GOING OFF THE DEEP END: USING PUBLIC OUTDOOR SWIMMING POOLS AS A DETECTION SURVEY TOOL FOR INVASIVE INSECTS

E. BULLAS-APPLETON1*, T. KIMOTO2, G. S. THURSTON3, A. SLATER3, A. KISS1 AND I. NEI3

Canadian Food Inspection Agency,
174 Stone Road West, Guelph, ON, N1G 4S9, Canada
email, erin.bullas-appleton@canada.ca

Abstract

In 2017, the Canadian Food Inspection Agency analyzed the contents of outdoor swimming pool filters in Essex County to determine if pools could be used to detect invasive insects. Insects from two orders and nine families were collected, with Scarabaeidae (Coleoptera) being the most numerous taxon. In addition to Japanese beetle (Popillia japonica Newman), we caught scooped scarab (Onthophagus hecate (Panzert)), European chafer (Amphimallon majale (Razoumowsky)), Asiatic garden beetle (Maladera castanea (Arrow)), northern masked chafer (Cyclocephala borealis Arrow) and southern masked chafer (C. lurida Bland) in the filters. Of these, M. castanea is a new record for Ontario, while C. borealis is a new Canadian record. In total, 74 scarab beetles were captured in the filters and all of them were in good condition to allow for morphological identification. These results show that examining the contents of pool filters shows promise as a detection tool for non-indigenous insects.

Published December 2019

Introduction

The Canadian Food Inspection Agency (CFIA) is responsible for safeguarding food, animals and plants in Canada. The CFIA and its partners mitigate the risks to Canada’s plant resource base through the development and delivery of surveillance activities designed to detect and delimit invasive plant pests. These surveys include both general and pest-specific tactics including semiochemical-baited traps, rearing insects from trees occurring in high risk areas and ground-based visual surveys (Bullas-Appleton et al. 2014).

* Author to whom all correspondence should be addressed.
2 Canadian Food Inspection Agency, 4321 Still Creek Drive, Burnaby, BC, V5C 6S7, Canada
3 Canadian Food Inspection Agency, 960 Carling Avenue, Bldg 18, Ottawa, ON, K1A 0Y9, Canada
The CFIA’s Plant Health Surveillance Unit (PHSU) designs new surveys and supports the development of novel tools and techniques to increase the efficiency and effectiveness of plant pest surveys. Through the implementation and evaluation of pilot projects, the PHSU assesses survey methods that may be adopted operationally to enhance and improve detection sensitivity. For example, the PHSU has recently tested whether commercially available unmanned aerial vehicles could detect simulated signs of damage caused by Asian longhorned beetle, *Anoplophora glabripennis* (Motschulsky) (Coleoptera: Cerambycidae) (Bullas-Appleton *et al.*. unpublished; Kimoto *et al.*. unpublished). When considering the ease and effectiveness of using pan traps to sample insects inexpensively (Campbell and Hanula 2007) and our experience of noticing insects either floating on top of water or gathered in pool filters, we decided to conduct a survey of outdoor pools to see if they could be used to detect non-indigenous plant pests. Brown marmorated stink bug, *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae), and Asian longhorned beetle are two insect species not indigenous to North America that have been collected in outdoor pool filters (USDA 2010), indicating that this may be a potential detection tool that can also promote invasive species public awareness.

The following pilot project was intended to 1) determine which insect taxa are intercepted in public outdoor swimming pools, 2) assess the condition and capacity for morphological identification of specimens intercepted in pool filters and 3) determine operational potential for this type of survey.

