Ecosystem functions and services in urban stormwater ponds: Co-producing knowledge for better management

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Abstract

1. Urban stormwater management ponds (SWMPs) are widely employed for stormwater control, but knowledge about their contributions to urban ecosystem function and service delivery remains unclear. We organized a workshop that brought together researchers, managers and students to assess and discuss current information on SWMP ecosystem function and services, identify perceived knowledge gaps and prioritize research needs, to advance understanding and management of SWMPs in Ontario, Canada.

2. Workshop participants identified habitat provisioning and regulation of water quality and quantity as key ecosystem functions in SWMPs. They also recognized carbon sequestration, flood prevention, water purification, educational potential, human health promotion and community engagement as important ecosystem services provided by SWMPs.

3. Despite the availability of engineering information and practitioner knowledge, workshop participants suggested that information on the impacts of maintenance operations, biological condition, water quality, costs and benefits and impact on surrounding landscape are important gaps that hinder a modern approach to design and management of SWMPs for multiple co-benefits.

4. Participants suggested current gaps can be tackled with a combination of continuous water-quality monitoring, field, laboratory and mesocosm experiments. They also suggested that future SWMP studies take advantage of existing community and governmental databases using meta-analyses to summarize knowledge and provide future directions.

For affiliations refer to page 8.

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5. Practical implication: By linking knowledge gaps to management needs, this practice insight provides a road map that can be used to advance management of SWMPs in Ontario and elsewhere.

KEYWORDS
ecological infrastructure, evidence-based management, green infrastructure, nature-based solutions, sustainable drainage system, SWMF, urban planning, urban run-off

1 | INTRODUCTION

Human populations continue to increase globally, especially in urban areas. The number of people living in cities has doubled in the past decade, and this trend is projected to continue into the future (United Nations, 2019). The process of urbanization transforms natural and agricultural lands into a built landscape with profound consequences to hydrology. Most often, urban infrastructure is impervious which reduces water infiltration and increases run-off. For that reason, large storm events often cause floods and cities require effective stormwater management systems. Current practices rely on engineered facilities that mitigate the effects of stormwater to natural surface waters, such as stormwater management ponds (SWMPs), which are components of sustainable drainage systems.

The SWMPs, are the most used structure for urban stormwater management worldwide (Tixier et al., 2011). They consist of a catchment basin with an inlet and outlet. The main purpose of SWMPs is to regulate the quantity (volume) and quality (e.g. dissolved sediments) of the run-off and to mitigate erosion in the receiving water body.

Despite their widespread use, many of the ecological and social aspects of SWMPs are poorly known (Beckingham et al., 2019; Prudencio & Null, 2018). This restrict the information needed to support standards and guidelines, impairing the implementation of effective sustainable urban stormwater management (Qiao et al., 2018). Specifically, improving our understanding of the ecosystem functions (i.e. the array of biological, geochemical and physical processes that occur, sensu Manning et al. (2018)) and ecosystem services (i.e. the benefits humans obtain from natural processes, sensu Millennium Ecosystem Assessment (2005)) can provide fundamental information for advancing SWMPs management towards effective nature-based solutions to urban environmental problems (Beckingham et al., 2019; Bertrand-Krajewski, 2021).

In Ontario, Canada, the primary purpose of SWMPs is to manage the quantity and quality of stormwater (Ontario Ministry of the Environment, 2003). This purpose dictates decisions on SWMP placement, construction (e.g. number, size and depth) and management. Ongoing management actions may require removing riparian/aquatic vegetation and animals that could impair the primary purpose, and dredging to remove accumulated sediments that reduce stormwater storage capacity (Ontario Ministry of the Environment, 2003). As SWMPs are considered ‘sewage works’ under the Ontario Water Resources Act, maintenance, including dredging activities, are conditions of Environmental Compliance Approval (ECA). Such activities can be expensive and municipalities in Ontario might struggle with the costs associated with SWMP maintenance (Drake & Guo, 2008). Despite this, SWMPs are widely employed in Ontario, and individual municipalities have developed specific guidelines on their design, inspection and maintenance (Toronto and Region Conservation Authority (TRCA) and CH2M Canada, 2016). The current focus on stormwater management has likely overshadowed the potential ecological and social significance of SWMPs in Ontario.

