waterway through scatter stocking (Williams and Threader, 2007). Water from the shipping bags was retained on-board the stocking boat, sterilized with a chlorine solution, and disposed of on land away from the water's edge.
The selection of the overall stocking locations was based on traditionally good commercial eel harvest areas. Specific stocking transects were arbitrarily selected based on habitat that would provide refuge or sanctuary for the eels while they assessed their new environment. The selection of stocking locations included areas with shallow depths (0.75 m to 1.5 m), muddy bottoms or rocky shorelines, and emergent and submerged aquatic vegetation present (Photo 10). In addition, the presence of nearby strong water current to aid in their upstream migration was also considered at some stocking sites. Maps illustrating the location of stocking transects at Mallorytown Landing and Deseronto, Ontario, are provided in Appendix II. From 2006 – 2009, stocking was repeated in two main areas at Mallorytown Landing: along the north shore of Grenadier Island east of Squaw Island and at the mouth of Jones Creek. The other locations at Mallorytown Landing were stocked on an experimental basis. For example, on May 15, 2008, Transect 5 (Appendix II) was selected not only because it met the criteria listed above but it was also suggested that the presence of a cormorant (*Phalacrocorax auritus*) colony would potentially further reduce the risk to glass eels from predatory fish. In 2008 and 2009, stocking was also conducted at four locations near Deseronto (Appendix II).

Each year from 2007 - 2009, the release of the juvenile eels was completed using the same equipment and methodology. Bags of fish were taken out to the stocking locations in limited batches (15 – 20 bags) to ensure that water temperatures in the bags remained stable and that adequate room was available in the boat for persons to work efficiently and safely (Photo 11). During the release process, the boat was moved slowly along a transect while eels were released, or “scatter stocked” at a constant rate, into the River from the seeder (Photo 12). One exception to this procedure occurred on June 21, 2007 when adverse weather abbreviated the stocking process and fish were mass stocked.

In total, an estimated 3.9 million eels were stocked into the USLR/LO system from 2006 through 2009. A full list of transect coordinates and a breakdown of number of eels per transect is provided in Appendix III.
4.0 EFFECTIVENESS MONITORING

The OPG Action Plan includes a component for effectiveness monitoring of the stocking program. Further, an Agreement signed between OMNR and OPG in June 2009, in accordance with Section 11 of Ontario Regulation 242/08 under the Endangered Species Act (2007), also includes the monitoring of the effectiveness of the stocking program consistent with the OPG Action Plan. Among other requirements, this Agreement specified that the effectiveness monitoring of the juvenile eel stocking program achieve the following objectives:

- to provide feedback on the success of the juvenile eel stocking program;
- to compare the ratio of stocked (marked) to natural migrants only at approved monitoring sites;
- to monitor the growth rates of stocked eels relative to ladder eels; and,
- to examine the gender of stocked eels when biologically feasible.

A preliminary assessment of this large-scale American eel conservation stocking program was initiated in 2008 and is reported under separate cover (Pratt et al., 2010). In general, effectiveness monitoring to date has involved utilizing electrofishing techniques to sample areas near the release sites of Deseronto and Mallorytown Landing. Preliminary data collected indicate that: 1) the stocked eels appear to readily disperse from the stocking locations; and 2) eels are growing rapidly based on length and weight data. Some specimens collected during the 2009 sampling effort were sacrificed and retained for age, sex, and OTC-HCL tag analysis. It is anticipated that results from these analyses will provide information on sex differentiation of the stocked population, growth compared to ladder eels, as well as whether OTC-HCL tagging is an effective means for marking eels.
5.0 OTHER INFORMATION RELATING TO THE STOCKING PROGRAM

5.1 Presentation to Canadian East Coast Elver Advisory Committee (Fishers) OPG Stocking Program

On January 18, 2008, OPG was invited to attend the Elver Advisory Committee Meeting in Dartmouth, Nova Scotia to explain the OPG American eel stocking program to Maritime fishers. The following components of OPG’s 2006 and 2007 program were discussed:

- purchase of elvers;
- holding and health assessments;
- marking;
- province of Ontario & Great Lakes Fisheries Committee approvals;
- transport of fish from the Maritimes to Ontario;
- stocking methods;
- monitoring studies; and,
- licensing.

Discussions were initiated with the fishers about the more rigorous protocols for quarantine and holding for 2008. The protocols were finalized in February 2008 at the Canadian Eel Science Group meeting. Following this, the protocols were introduced by OPG to fishers and aquaculture facility managers and successfully implemented during the 2008 and 2009 stocking season.

