WHC White Paper

Restoring Ecosystems Through Invasive Species Control

Methods for Preventing, Monitoring and Eradicating Invasive Species on Corporate Lands

Sponsored by

ONTARIO POWER GENERATION

WHC

wildlifehc.org

Ontario Power Generation manages invasive phragmites at its Western Waste Management Facility & Bruce Complex site.

Message from our sponsor:

ONTARIO POWER GENERATION

Ontario Power Generation (OPG) is dedicated to safeguarding and improving the biodiversity of its properties. We recognize that managing invasive species is not only crucial to protecting sensitive ecosystems but also to combating the effects of climate change. OPG aims to responsibly manage these species, replacing them with native species to aid in carbon sequestration and mitigate the impacts of climate change. Managing non-native species on OPG properties also contributes to the WHC (Wildlife Habitat Council) certifications at many of our sites in Ontario, Canada, and supports an ecosystem approach to conservation and ecosystem restoration.

Over the years, we have managed foreign species through a combination of prevention techniques that include regular biological assessments for early detection and rapid response. Some of the specific actions that OPG takes to manage invasive species include:

- Developing and implementing management plans that are tailored to each of our properties.
- Conducting regular surveys and monitoring of our properties to aid in early detection.
- Prioritizing the management of species that have the greatest potential impact on biodiversity.
- Using a variety of management techniques to control their growth, including manual removal, mechanical control and herbicide application.
- Engaging in research and monitoring to evaluate the effectiveness of our management activities and to identify new and emerging invasive species.
- Educating and engaging our employees, the public and Indigenous communities on the importance of management and prevention.

Overall, OPG's approach to controlling invasive species plays an important role in our broader commitment to sustainability and our efforts to combat climate change and biodiversity loss.

Heather Brown
Vice President, Environmental Health & Safety
Ontario Power Generation

Contents

WHC

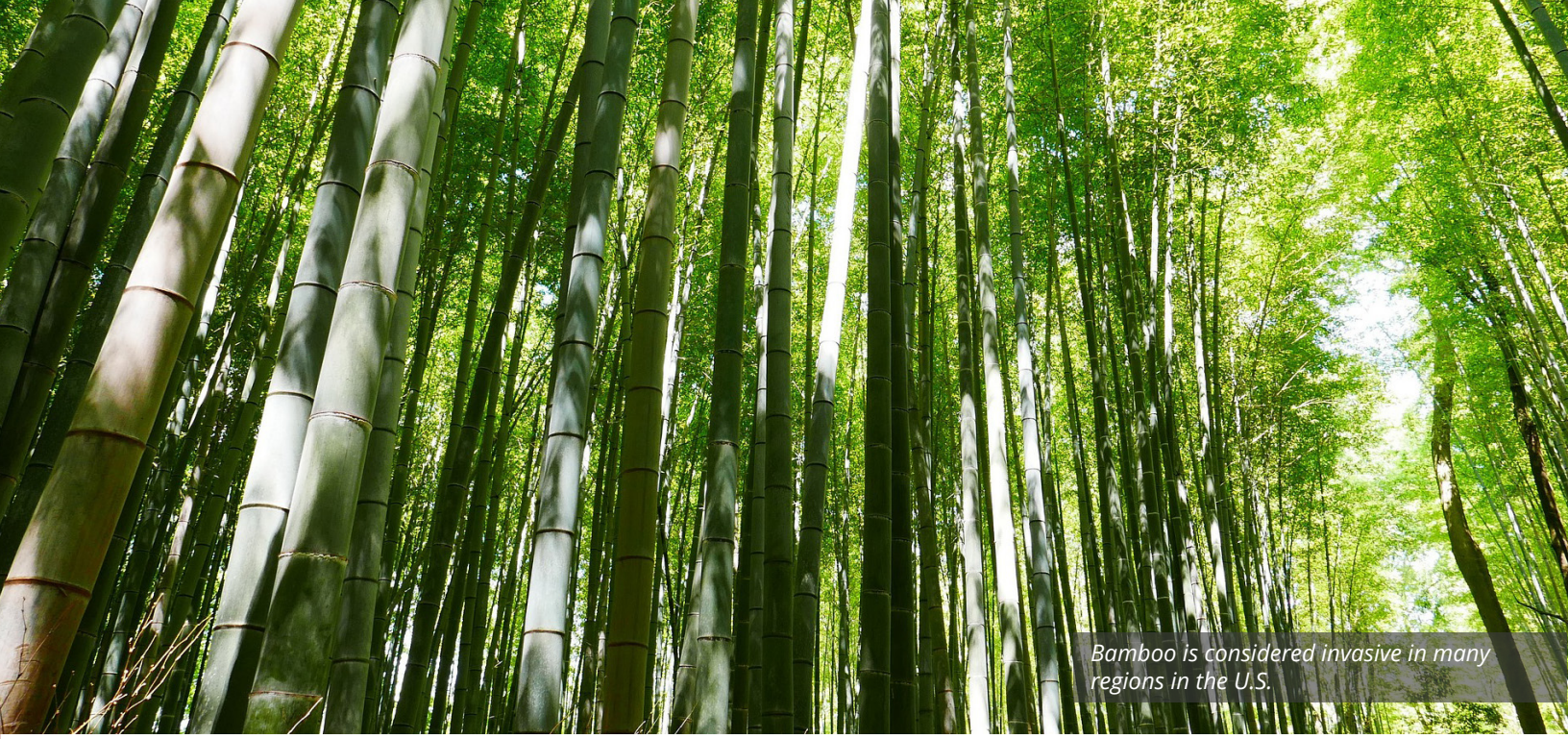
Introduction

Invasive species are within the top five threats to biodiversity worldwide.[1] When plant or animal species are introduced into an ecosystem that is outside of their native habitat, they lack the factors, such as predators or climate, that previously limited them. As such, these invasive species are able to proliferate in this new environment, leading to a large homogeneous population that outcompetes native species for resources. Research finds that just a 20-30% increase in invasive species could lead to large-scale biodiversity loss across the globe, with factors like climate change exacerbating this effect.[2]

The impact of non-native flora and fauna is far-reaching, extending beyond the consequential environmental risks to result in potentially devastating effects on the economy as well as human health and safety. Because of the negative impact of invasive species on both habitat quality and biodiversity, managing and controlling the spread of invasive species is a key element of conserving habitats and protecting native wildlife.