Here, we report on the workshop ‘Ecosystem Functions and Services of Urban Ponds in Southern Ontario’, held by the Centre for Urban Environments at the University of Toronto Mississauga, Ontario, Canada on 29–30 September 2022. The workshop brought together academics, managers and students to discuss the ecology and management of SWMPs in the Greater Toronto Area (GTA). The objectives of this workshop were as follows: (1) to facilitate communication and collaboration among urban SWMP managers, researchers and students; (2) to conduct an overview of the perceived knowledge about the ecosystem functions and services of urban SWMPs and related management needs; and (3) using a knowledge co-production approach to identify perceived knowledge gaps and research needs to advance urban SWMP management (see agenda in Supporting Information). This practice insight paper reflects the consensual perspectives of all the participants, following the discussion and activities held at the workshop.

2 | WORKSHOP APPROACH

Urban stormwater infrastructure have the potential to support a whole ecosystem with important functions and services, but empirical evidence still needed (Beckingham et al., 2019; Hassall, 2014; Prudencio & Null, 2018). This is specially the case for information needed for better management (Beckingham et al., 2019). To advance towards the perceived knowledge gaps in the field, we have invited academics, managers and students for a workshop (Table 1).

The workshop was based on the co-production of knowledge which refer to the iterative and collaborative process involving multiple players with diverse types of expertise with the goal of creating knowledge to inform decision-making (Lemos & Morehouse, 2005; Norström et al., 2020; Figure 1). For that, we contacted key experts with diverse experience on research, teaching and management of SWMPs. Such experts received an invitation email and were asked to forward the invitation to their network, creating a snowball
At total of 36 participants attended the workshop (Table 1). This practice insight manuscript is authored by all participants that manifested interest on contributing.

On the first day of the workshop, we began by broadly defining the terms ‘ecosystem function’ and ‘ecosystem services’ to participants. This was performed during an opening talk. Ecosystem functions were defined to the group as the physical, chemical and biological processes that occur within an ecosystem within and/or external to the SWMPs without considering explicit benefits to humans (Manning et al., 2018). While ecosystem services were defined as the economic, direct and indirect benefits that humans realize from an ecosystem (Millennium Ecosystem Assessment, 2005). Following the definition of terms, participants were divided into three breakout groups and asked to write down on large Post-Its® notes all the SWMPs’ ecosystem functions and services they were aware of (Figure 1a,b ovals). Workshop mediators made sure to compose groups with individuals from all three participant categories to allow discussions with multiple views. Each breakout group reported back to the whole group by sticking their Post-Its® notes on a whiteboard. The workshop mediators discussed the contents of the notes and assessed their classification with the whole group to form consolidated lists of functions and services perceived by participants was compiled (Tables 2 and 3; Figure 1a triangle). Ecosystem functions were categorized into biological, biogeochemical and physical processes (Manning et al., 2018; Table 2), while ecosystem services were categorized into regulating and cultural services following the Millennium Ecosystem Assessment (2005, Table 3). Supporting services such as habitat provisioning were not itemized because they encapsulate basic ecosystem functioning exposed in Table 2, and we did not consider provisioning services because SWMPs, which can accumulate pollutants, were not seen as feasible for food and goods production.
TABLE 2 Ecosystem functions in stormwater management ponds (SWMPs) identified by the workshop participants and categorized into biological, biogeochemical and physical processes.