**Materials and Methods**

Samples were collected from 01 June to 31 August 2017, in Essex County, Ontario. Large plastic containers were left with staff at six outdoor public pools in Windsor and at each of the outdoor pools in the towns of Tecumseh and LaSalle (Fig. 1). All pools have an indoor filtration system involving diatomaceous earth or sand in addition to either external grates, skimmer baskets or hand-held skimmers that complement the internal filters. Pool debris intercepted by these filtration systems was placed in plastic containers by the pool staff. As it was quite disruptive to ask staff to empty the filters on a regular basis, allowing them to fill the plastic containers on their schedule enabled their cooperation in this project. These containers were picked up by CFIA from each pool weekly or every other week, and brought back to the office where insects were carefully removed from pool debris. Initially, the targeted insects were wood boring beetles in the families Cerambycidae, Buprestidae, Curculionidae (primarily Scolytinae) and sap beetles (Nitidulidae), the latter being vectors of oak wilt, *Bretziella fagacearum* (Bretz). However, upon sorting the first samples, it was evident that taxa other than the target insects were present. From that point onward only the hard-bodied insects were placed into vials with 75% non-denatured ethanol and sent to CFIA’s entomology laboratory for identification. Only specimens in adequate morphological condition were identified. Non-target taxa, such as dragonflies, earwigs, spiders, moths, flies, etc. were discarded and not identified. Entomologists from Agriculture and Agri-Food Canada and the Canadian Museum of Nature (Ottawa, Ontario) provided verification of the identifications done by CFIA’s entomology laboratory.
Results and Discussion

Insects from two orders and nine families were sent for further identification. By far, Scarabaeidae (Coleoptera) was the most numerous taxon captured and included the following species: Asiatic garden beetle, *Maladera castanea* (Arrow), northern masked chafer, *Cyclocephala borealis* Arrow, southern masked chafer, *C. lurida* Bland, scooped scarab, *Onthophagus hecate* (Panzer), European chafer, *Amphimallon majale* (Razoumowsky) and Japanese beetle, *Popillia japonica* Newman (Table 1). *Maladera castanea* is a new record for Ontario while *C. borealis* represents a new Canadian and provincial record (Bousquet et al. 2013). Although *C. lurida* has been collected from Rondeau Provincial Park (Ratliff and Cave 2017), this is only the second record for Ontario. The lone *C. borealis* specimen is archived at the CFIA Ontario Plant Laboratory (Entomology), Central Experimental Farm, Ottawa, Ontario. Two *M. castanea* (CNC 312509, CNC 312510) and three *C. lurida* (CNC 1174733) specimens have been deposited at the Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario. *Maladera castanea* is native to temperate East Asia, but now occurs throughout most of northeastern North America including Quebec and Nova Scotia (Bostanian et al. 2003; Chantal 2003; Cutler and Rogers 2009; Löbl and Löbl 2003).
Twenty-six percent of all scarabs were *M. castanea* and were collected from LaSalle and all six Windsor pools, suggesting that it has probably been established in Essex County for some time. This beetle is considered a minor pest whose populations can increase to levels such that they occasionally cause economic damage to turf, field crops, and gardens (Cutler and Rogers 2009). *Cyclocephala borealis* and *C. lurida* are indigenous to the eastern US but the former had previously not been found in Canada and the latter is a second record for Ontario (Bousquet *et al.* 2013; Gyawaly *et al.* 2016). One *C. borealis* was collected from Central Pool in Windsor and six *C. lurida* specimens were collected from the pool in LaSalle (Table 1). Similar to Japanese beetles, *C. borealis* and *C. lurida* larvae feed on grass roots and can be turfgrass pests in the US (Gyawaly *et al.* 2016). *Onthophagus hecate* is native to Canada while *A. majale* was introduced from Europe and has occurred in Ontario since the 1960s (Turner 1964; Klimaszewski *et al.* 2017). The latter can cause serious damage to lawns and turf in Canada and the US (Simard *et al.* 2001). Although *A. majale* has occurred in Ontario for many decades, only three specimens were collected, each from a different pool, suggesting that populations may have been low in 2017 or this survey technique is not appropriate for this species. *Popillia japonica* occurred in all eight pools and was the most common scarab, representing 59% (44 of 74 specimens) of the collection. This beetle is native to Japan and was discovered in New Jersey in 1916 (Potter and Held 2002). It now occurs in eastern Canada, ranging from Ontario to Nova Scotia, as well as central and eastern USA (Potter and Held 2002; Bousquet *et al.* 2013; Klimaszewski *et al.* 2017). Additionally, 19 carabids and one *Neandra brunnea* (Fabricius) (Coleoptera: Cerambycidae) were also collected. The families Dytiscidae, Elateridae, Lampyridae, Rhopalidae and Notonectidae were also found in the filters but these were not identified to species because they are not plant pests and were not targeted in this survey.