Our globally connected world means that invasive species can spread farther and faster than ever before. Air, sea and land transportation aid invasive species in crossing borders, indicating the need for global frameworks and international regulations to address the spread of these species. In 2014, the European Union established a regulation requiring member states to prevent the introduction and spread of specifically listed species through measures like prevention, early detection and rapid eradication, and management. More recently, the 15th Conference of Parties to the UN Convention on Biological Diversity adopted the Kunming-Montreal Global Biodiversity Framework in December 2022, which provides a set of international targets to reach by 2030. Among them is the goal of preventing the introduction of priority invasive species, as well as reducing the introduction of other invasive species by at least half.[3]

While these global targets and regulatory measures are necessary to control invasive species and thereby protect biodiversity at a global level, larger frameworks correlate well with smaller, voluntary conservation efforts. As privately owned lands make up a vast amount of the earth's land surface, it is imperative that the corporate sector become an active player in invasive species management



Bamboo is considered invasive in many regions in the U.S.

efforts. For companies already invested in conservation, controlling invasive species on their lands can become a vital part of an existing habitat restoration project in order to ensure the vitality and success of native species. Efforts to prevent and eradicate invasive species also provide opportunities for corporations to involve the local community in the form of awareness-raising and/or removal events.

Invasive species management requires a long-term commitment from companies, as eradication can only be achieved through consistent effort. In addition, invasive species go beyond fence lines, so strong partnerships with adjacent landowners, conservation organizations and suppliers and other companies can maximize a corporation's efforts and ensure that the target species is eradicated.

This white paper details the key methods corporations can use to control invasive species, restore native habitats and educate the surrounding community.

”

Terminology

The language used to describe invasive species varies widely. Other terms that are sometimes used include "invasive alien species (IAN)," "non-native species," "non-indigenous species" and "introduced species." Some words associated with invasive species, such as "noxious" or "aggressive," have negative connotations, and the broad variation in terminology often leads to confusion.[4] At present, there is no field-wide consensus on terminology, so WHC uses "invasive species."

WHC

Preventing the Introduction of Invasive Species

One of the most foundational methods of invasive species control is prevention. Predicting areas or sites that are most vulnerable to invasive species and taking steps to address those vulnerabilities reduces the risk of introduction. A key method of preventing the introduction and spread of invasives is through the breaking or blocking of a pathway by which the species could be introduced into an area.

One approach for determining these potential pathways is by utilizing a Hazard Assessment and Critical Control Point (HACCP) analysis. First developed by NASA in the 1960s to ensure that foods used during space travel were free of pathogens, HACCP also has applications outside of food safety management.[5] The steps of a HACCP process are as follows:

1. Determine how the invasive species could have been introduced.
2. Identify the potential impact of the invasive species' presence, whether from an ecological, economic or health-related standpoint.
3. Determine the specific pathways by which an invasive species might have arrived. About 90% of the world's trade is accomplished by way of ships,[6] making global shipping a significant vector for the spread of invasive species. The transportation of people via vehicles, as well as outdoor recreational activities like hiking, horseback riding or off-roading, can facilitate the spread of invasive species.[7]
4. Find the critical control point – that is, the most effective place in the identified pathway to stop the introduction of invasive species. For example, if an assessment determines that an invasive aquatic species like the zebra mussel is spreading from one location to another via contaminated equipment or gear used in multiple bodies of water, the critical control point may be a requirement for staff to fully clean and dry the equipment between uses.

By utilizing data to determine the locations most likely to be affected by invasive species, corporate conservation professionals can efficiently facilitate the prevention of infestation by directing resources to the most at-risk sites.

WHC

Dame's rocket is an aggressive species that invades woodlands and open areas.

CONSERVATION IN ACTION

ITC HOLDINGS | MICHIGAN, U.S.A.

While monitoring for herbaceous and woody invasive species on-site, ITC Corporate Headquarters recognized that adjacent lands could serve as a pathway to spread additional phragmites onto the site.

ITC Holdings' corporate headquarters is located northwest of Detroit, Michigan, in Novi. Previously an underdeveloped area, the site comprises 92 acres, with 62 acres actively managed for wildlife in habitats including a forest, several landscaped gardens for pollinators, ponds and vernal pools.

The team actively controls a 72-acre area for invasive species such as phragmites, common buckthorn, crown vetch, dame's rocket and more. Team members monitor these target species multiple times during each growing season, documenting the species name and where it is located. If invasive species are found in a new area of infestation, that location is added into the routine rotation of treatment, with high-priority areas assessed more often than low-priority ones. Treatments include chemical methods (broadcast herbicide) and mechanical means (hand-pulling).

Through mapping conducted in 2017, ITC determined that dense populations of phragmites persisted next to the headquarters property. Recognizing that this could be a potential pathway for introduction onto the site, the team began considering a plan to collaborate with adjacent landowners to control the spread of phragmites. Not only do partnerships across the fence line help to block pathways of re-introduction, but they also demonstrate leadership in invasive species management and build goodwill with the community.

WHC-CERTIFIED SINCE 2010 **CERTIFIED GOLD**

WHC

Removing house wren nests at Fidelity Investments' Smithfield site creates more nesting opportunities for native bluebirds.

CONSERVATION IN ACTION

FIDELITY INVESTMENTS | RHODE ISLAND, U.S.A.