<table>
<thead>
<tr>
<th>Ecosystem functions of SWMPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological processes</td>
</tr>
<tr>
<td>- Habitat provisioning (shelter and breeding grounds)</td>
</tr>
<tr>
<td>- Improving landscape connectivity (stepping-stones)</td>
</tr>
<tr>
<td>- Promoting biodiversity</td>
</tr>
<tr>
<td>Biogeochemical processes</td>
</tr>
<tr>
<td>- Cycling of nutrients</td>
</tr>
<tr>
<td>- Decontamination of water</td>
</tr>
<tr>
<td>Physical processes</td>
</tr>
<tr>
<td>- Controlling erosion</td>
</tr>
<tr>
<td>- Facilitating sedimentation</td>
</tr>
<tr>
<td>- Regulating of water temperature</td>
</tr>
<tr>
<td>- Retaining stormwater retention</td>
</tr>
</tbody>
</table>

On the final moments of the first day of the workshop, the mediators promoted a whole group brainstorm on the information needed for better management and a consensus list was created (Figure 1b circle).

On the second day of the workshop, participants were divided into three breakout groups and asked to link the consensus information needed for better management to perceived knowledge on functions and services (Figure 1c oval). Workshop mediators made sure to compose groups with participants that did not interact before, creating new opportunities for engagement. The breakout groups reported back to the whole group consolidating a list of knowledge gaps necessary for better understanding ecosystem functions and services with application to management (Figure 1c triangle). Then, participants prioritized the knowledge gaps needed for better management through a ‘dotocracy’ exercise where each participant was given five votes (coloured dots) and asked to vote for each management need by placing one or more dots next to the management need(s) they felt were the greatest priority (Figure 1c circle). This exercise facilitated individual, diverse voices to be expressed. At the end of the exercise, the dots for each management need were counted, and the needs were ranked based on the total counts (Table 4; Figure 1d oval). Following prioritization, the whole group brainstormed strategies to address the perceived knowledge gaps (Figure 1d square).

The consensus information on ecosystem functions, ecosystem services, information needed for better management and priority areas for advancement is summarized below.

3 | ECOSYSTEM FUNCTIONS IN SWMPs

One of the most readily recognized ecosystem functions of SWMPs perceived by the participants was habitat provisioning (Table 2). Within the urban matrix, mainly composed of impervious surfaces that do not retain water, SWMPs can provide important habitat for aquatic species (e.g., plants, invertebrates, amphibians, fishes and turtles) and semi-aquatic/terrestrial species (e.g., plants, birds and small mammals). This perception is consistent with the current literature suggesting SWMPs can serve as variable quality habitat for multiple species (McKercher et al., 2024). Participants also identified SWMPs can serve as dispersal stepping-stones, helping species to move throughout the urban landscape (Table 2; e.g., Birch et al., 2024).

Participants reported SWMPs have important geochemical and physical functions, primarily related to the regulation of water quality (Table 2). Water retention in SWMPs was perceived to facilitate sedimentation of particulate matter and processing of contaminants from urban stormwater. Water retention was deemed to affect nutrient processing (settling, burial and biological assimilation), reducing loads of nitrogen and phosphorous and affecting outflow water temperature. These perceptions coincide with the existing literature on the effect of SWMPs on water-quality parameters (Gu et al., 2017; Shahirmia et al., 2023; Song et al., 2013; Vander Meer et al., 2021).

4 | ECOSYSTEM SERVICES PROVIDED BY SWMPs

Stormwater management infrastructure has the potential to provide a range of ecosystem services for people in cities (Moore & Hunt, 2012). However, information on the services provided by SWMPs is limited (Hassall, 2014).

The regulating services include the benefits that humans obtain from the regulation of ecosystem processes in SWMPs (Gómez-Baggethun et al., 2013). Participants identified carbon sequestration (through carbon accumulation in soil), regulation of local climate
through temperature and moisture control), flood prevention and water purification (through water retention) as important regulating services provided by SWMPs (Table 3). They also noted cultural services that provide non-material benefits to people, such as environmental education (through exposure to naturalized green spaces), human health (through exercise and recreation) and community engagement (through socialization and job creation; Table 3). Indeed, SWMPs are expected to provide a wide range of ecosystem services to people in cities (McKercher et al., 2024; Moore & Hunt, 2012; Prudencio & Null, 2018).