Only six pentatomids were captured in filters (Table 2), including two specimens of brown marmorated stink bug, *Halyomorpha halys* (one at the Riverside Centennial pool and the other at the Lasalle pool). This finding suggests pools are not an effective sampling tool for Pentatomidae.

The 74 scarab and 19 carabid beetles collected from pools were all in very good condition, which allowed for morphological identification. Some showed slight signs of decay but this did not affect key features.

**TABLE 1:** Number of scarab beetles (Coleoptera: Scarabaeidae) collected from pools in Essex County, Ontario in 2017.

<table>
<thead>
<tr>
<th>Pool</th>
<th>Amphimallon majale</th>
<th>Cyclocephala borealis</th>
<th>Cyclocephala lurida</th>
<th>Maladera castanea</th>
<th>Onthophagus hecate</th>
<th>Popillia japonica</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atkinson</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Central</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Lanspeary</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Mic Mac</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Remington</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Riverside</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Tecumseh</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>LaSalle</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
<td><strong>1</strong></td>
<td><strong>6</strong></td>
<td><strong>19</strong></td>
<td><strong>1</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>
Swimming pools as a detection survey tool for invasive insects  JESO Volume 150, 2019

TABLE 2: Number of pentatomids (Hemiptera: Pentatomidae) collected from each pool in Essex County, Ontario in 2017.

<table>
<thead>
<tr>
<th>Pool</th>
<th>Halyomorpha halys</th>
<th>Euschistus sp.</th>
<th>Holcostethus sp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atkinson</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Central</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lanspeary</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mic Mac</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Remington</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Riverside Centennial</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Tecumseh</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LaSalle</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
<td><strong>3</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

The new provincial and Canadian records are a positive proof of concept of this survey. However, it is unclear how effective outdoor public swimming pools are at detecting new species because we did not have enough time or resources to assess the population of captured insects within the surrounding environment. Future research should try to determine if the catch rate is comparable to survey methods that deploy traps or involve visual examination. Such projects could also assess how abundance in the environment affects pool catch rate. Targeting pools that have lights turned on at night, as well as sampling immediately after strong winds, could also be examined in future studies as these will impact the diversity and quantity of species collected. One limiting factor when considering using outdoor public swimming pools as a detection survey tool is their restricted geographical distribution. Alternatively, assessing the filter contents of residential outdoor pools in areas where these are common may provide interesting results (e.g. Quebec has some of the highest concentrations of outdoor pools in North America according to Perreaux 2012).

Inviting citizens to participate in invasive species surveys has many benefits, such as increasing the probability of discovering a previously unreported species and contributing to the distribution of established species. Furthermore, datasets generated from such projects have the potential to advance scientific knowledge and enhance survey capacity, influence policy and guide resource management (Kosmala et al. 2016).

**Acknowledgements**

This project was funded by the CFIA. We’d like to thank the following for their contributions. Mireille Marcotte (CFIA) for administrative support and manuscript review. Cheryl Cakebread, Kenn Little, Kristen Brunette and Jen Knights (City of Windsor), Julie Turnbull (Town of Lasalle) and Ray Hammond (Town of Tecumseh) for collecting contents of the pool filters and skimmers. Serge Laplante and Henri Goulet (Agriculture and Agri-Food Canada) and Andrew B.T. Smith (Canadian Museum of Nature) for species determination.
References


Swimming pools as a detection survey tool for invasive insects  JESO Volume 150, 2019

Experiment Station, New Haven, CT. May 1964.