At Fidelity Investment's corporate office, located just outside of Providence, Rhode Island, in Smithfield, the conservation project team supports the native eastern bluebird population by discouraging house wren nesting.

House wrens are known to compete with other birds, particularly eastern bluebirds, for nesting space. Male house wrens will build "dummy nests" to maximize options for females to choose, taking available nesting resources from bluebirds.[8] To ensure that eastern bluebirds have adequate nesting space, volunteers at the Smithfield site are trained on the detrimental impact of house wrens to the bluebird population as well as how to identify house wren nests. Volunteers then conduct weekly monitoring of the 12 bluebird nesting boxes on-site.

Any house wren nests not actively being used are removed from the nest boxes, thereby encouraging bluebirds to utilize that space. In this process, nest-building by wrens serves as the point at which the team intervenes to prevent this invasive avian species from pushing out a native species. The introduction of this process at the Smithfield site resulted in a decrease in house wren presence, with the team continuing to evaluate additional methods to protect bluebirds.

WHC-CERTIFIED SINCE 2006

WHC

Thoroughly Monitoring to Determine a Response

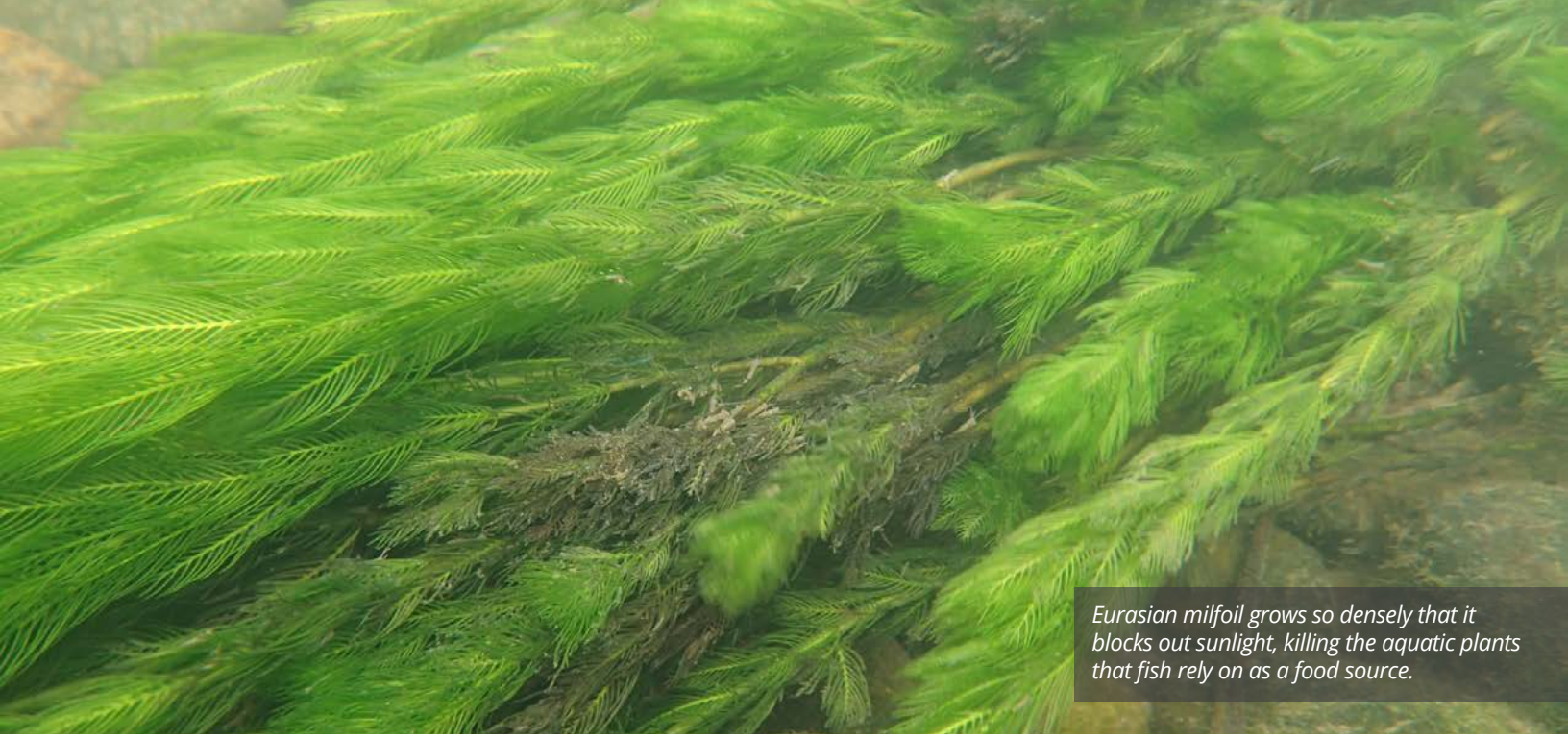
Understanding the abundance of an invasive species is critical to determining an efficient plan to control or eradicate it. Methods like Early Detection-Rapid Response (EDRR), also known as sentinel monitoring, involve a coordinated response to monitor and address invasive species.

While definitions vary, this process generally involves surveying for invasive species in order to prevent them from proliferating and following up with efforts to eradicate, control or contain the invasive species once detected. The definition of "rapid" depends on the specific conditions of the location; therefore, the timeline of response can fall anywhere from a few weeks to several years.[9] EDRR is an iterative process that requires repetition and evaluation.

Advances in technologies such as artificial intelligence (AI), social media, geographic information systems (GIS) and satellite imagery can further facilitate and assist in EDRR efforts. Through AI, or machine learning, computer programs can be trained to verify data related to invasive species abundance, resulting in more reliable information. Social media analysis of

Free Monitoring Technology

Google Earth can be a powerful tool to monitor the presence of invasive species, specifically for terrestrial species like trees. This technology is free, easily accessible and relatively user-friendly. While the low resolution of imagery available from Google Earth would limit its application in the use of machine learning algorithms, it is possible to use Google Earth images to visually track changes in an invasive species infestation over time.