### 5 MAPPING EXISTING INFORMATION TO MANAGEMENT NEEDS TO IDENTIFY AND PRIORITIZE KNOWLEDGE GAPS

Participants identified information gaps that, based on their knowledge and experiences, hinder advancements in management of SWMPs in Ontario (Table 4). They recognized a need for information on the impact of construction and periodic maintenance operations (e.g. dredging and other cleanout operations necessary to maintain the primary purpose) on biotic and abiotic processes. This is likely a prevalent gap as a quick literature search did not return any papers on this topic. Despite current studies reporting on the biodiversity of SWMPs (McKercher et al., 2024; Meland et al., 2020), participants indicated a need for more information on invasive species and species at risk observing critical periods, species tolerance and community structure and dynamics. Participants also identified the need to better assess and understand the dynamics of water-quality indicators beyond turbidity, such as nutrients, heavy metal and chloride contamination. This can help clarify the retention capacity of SWMPs for some contaminants, which still under debate (Lam et al., 2020).

Workshop participants exposed the importance of better evaluating the impacts of SWMPs on surrounding landscape. This is likely because a few existing studies suggest negligible effects of SWMPs to downstream ecosystems (Ivanovskiy et al., 2018), but experience seems to suggest otherwise. They also indicated a need for cost–benefit analyses that includes ecological, socio-economic and engineering

### Table 4 Information needed for advancing practices on stormwater management ponds in Ontario and prioritization following a ‘dotmocracy’ exercise.

<table>
<thead>
<tr>
<th>Information needed for better management</th>
<th>Aca</th>
<th>Man</th>
<th>Stu</th>
<th>Total</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence on the impact of cleanout and dredging that assess the level of disturbance, recovery rate and restoration strategies</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Understand the biology of the environment evaluating the critical periods for the biota, species tolerances, biodiversity patterns and community structure/dynamics</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Improve water-quality assessment by considering stratification, anoxia patterns, nutrient dynamics, sedimentation, heavy metals and chloride contamination</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Impact on surrounding/downstream landscape</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Cost–benefit analysis incorporating engineering and ecological views</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Interdisciplinary design that involves engineers, hydrologists, landscape architects, biologists and social scientists</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>Low priority</td>
</tr>
<tr>
<td>How to deal with species at risk?</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>Low priority</td>
</tr>
<tr>
<td>Public perception/behaviour</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>Low priority</td>
</tr>
<tr>
<td>Climate change resiliency (temperature variations and precipitation)</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>Low priority</td>
</tr>
<tr>
<td>Invasive species management</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>Low priority</td>
</tr>
<tr>
<td>Use of SMPs as wetland offsets</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>Low priority</td>
</tr>
<tr>
<td>Contaminant loads in organisms (ecotoxicology)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Low priority</td>
</tr>
<tr>
<td>Phytoremediation—which plants to use?</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Low priority</td>
</tr>
<tr>
<td>Jurisdictional uncertainty, differences among administrative regions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Low priority</td>
</tr>
</tbody>
</table>

The votes of academics (Aca), managers (Man) and students (Stu) were summed, and the total was used to rank the most urgent information needed from 1 to 5, whereas the remaining were classified as low priority.
metrics, ideally following a bottom-up approach (Carolus et al., 2018). Such analysis would allow to assess the public perception and consider an interdisciplinary design that addresses multiple purposes and benefits of SWMPs (Bertrand-Krajewski, 2021). This information can help advance towards a more comprehensive valuation of ecosystem services provided by SWMPs (Moore & Hunt, 2012).

Participants noted the importance of exploring the effects of ponds in contributing to or mitigating climate change (e.g. methane and nitrous oxide generation vs. carbon sequestration). This likely reflects current discussions of the role of SWMPs in carbon burial/emission (Goecckner et al., 2022; Kavehei et al., 2018). Participants also suggested advancing the understanding of contamination loads in organisms (e.g. Lynch et al., 2015), the need for determining the jurisdictional competence of SWMPs (i.e. who is responsible for management) and accessing the implications of using SWMPs as wetland offsets.