5.2 2008 Experimental Conservation Licenses

Based on discussions at the Elver Advisory Meeting, OPG, in concert with Atlantic Eel Canada and SST, requested DFO to allow, on an experimental basis, 50 kg of fish to be transferred from their aquaculture licenses for conservation purposes in 2008. DFO authorized the 50 kg transfer to both Atlantic Eel Canada and SST for one year. The 50 kg from each aquaculture facility was used in 2008 to supplement stocks after health assessments were received.
In 2009, Atlantic Eel Canada made a similar request to DFO to allow the transfer of their eels to OPG for conservation purposes prior to growing-out; however, in 2009 Atlantic Eel Canada requested a 100-kg transfer instead of 50 kg as in 2008. The DFO denied the request for a 100-kg transfer; however, they again approved a 50-kg transfer to OPG. While OPG did secure these 50 kg of fish from Atlantic Eel Canada in 2009, none was used for stocking since health assessment results indicated that *Yersinia ruckeri* was present in these eels. OPG intended to stock these fish at Waupoos, Ontario in 2009. Subsequent to this, the Waupoos study site was used only as a reference location for effectiveness monitoring because no stocking occurred at Waupoos.
6.0 REFERENCES


Casselman, J. 2007. PowerPoint presentation of “Marking Fish with Special Reference to Calcified Structures and Eels” at Montreal, Québec. Biology Department, Queens University. Kingston, Ontario, Canada.


APPENDIX I

Photographs
Photo 1. Nematode larvae shown in histological examination of Guysborough County eels, 2007. Arrows indicate sections through larva located in wall of pneumatic duct.


Photo 4. Eels in plastic transport bags.
Photo 5. Arrival of eels at Mallorytown, May 15, 2008 showing eels acclimatizing to river water.

Photo 6. Transfer of eels from transport bag to mesh net.
Photo 7. Transfer of eels from mesh net to eel “seeder”.

Photo 8. Eels in “seeder” prior to distribution.
Photo 9. “Seeder” gravity flow bucket.

Photo 10. Typical release habitat.
Photo 11. Boat and equipment used for distribution of eels.

Photo 12. “Scatter stocking” along transect.
APPENDIX II

Maps and Figures
Figure 1: Study Area Location (Mallorytown Landing)
Figure 2: Study Area Location (Deseronto)
Figure 3:
Transect Locations at Mallorytown Landing (Oct 12, 2006)
Figure 4: Transect and Plot Locations at Mallorytown Landing (June 21, 2007)
Figure 5: Transect Locations at Mallorytown Landing (May 15, 2008)
Figure 6:
Transect Locations at
Mallorytown Landing (May 29, 2008)
Figure 7: Transect Locations at Deseronto (June 11, 2008)
Figure 8: Transect Locations at Deseronto (June 2, 2009).
Figure 9: Transect Locations at Mallorytown Landing (June 2, 2009).
APPENDIX III

Stocking Transect Coordinates and Data
### Stocking Transect Coordinates and Data

**October 12, 2006**

<table>
<thead>
<tr>
<th>Point</th>
<th>Time</th>
<th>Lat/Long</th>
<th>UTM</th>
<th>Depth Range (m)</th>
<th># Bags</th>
<th># Eels</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transect 1 start</td>
<td>12:30</td>
<td>44°25.28N 75°52.14W</td>
<td></td>
<td>1 - 1.8</td>
<td></td>
<td>36,075</td>
<td>- Grenadier Island, east of Squaw Island</td>
</tr>
<tr>
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<td>44°26.18N 75°50.37W</td>
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<td>1 - 2.7</td>
<td></td>
<td>36,075</td>
<td>- Adelaide Island</td>
</tr>
<tr>
<td>Transect 2 end</td>
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<td>44°26.23N 75°50.28W</td>
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<tr>
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<td></td>
<td>44°30.10N 75°48.26W</td>
<td></td>
<td>1 - 2.25</td>
<td></td>
<td>72,150</td>
<td>- mouth of Jones Creek</td>
</tr>
<tr>
<td>Transect 3 end</td>
<td>14:00</td>
<td>44°30.21N 75°48.28W</td>
<td></td>
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### Stocking Transect Coordinates and Data

**June 21, 2007**

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<th>Depth Range (m)</th>
<th># Bags</th>
<th># Eels</th>
<th>Comments</th>
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<td>Transect 2 start</td>
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<td>44°26.184N 75°50.783W</td>
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<td>1 - 2.7</td>
<td>98,100</td>
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<tr>
<td>Transect 2 end</td>
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<td>44°26.530N 75°49.726W</td>
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<td>1 - 2.25</td>
<td>98,100</td>
<td></td>
<td>- cut short due to storm</td>
</tr>
<tr>
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<td>44°27.423N 75°51.164W</td>
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## Stocking Transect Coordinates and Data

**May 15, 2008**

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<th># Bags</th>
<th># Eels</th>
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<td>(1.55 kg/bag, 5145 eels/kg)</td>
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<td>44°27.614N</td>
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<td>434765</td>
<td>4.2</td>
<td>4</td>
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<td>- river temp. 14°C - 1 bag (of 27) weighed 0.75 kg</td>
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## Stocking Transect Coordinates and Data

**June 11, 2008**

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<th># Eels</th>
<th>Comments</th>
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<td>- Sucker Creek, begin at mouth</td>
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<td>- eels at 20C</td>
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<td>0.7 - 3.1</td>
<td>10</td>
<td>75,025</td>
<td>- transect goes from start to 4410.712N 07703.249W, then loops south again before going to end point on south side of Foresters Island</td>
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<td>1.1 - 3.1</td>
<td>31</td>
<td>228,076</td>
<td>- 1 bag weighed 0.5 kg</td>
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## Stocking Transect Coordinates and Data

**Deseronto Area**

**June 2, 2009**

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### Stocking Transect Coordinates and Data

**Mallorytown Landing Area**

**June 2, 2009**

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