Eurasian milfoil grows so densely that it blocks out sunlight, killing the aquatic plants that fish rely on as a food source.

user-generated content or geo-tagged posts not only provide details about the abundance or location of a particular invasive species, but this data also offers information about the public's understanding and perception of these species.[10]

The use of unmanned aerial vehicles, or drones, can be a cost-effective method for monitoring invasive flora and fauna. Drone imagery can be particularly useful for very large land areas or areas that present difficulties for human access. Much like typical photo-monitoring, conservation team members can use drone photographs to compare invasive species abundance and locations year by year.

CONSERVATION IN ACTION

EXXONMOBIL | ILLINOIS, U.S.A.

The team at ExxonMobil's Joliet Refinery utilized several forms of monitoring to identify the invasive species on-site as well as the solutions to control them.

Located in Channahon, Illinois, and one of ExxonMobil's newer oil refineries in the U.S., the Joliet Refinery includes nine acres of lake and connected wetlands. In order to improve the lake habitat for native fish, in 2016, ExxonMobil began the process of removing invasive aquatic species such as phragmites and Eurasian milfoil by commissioning a baseline fish population survey. Results showed that there were low numbers of fish in the lake and a high abundance of the invasive milfoil. Consultation with a local fish biologist helped identify a course of action to remove phragmites and milfoil, both of which have adverse effects on the lake ecosystem.

Control measures identified included utilizing spot herbicide treatment on the phragmites and introducing sterile grass carp into the lake to feed on the milfoil. In 2021, ExxonMobil followed up with a manual fish survey, which illustrated a good range of healthy largemouth bass in the lake.

By surveying the area, not only was the Joliet Refinery team able to determine the abundance of invasive species on-site, but they could also select the most effective methods of controlling these species.

WHC-CERTIFIED SINCE 2016 **CERTIFIED GOLD**

WHC

The Arrival of Starlings

In the late 1800s, amateur ornithologist and wealthy eccentric Eugene Schieffelin helmed efforts by the American Acclimatization Society to introduce non-native species into North America. Among these was the release of 40 pairs of European starlings in New York City's Central Park between 1890 and 1891. Some accounts explain this effort as an attempt to introduce all the birds mentioned in William Shakespeare's works into the U.S., although there is no concrete record of Schieffelin's motivation. The introduction of starlings may have instead been part of a pest control effort or a research project to understand the impact of intentionally introducing non-native species. [11]

CONSERVATION IN ACTION

WM | MAINE, U.S.A.

WM's Crossroads Landfill in Norridgewock, Maine, developed a plan to manage one of the world's most abundant songbirds: the invasive European starling.

European starlings cost about $800 million in agricultural damage each year,[12] in addition to their environmental impact of forcing cavity-nesting birds out of their nesting spaces. The goal of WM's 15-year-plan, which began in 2011, is to eradicate European starlings on-site and prevent populations from spreading to neighboring areas.

WM identified a 105-acre area to actively control, utilizing methods such as netting, trapping, exclusion, harassment and predation to discourage foraging and breeding. On a monthly basis, representatives from the United States Department of Agriculture (USDA) visit the site to shoot or trap starlings as needed. WM also uses rotating harassment methods, as starlings will become accustomed to any one type of repeated harassment. In 2018, when the team added nest boxes for bluebirds and tree swallows, they ensured that the holes were too small for starlings to enter.

In addition to providing assistance with trapping and shooting, WM's federal partner USDA also conducts a monthly bird survey. Monitoring showed that starling numbers on-site decreased at a steady pace until 2019, when the breeding season resulted in an increase and then another decline. The team's thorough monitoring ensures that they have a full understanding of the species on-site and can effectively adjust control methods based on the data.

WHC-CERTIFIED SINCE 2007 | CERTIFIED GOLD

Controlling the Spread Through Removal

There is no one-size-fits-all approach to removing invasive species. The ideal method of control depends on various factors, including the type of invasive species (woody, herbaceous or marine), type of biome, local regulations or restrictions, budget and time restraints. Several common methods of on-the-ground removal to reduce or eradicate invasive species include mechanical, chemical, cultural and biological controls. Integrated Pest Management and Integrated Vegetation Management, approaches to managing pests and cultivating healthy plant communities, often utilize a combination of these methods.

Mechanical control of invasive flora includes removal methods such as hand-pulling, cutting or mowing. Hand-pulling in particular is common for smaller projects or sites. Mechanical means can be strategically combined with chemical controls such as herbicides or pesticides. As these chemicals can negatively impact other elements of the ecosystem, such as non-target species or air and water quality, these methods must be used according to regulations and with the appropriate permits.

Cultural control methods involve changing human behavior and habits to reduce the introduction and spread of invasive species. These efforts can be as simple as installing signage that reminds employees and visitors to clean their shoes or check vehicles for invasive plants or insects before leaving an area, or they can involve more technical methods such as prescribed grazing or burning.

Extremely efficient and cost-effective, biological control measures can be applied to both plant and animal invasive species. This method introduces living organisms to control or reduce an invasive species population. One specific type of biological control, called classical control, incorporates natural predators to control the invasive species. For example, fire ant decapitating flies (*Pseudacteon*

WHC

Prescribed grazing by goats reduces invasive species while supporting soil health.

tricuspis) were deployed against imported red fire ants in the U.S. beginning in 1997.[13] Biological control is a long-term measure requiring extensive research, and takes, on average, ten years from evaluation of the predator to its release and establishment in the area.[14]

Other methods of removing invasive fauna from a location include trapping, hunting or fishing. Depending on the severity of the infestation, governments may institute bounties on particular invasive species, incentivizing community members to participate in removal efforts; however, in some cases, bounties have inadvertently created a market for the species and led to further proliferation.