Among the perceived needs described above, the most urgent information is related to maintenance operations, biology of the environment, extended water-quality assessments, impacts of SWMPs on surrounding landscape and their overall costs and benefits (Table 4; Figure 2). Overall, academics, managers and students had similar perceptions on the information needs that should be prioritize (Table 4).

6 | ADDRESSING KNOWLEDGE GAPS

Workshop participants identified and came to a consensus about the actions that could address each of the top five information needs for advancing management of SWMPs in Ontario (Figure 2), as follows.

6.1 | Impact of maintenance (priority #1)

For improving knowledge on the impact of maintenance operations such as cleanout and dredging, participants indicated a need for studies that assess the changes to biotic and abiotic factors pre- and post-maintenance. Specifically, studies that track the trajectory of community assembly (e.g. changes in species diversity) coupled with water-quality indicators (e.g. dissolved oxygen, temperature, pH and conductivity) post-maintenance operations are perceived as crucial. Important aspects of these studies would include contrasting different maintenance methods and pond size/depth compared to natural ponds and restored wetlands. Studies should be especially careful to consider the effect of species introductions on community assembly. Such information can further help understanding how maintenance influences the provisioning of ecosystem services to people, which contribute to an integrated approach that advances towards more effective management SWMPs (Beckingham et al., 2019; Prudencio & Null, 2018). Overall, participants agree that laboratory, field and/or mesocosm experiments (e.g. experimental ponds) can help identifying the mechanisms for recovery of the biota and water-quality indicators following maintenance operations. Workshop participants also identified that some information on the effect of maintenance operations is routinely collected by managers in municipalities and

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**FIGURE 2** Priority knowledge and actions needed for effective management of SWMPs in Ontario. The knowledge and actions listed derived from breakout group discussions and whole group consolidation during the workshop and were defined following a dotocracy exercise.
6.2 | Biology of the environment (priority #2)

Information on the biology of the SWMP ecosystem was recognized as another area for improvement. Workshop participants indicated a shortage of information about how the biodiversity/community structure of SWMPs differs from natural ponds, how SWMPs biodiversity changes over time and space and whether they act as viable overwintering and source/sink habitats for certain species. There is a need to understand how biodiversity, including riparian and aquatic plants—planted and unplanted—affect ecosystem function (i.e. biodiversity–ecosystem function dynamics). Another important aspect indicated by participants was the need for advancing towards understanding the process by which macrofauna (e.g. beavers and muskrats) arrive and establish in SWMPs.

Workshop participants reported that, in most cases, SWMPs are not legally stocked, but fishes often become established. Of particular interest was assessing whether SWMPs should be stocked with fishes and whether stocking could help control invasive species such as the Goldfish, Carassius auratus, or affect water quality. They also highlighted the importance of considering the role of human perception and interaction (of practitioners, scientists and public) in shaping biodiversity. Overall, participants recognized a need for inter- and trans-disciplinary studies capable of integrating the environmental, engineering and social factors defining biodiversity to better inform the management of SWMPs.

6.3 | Water-quality assessment (priority #3)

Workshop participants indicated that, although water quality in SWMPs has sometimes been tested by conservation agencies and municipalities, these tests are often focused on total suspended solids because they provide information about levels of sediment deposition which affects primary purpose of SWMPs. They suggested that water-quality assessments should consider additional indicators, such as different forms of nitrogen and phosphorous, temperature, pH and conductivity. Specifically, they indicated that better understanding the fate of road salt can be important for estimating its effects on water stratification and the SWMP ecosystem. Participants suggested meta-analyses as an efficient way to explore the effectiveness of SWMPs in improving different water indicators and identifying water-quality indicators requiring further investigation and ongoing monitoring. They further proposed that integrating large data sets, collected by conservation agencies and municipalities as part of routine monitoring, can help identify the drivers of change to water quality at different scales. Participants also indicated a need for assessing how the biota affects nutrient dynamics/contaminant processing and for evaluating the effect of different pond designs (width, depth) and management strategies (aeration, stocking species and maintenance procedures) on water-quality indicators.