Total vs. Partial Control

Many sites, particularly those with very large land areas, will opt for partial control when total control or eradication is not feasible. This allows a team to focus their efforts on a particular area while still preventing the spread or reducing the population size of invasive species.

Intense trapping efforts, like those at FCX's Port Nickel site, often cause feral hogs to shift their home range and leave the affected area.

CONSERVATION IN ACTION

FREEPORT-MCMORAN | LOUISIANA, U.S.A.

First introduced into the U.S. in the 1900s for sport hunting,[15] invasive feral hogs represent a serious issue to landowners throughout the country — particularly in southern states such as Louisiana where this invasive species' population numbers 700,000. One of the most destructive behaviors feral hogs exhibit is rooting, in which they use their snouts to disturb the surface of the soil in search of food. Rooting by hogs destroys vegetation, disrupts the soil's decomposition cycle and exacerbates erosion.[16] In addition to their detrimental effects on vegetation and soil health, feral hogs also damage crops, costing farmers in Louisiana alone $91.1 million in agricultural damages.[17]

At Freeport-McMoRan's (FCX) closed Port Nickel mine site in Braithwaite, Louisiana, feral pigs have disturbed grass roots and created mud wallows throughout the habitat. Due to a flood control system in place at the site, FCX could not install fencing that would preclude feral hogs from entering the area while also allowing migration of flood waters, so instead, the company worked with the Louisiana Department of Wildlife and Fisheries (LDWF) to implement a cage trap system. Leading to the trap is a maze comprised of logs and other obstacles, as well as a trail of corn that leads to a pile of bait. A spring-loaded gate at the entrance to the cage is suspended with a pulley system connected to a stick which, once bumped by the hog's snout, will allow the gate to close. The team pre-baits the trap, leaving the gate open to allow hogs to become comfortable with feeding around the trap.

From 2016 to 2018, the team worked with an LDWF officer to support the trapping. Since 2020, the on-site caretaker has reported no visual sightings of feral hogs as well as no tracks or other indications of hogs. By taking the specific needs of the site into account to develop a trapping system, the Port Nickel team significantly reduced feral hog populations on-site.

WHC-CERTIFIED SINCE 2012 **CERTIFIED GOLD**

WHC

Restoring the Native Habitat and Providing Co-Benefits

Reducing or eradicating invasive species helps restore the native habitat and plant communities. Controlling invasive species not only allows native species to flourish, but it also allows for the improvement of soil health, hydrology, forest health and even fire regimes. Invasive organisms, such as earthworms, can alter soil chemistry, so reducing or removing them improves the health of the soil and facilitates plant growth.[18]

In forest ecosystems, invasive shrubs impede the growth of young native trees, and an infestation of invasive species can impact the properties of natural fuel (i.e. grass, leaves, brush, etc.), thus altering the intensity or frequency of natural fire regimes. For example, the infiltration of cheatgrass (*Bromus tectorum*) in North America increased the fire regime of the sagebrush steppe ecosystem, which typically burned every 60-110 years, to five-year intervals.[19]

Removing invasive species also has numerous co-benefits for the community beyond biodiversity uplift. A proliferation of invasive species can pose a threat to human health and safety; introduced animal and insect species can carry pathogens that can infect humans, and overpopulation of an invasive species can increase the potential for dangerous human-wildlife interactions. Removing these invasive species ultimately benefits a site's employees and surrounding community.

CONSERVATION IN ACTION

GENERAL MOTORS | ANHUI, CHINA

By replacing an invasive plant species with a native one, the team at General Motor's (GM) Guangde Proving Ground is restoring the ecosystem to a more balanced state.

Guangde Proving Ground is China's largest automotive proving ground. Once a barren wasteland, the site houses old automotive testing roads as well as a grassland habitat, landscaped gardens and fruit tree orchards. The proving ground contains a 74,800-square-meter area being actively controlled for Canada goldenrod (Solidago canadensis), an herbaceous invasive plant species originally introduced to Shanghai in 1935 as an ornamental plant that has since rapidly expanded throughout China.[20]

In addition to using chemical herbicide treatments and mechanical pulling methods, GM also introduced

Canada goldenrod spreads through wind dispersal of seeds as well as underground stems called rhizomes.

native bamboo to replace the Canada goldenrod being removed. In 2020, the team planted 10,000 square meters of bamboo on-site. Bamboo is widely considered among the fastest-growing plants on earth, and it has a high potential to store and sequester carbon, making it an effective tool in climate change mitigation strategies.[21]

GM's decision to plant bamboo is an important reminder of the nature of provinciality — what is considered invasive on one continent, like bamboo in North America, is an important native species to be cultivated in another, like Asia. Due to GM's efforts, Canada goldenrod on-site has decreased from 2,200 square meters when the project began in 2013 to 650 square meters by the end of 2020.

WHC-CERTIFIED SINCE 2014 **CERTIFIED SILVER**

Reuse of Invasive Species

Once an invasive species has been removed from an area via mechanical means, it can be recycled or reused in several useful ways. Some invasive plants, like bamboo outside of Asia, have been repurposed as building materials, and many aquatic invasive species can be incorporated into foods or medicines. Canada goldenrod can be used to produce a natural dye product,[22] to create paper products,[23] and as a medium to facilitate phytoremediation of soils contaminated with zinc.[24]

WHC

Wild boar are some of the world's most invasive mammals.

CONSERVATION IN ACTION

DUPONT | ASTURIAS, SPAIN

Removing invasive wild boar at DuPont's facility in Asturias, Spain, not only promotes the health and survival of native species, but it also supports the safety of employees and community members.

Wild boar are a serious threat in Spain, with their populations expected to pass two million in 2023.[25] In addition to the damage they cause to agriculture and nesting birds, wild boar also pose a threat to the safety of humans. As boar become more accustomed to proximity to humans — especially when they scavenge for food in heavily populated areas — they become more likely to interact with and potentially harm people.

In order to minimize interactions between wild boar and employees and local community members, the team at DuPont has worked to control the wild boar population since 2003. Beginning in 2003, they utilized trap cages to capture wild boar. This trapping program continued for 15 years, with trapping occurring in two-year periods. Over the years, several control methods were added to the project, such as shooting by authorized personnel and using tracking dogs and hunters to scare wild boar from the area.

Between May and August 2021 alone, the project captured 28 wild boar via trap cages, significantly decreasing the population in the area, improving employee safety on-site, and also benefiting local farmers and native bird populations.

WHC-CERTIFIED SINCE 1994 | CERTIFIED SILVER

Widespread Wild Boar

Most of the world's invasive wild boar were introduced to non-native locations for sport hunting or as a food source. While native to Eurasia, wild boar have been pushed out of their home territories and into more populated areas, leading to ecological damage and safety issues.

WHC

Educating and Involving the Community

Community-driven, local efforts to support environmental health, such as planting trees or invasive species control, are often referred to as civic ecology practices.[26] As interdisciplinary representation is key to these practices, the private sector can play an important role in offering resources, knowledge and technology for invasive species removal projects.

Corporate invasive species projects present an opportunity to not only involve the community in removal projects, but also to provide environmental stewardship training, increasing awareness of the targeted invasive species. Research shows that students who participated in invasive species restoration projects had a higher sense of personal effectiveness and higher attitudes of caring for particular places than students who were not involved in the project.[27] These results indicate the importance of students' participation in hands-on environmental projects, and invasive species restoration represents an ideal way to involve students.

Transformative Learning Theory

The process of learning about and removing invasive species maps onto the transformative learning theory, which demonstrates how important life events affect an individual's perspective and understanding. Through invasive species control projects, community members are exposed to a new perspective — i.e., the problem of invasive species and how they arrived or spread — plan a course of action to address the invasive species and gain skills and knowledge to address the problem.[28]

Phragmites removal events allowed Bruce Power to educate and involve about 1,000 community members.

CONSERVATION IN ACTION

BRUCE POWER | ONTARIO, CANADA

Community involvement in the removal of invasive phragmites not only improves the health of Bruce Power's wetland site, but it also educates the public about the environmental impact of invasive species.

Bruce Power's Bruce Site is located along Lake Huron in Tiverton, Ontario. A 2014 assessment determined that 63 hectares of wetland were affected by invasive phragmites, considered one of Ontario's worst invasive species. Bruce Power then partnered with the Invasive Phragmites Control Centre (IPCC), an organization that assists with education, assessments, control and monitoring of phragmites in Canada. Through this partnership, Bruce Power funded an educational and outreach project with two goals: to educate the general public about phragmites in the area and to provide the community with the information and tools necessary to control phragmites themselves. The target audience of the project includes community members, particularly property owners adjacent to the facility, as well as hunting and fishing groups and naturalist and recreational organizations.

The project begins by educating participants on the negative impacts of phragmites on aquatic habitats and species, as well as the methods that are used to control them. Volunteers then receive training on identifying phragmites based on factors like seed head, stand density and stem and leaf color. They also learn how to use the 'cut to drown' technique, in which they use a raspberry cane cutter, a pruning tool originally used to clean out raspberry canes, to cut the stems as close to the lakebed as possible.

Since on-the-ground work began in 2018, about 1,000 people have participated in these opportunities each year, and as of 2021, only 19 of the 63 hectares are still affected by phragmites. Community involvement and education allows Bruce Power to not only have a greater impact on-site, but it also empowers community members to contribute to removal efforts in the surrounding areas.

WHC-CERTIFIED SINCE 2020 **CERTIFIED SILVER**

WHC

Building Partnerships to Strengthen Efforts

Information-sharing is key to managing and preventing invasive species. As invasive species do not recognize land ownership and fencelines, building partnerships with neighboring landowners and local conservation organizations strengthens a company's response to these species.

Understanding the abundance and tracking the spread of invasive species relies on widespread data. Invasive species information networks, comprised of governmental bodies, non-profit groups, academia and the private sector, supply this data across disciplines and geographic areas. Management initiatives across regions are critical to the control of invasive species, but they are only as useful as the data behind them, which is why contributing information to these networks is a crucial element of widespread invasive species control.[29] In order to expand the knowledge base about a particular invasive species, the private sector can both contribute to and utilize this data.

Inter-industry collaboration helps to facilitate the widespread control of invasive species in an area. Conducting risk assessments with other companies within the supply chain or operating in the same location can reduce the introduction of invasive species, and sharing removal methodologies and tools with neighboring landowners maximizes the efficiency of a company's efforts on-site.

CONSERVATION IN ACTION

CALIFORNIA RESOURCES CORPORATION | CALIFORNIA, U.S.A.

As part of its Bolsa Chica Wetlands Ecosystem Partnership program, petroleum company California Resources Corporation (CRC) partnered with the Bolsa Chica Conservancy, a non-profit organization that connects the community with hands-on restoration opportunities, to control invasive plant species at the Bolsa Chica Ecological Reserve in Huntington Beach, California. This reserve is comprised of approximately 1,300 acres of salt and freshwater marsh, dunes, sage

WHC

As CRC's project progressed, a decreasing amount of Sahara mustard was found at the Bolsa Chica Ecological Reserve.

scrub and more. The species targeted include several types of iceplant, Sahara mustard, stinkwort and fennel. Originally, the on-the-ground control efforts targeted only iceplant, but the team expanded their efforts to include emergent species that were observed nearby.