6.4 | Impact on surrounding landscape (priority #4)

Workshop participants considered important further studies on the effects of SWMPs to the water quality of nearby water bodies. This is likely influenced by current debates on the extent to which SWMPs helps to protect urban aquatic ecosystems (Hess et al., 2022). Participants recommend future research to take advantage of before/after construction, or upstream/downstream design to assess the effect of SWMP to nearby water bodies. Specially, they suggest the use of stable isotopes can be advantageous to track the origin of contaminants to downstream ecosystems. This can help further assess the effects of SWMPs that are directly connected to nearby water bodies (online SWMPs) and those that are not connected. Beyond the effects on water quality, participants indicate that it is fundamental to understand whether SWMPs facilitate the success of tolerant species, especially invasive species such as Goldfish (e.g. Kwik et al., 2013).

6.5 | Costs and benefits (priority #5)

While the costs of SWMPs construction and maintenance are readily accessible, the ecological and social costs and benefits are rarely quantified (Beckingham et al., 2019; Prudencio & Null, 2018). Workshop participants suggested a review/meta-analysis of ecosystem services and valuation of SWMPs could help identify the links between humans and SWMPs, exposing patterns among different regions. Conducting ecosystem service valuations that involve multidisciplinary specialists, such as ecological economists and social scientists, can be important to provide further empirical evidence for cost-benefit analyses.

7 | LIMITATIONS

Despite exposing important knowledge areas necessary for advancing the management of SWMPs, the workshop had limitations. Participants identified that many players directly or indirectly affected by the management of SWMPs, such as community members, developers, consultants and policymakers were not present in the workshop. Therefore, the knowledge needs, and prioritization described here reflect solely the perspective of academics, managers and students. Another limitation is that knowledge gaps described here relied on participants previous knowledge, and thus may not entirely reflect the information available in the literature and/or indicate that existing information is not detailed enough to support management actions. Also, the workshop focused on discussing the ecosystem services (i.e. benefits humans obtain from ecosystems)
provided by SWMPs. However, current literature raises caution about the ecosystem disservices (i.e., disadvantages humans obtain from ecosystems) SWMPs can deliver, such as creating ecological traps and facilitating the spread of invasive species (McKercher et al., 2024; Sinclair et al., 2020).

8 | CONCLUSION

Workshop participants identified knowledge gaps that hinder advancements in the management actions of SWMPs in Ontario (Figure 2). Such gaps can only be addressed if management evolves from the current approach where SWMPs are primarily used as structures for flood control (Ontario Ministry of the Environment, 2003) to a more integrated approach recognizing the multiple ecological and social roles of these systems. This is because, as reported here and elsewhere, SWMPs can serve a multitude of ecosystem functions and services (Hassall, 2014; Moore & Hunt, 2012; Oertli & Parris, 2019; Tables 2 and 3). We provide a roadmap that can be used to facilitate the integrated management of SWMPs in Ontario and other urban areas. Such an integrated approach can help bridge diverse urban practitioners, from engineers to researchers and managers, towards science-based solutions that encourage sustainable expansion of cities in an increasingly urban world.

AUTHOR CONTRIBUTIONS

Piatã Marques, Marc W. Cadotte and Nicholas E. Mandrak conceived and led the writing of the manuscript. All the remaining authors: Edina Illyes, Shannon McCauley, Donald A. Jackson, Diana Michalakos, Ilia Maria C. Ferzoco, Laura Timms, Rosalind L. Murray, Zira S. MacFarlane, Tim P. Duval, Rebecca Dolson, Sajjad Din, Dale Pebesma, Andrea E. Kirkwood, Nicole A. Turner, Jon Clayton, Kaitlyn Horton, Christine M. Boston and Ekaterina Sapozhnikova critically discussed the topics, provided ideas during the workshop and reviewed the manuscript.

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Sajjad Din was employed by the Toronto Inspection Ltd. and Ben Engineering during the writing of this paper. Marc Cadotte is a Senior Editor of Ecological Solutions and Evidence but took no part in the peer review and decision-making processes for this paper. Remaining authors declare no conflict of interest.

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Empirical data were not used in this paper.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Supporting Information S1. Supplementary Material.