CRC, the Bolsa Chica Conservancy and the California Department of Fish and Wildlife collaborated on three weeding events between August 2020 and September 2022, where CRC staff and community volunteers hand-pulled and cut the targeted plants, placing any removed plants in trash bags. If deemed necessary, the Bolsa Chica Conservancy also occasionally used herbicides in addition to mechanical control methods. In total, these three events resulted in 11,500 invasive weeds being removed from the site. For Earth Day 2022, CRC and the Bolsa Chica Conservancy held a weeding and trash clean-up event as part of the Conservancy's Earth Day Festival. Volunteers collected weeds, trash and other debris near the north side of the reserve and along the Pacific Coast Highway, ultimately gathering over 100 pounds of weeds and trash. These events have become less frequent in recent years due to the proven success of invasive species removal.

By partnering with a local conservation organization as well as a government agency, CRC expanded its reach, knowledge and capacity to remove invasive species.

WHC-CERTIFIED SINCE 2016

WHC

Zebra mussels attach themselves to rocks, cement, boat hulls or even native mussels.

CONSERVATION IN ACTION

CONSTELLATION | ILLINOIS, U.S.A.

Due to its proximity to the Mississippi River, Constellation's Quad Cities Generation Station focuses on aquatic conservation — particularly the monitoring of zebra mussels.

In the 1980s, zebra mussels were first introduced to the Great Lakes via the ballast water of cargo ships,[30] after which they rapidly spread to other major rivers and inland lakes. They were first documented in the Upper Mississippi River (UMR) in 1991 in Alton, Illinois.[31] Zebra mussels attach to hard substrates and form dense colonies, with adult females producing more than one million eggs each year.[32] In addition to filtering out algae that native species rely on as a food source, zebra mussels will also attach to and destroy native mussels.

Due to the rapid proliferation of and ecosystem damage caused by zebra mussels, the team at Constellation's Quad Cities Generation Station nuclear power plant in Cordova, Illinois, opted to focus much of their efforts on this species. Since 1997, the team has monitored the species across a 10,400-acre area and noted any population changes. The team conducts whole-water sampling and artificial substrate sampling to determine the density of zebra mussel populations.

The collected data is then shared with UMR basin managers at the state and federal level to provide information that will inform their management of the zebra mussel. As the only extensive monitoring program being conducted in the UMR, results from Constellation's program are also reported annually to the Upper Mississippi River Conservation Committee Freshwater Mussel working group. Results of two decades of monitoring show that zebra mussels within the system are decreasing and the UMR is recovering.

By sharing monitoring data, the Constellation team is guiding state and federal partners on decision-making regarding zebra mussel control efforts.

WHC-CERTIFIED SINCE 2007 **CERTIFIED SILVER**

WHC

A Call to Action for Corporate Landowners

As the examples contained in this white paper have shown, invasive flora and fauna have the potential to encroach on corporate lands of all sizes, locations or habitat types, which means invasive species control projects are well-suited for almost any sites. Due to the dire biodiversity impact of invasive species, these efforts also align well with corporate biodiversity and sustainability commitments.

While many corporations may be required by regulations to control invasive weeds on their lands, they can receive WHC recognition for their invasive species management work by exceeding these requirements — by controlling invasive species that are not required by regulations, breaking a pathway of introduction or controlling invasive species that affect threatened or endangered species.

Companies can address invasive species on corporate lands by:

- Preventing the introduction of invasives by conducting a HACCP or similar assessment.
- Monitoring the abundance and growth of invasive species via observations, technological advances and citizen science projects.
- Controlling the spread through removal methods such as mechanical, chemical or cultural.
- Restoring native plant communities to support the ecosystem.
- Educating the community about the value of removing invasive species and incorporating community partners into the removal process.
- Sharing your story of a successful invasive species project by seeking WHC Conservation Certification, a rigorous, third-party standard. Through the Invasive Species and Invasive Species Coordinated Approaches themes, WHC Conservation Certification recognizes and incentivizes voluntary conservation activities that address invasive species.

WHC

Endnotes

1. IPBES. 2019. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673
2. Essl, F. et al. 2020. Drivers of future alien species impacts: An expert-based assessment. Global Change Biology 26:4880–4893. DOI: 10.1111/gcb.15199
3. Convention on Biological Diversity. 2022. Nations adopt four goals, 23 targets for 2030 in landmark UN biodiversity agreement. https://www.cbd.int/article/cop15-cbd-press-release-final-19dec2022
4. Mohn, C. 2021. Reconsidering the language and ideas of 'invasive' species. Mississippi Park Connection. https://parkconnection.org/blog/2021/reconsidering-invasive-species-language
5. Weinroth, M.D., Belk, A.D., and Belk, K.E. 2018. History, development, and current status of food safety systems worldwide. Anim Front. 8(4):9-15. doi: 10.1093/af/vfy016. PMID: 32002225; PMCID: PMC6951898.
6. Huseyin, E., Parlak, A., and Cakmakcı, M. 2013. Effect of Ballast Water on Marine and Coastal Ecology. Journal of Selçuk University Natural and Applies Science.
7. Anderson, L.G., Rocliffe, S., Haddaway, N.R., and Dunn, A.M. 2015. The role of tourism and recreation in the spread of non-native species: A systematic review and meta-analysis. PLoS ONE 10(10): e0140833. doi:10.1371/journal.pone.0140833
8. Spreyer, M. 2018. House wren known as the 'nonstop nester.' Daily Herald. https://www.dailyherald.com/submitted/20180717/house-wren-known-as-the-nonstop-nester
9. Reaser, J.K., Burgiel, S.W., Kirkey, J., Brantley, K.A., Veatch, S.D., and Burgos-Rodríguez, J. 2020. The early detection of and rapid response (EDRR) to invasive species: a conceptual framework and federal capacities assessment. Biol Invasions 22:1-19. https://doi.org/10.1007/s10530-019-02156-w(0123456789().,-volV()0123456789().,-volV)
10. Martinez, B., Reaser, J.K., Dehgan, A. et al. Technology innovation: advancing capacities for the early detection of and rapid response to invasive species. Biol Invasions 22, 75–100 (2020). https://doi.org/10.1007/s10530-019-02146-y
11. Bittel, J. 2022. The Shakespearean tall tale that shaped how we see starlings. The New York Times. https://www.nytimes.com/2022/04/11/science/starlings-birds-shakespeare.html
12. Pimentel, D., Lach, L., Zoniga, R., and Morrison, D. 2000. Environmental and economic costs of nonindigenous species in the United States. BioScience 50:53-65.
13. University of Florida. Institute of Food and Agricultural Sciences. 2017. Featured creatures. https://entnemdept.ufl.edu/creatures/beneficial/flies/ant_decapitating_phorids.htm
14. U.S. Department of Agriculture. U.S. Forest Service. Biological control. https://www.fs.usda.gov/foresthealth/applied-sciences/biological-control/
15. U.S. Department of Agriculture. Animal and Plant Health Inspection Service. N.d. History of feral swing in the Americas. https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/operational-activities/feral-swine/sa-fs-history
16. Rooting behavior of feral hogs. N.d. Extension Foundation. Cooperative Extension. https://feralhogs.extension.org/rooting-behavior-of-feral-hogs/#:~:text=One%20of%20the%20more%20destructive,depth%20of%20area%20uprooted%20(Fig.
17. Bruhl, A. 2022. Feral hogs costing Louisiana farmers millions, study says. BRProud. https://www.brproud.com/news/louisiana-news/feral-hogs-costing-louisiana-farmers-millions-study-says
18. Wisconsin Department of Natural Resources. Why we should care about invasives. https://dnr.wisconsin.gov/topic/Invasives/care.html
19. Audubon. N.d. Cheatgrass, fire, and sagebrush: How cheatgrass and other invasives are threatening the very existence of the sagebrush steppe ecosystem. https://rockies.audubon.org/sagebrush/cheatgrass-fire
20. Dong, M., Lu, J., Zhang, W., Chen, J., and Li, B. 2006. Canada goldenrod (solidago canadensis): An invasive alien weed rapidly spreading in China[]]. J Syst Evol, 44(1): 72-85. DOI: 10.1360/aps050068
21. Song, X., Zhou, G., Jiang, H., Yu, S., Fu, J., Li, W., Wang, W., Ma, Z., and Peng, C. 2011. Carbon sequestration by Chinese bamboo forests and their ecological benefits: assessment of potential, problems, and future challenges. Environmental Reviews. 19(NA): 418-428. https://doi.org/10.1139/a11-015
22. Leitner, Christa Fitz-Binder, C., Mahmud-Ali, A., and Bechtold, T. 2012. Production of a concentrated natural dye from Canadian Goldenrod (Solidago canadensis) extracts. Dyes and Pigments 93 (1–3), 1416-1421. https://doi.org/10.1016/j.dyepig.2011.10.008.
23. Urban Innovative Actions. 2019. We successfully made paper from Invasive alien plant species - Canadian / Giant Goldenrod. https://www.uia-initiative.eu/en/news/we-successfully-made-paper-invasive-alien-plant-species-canadian-giant-goldenrod
24. Bielecka, A. and Królak, E. 2019. Solidago canadensis as a bioaccumulator and phytoremediator of Pb and Zn. Environ Sci Pollut Res Int. 26(36):36942-36951. doi: 10.1007/s11356-019-06690-x
25. Gea, A. 2022. 'They roam about like cats': Spanish cities try to halt wild boar invasions. Reuters. https://www.reuters.com/world/europe/they-roam-about-like-cats-spanish-cities-try-halt-wild-boar-invasions-2022-08-17/
26. Krasny, M. E., P. Silva, C. Barr, Z. Golshani, E. Lee, R. Ligas, E. Mosher, and A. Reynosa. 2015. Civic ecology practices: insights from practice theory. Ecology and Society 20(2): 12. http://dx.doi.org/10.5751/ES-07345-200212
27. Dresner, M. and Fischer, K. 2013. Environmental stewardship outcomes from year-long invasive species restoration projects in middle school. Invasive Plant Science and Management, 6(3), 444-448. doi:10.1614/IPSM-D-12-00079.1
28. Chao, R. 2017. Using transformative learning theory to explore the mechanisms of citizen participation for environmental education on the removal of invasive species: The case of Green Island, Taiwan. EURASIA Journal of Mathematics Science and Technology Education 13(6): 2665-2682. DOI 10.12973/eurasia.2017.01246a
29. Simpson, A., Jarnevich, C., Madsen, J., Westbrooks, R., Fournier, C., Mehrhoff, L., Browne, M., Graham, J., and Sellers, E. 2009. Invasive species information networks: collaboration at multiple scales for prevention, early detection, and rapid response to invasive alien species, Biodiversity, 10:2-3, 5-13, DOI: 10.1080/14888386.2009.9712839
30. Invasive Mussel Collaborative. What are invasive mussels? https://invasivemusselcollaborative.net/about/mussel-facts/
31. Cope, W.G., M.R. Bartsch, M.R., and Hightower, J.E. 2006. Population dynamics of zebra mussels dreissena polymorpha (Pallas, 1771) during the initial invasion of the Upper Mississippi River, USA. Journal of Molluscan Studies, Volume 72, Issue 2, May 2006, Pages 179–188, https://doi.org/10.1093/mollus/eyi063
32. Zebra mussels (Dreissena polymorpha). N.d. Virginia DWR. https://dwr.virginia.gov/wildlife/zebra-mussels/

Thank you to Ontario Power Generation for underwriting the production of this publication.

ONTARIO POWER GENERATION

WHC can help support a wide spectrum of conservation activities from the design and planning, to the implementation and management of a program. We do so through a framework that connects business drivers, stakeholder and community relations, and ROI to positive environmental and conservation education outcomes. For more information, please contact us at whcconsulting@wildlifehc.org.

wildlifehc.org

WHC

wildlifehc.org

© WILDLIFE HABITAT COUNCIL 2023