A plan for the eradication of invasive alien species from Arctic islands

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Abstract Invasive alien species represent one of the most significant threats to Arctic ecosystems and their inhabitants. Rapidly changing environmental conditions and a growing interest in resource extraction, settlement and tourism make the Arctic region particularly vulnerable to biological invasion. For this reason, invasive alien species are of substantial concern to the Arctic Council, a multi-national body comprised of Canada, the Kingdom of Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russia, Sweden, and the United States, as well as six international organisations that represent Arctic indigenous peoples as Permanent Participants. The Arctic Council's *Arctic Invasive Alien Species (ARIAS) Strategy and Action Plan* includes the priority to: "actively facilitate the eradication of invasive alien species from island ecosystems throughout the Arctic, as well as the recovery of native island species and habitats that have been impacted by invasive alien species." A multi-national team of governmental and non-government partners is collaborating in the development of an action plan (hereafter 'islands plan') for the eradication of invasive alien species from Arctic island ecosystems. The intent of the plan is to provide a vision and strategy for a region-wide approach to the eradication of island invasive alien species as a multi-national commitment. The islands plan will set forth a strategy for prioritising island eradications consistent with the growing pressures on ecological and cultural systems. We have a unique opportunity in the Arctic to take decisive action to prevent and mitigate the adverse impacts of invasive alien species that plague much of the rest of the world. The eradication of invasive alien species from islands in other parts of the world provides useful insights into best practices, including approaches to prioritisation and cost-effectiveness.

Keywords: Arctic Council, invasive alien species, non-native species, policy, prioritisation

INTRODUCTION

Throughout the world, invasive alien species have driven the endangerment and extinction of a wide range of plants and animals (Wilcove, et al., 1998; McNeely, et al., 2001; Bellard, et al., 2016), contributed to the degradation of freshwater, marine, and terrestrial ecosystems (Howard, 1999; Rahel & Olden, 2008; Pejchar & Mooney, 2009) and hastened the alteration of ecological cycles (Chapin, et al., 2000; Towns, et al., 2006; Kurle, et al., 2008; Doherty, et al., 2015). Invasive alien species place constraints on a wide range of ecosystem services that underpin human well-being and economic growth, such as pollination, food and fibre production, disease prevention, climate resilience, and recreational opportunities (Mack, et al., 2000; Mooney & Hobbs, 2000; McNeely, 2001; Ehrenfeld, 2010; Simberloff, 2011). Invasive alien species are regarded as a threat to national security; in addition to undermining food, water, and energy security, they may impede military readiness or cultural survival of native peoples (White House, 2016).

Three primary factors make islands particularly vulnerable to the impacts of invasive species: geographic isolation, size and high percentage of global biodiversity per area (Reaser, et al., 2007; Kier, et al., 2009). While relatively few invasive alien species have been documented in the Arctic region (Fig.1) and there is currently no systematic effort to build a comprehensive dataset and thus provide species lists, biological invasion is expected to increase in concert with increasing human activity and climate change (Walther, et al., 2009; Hall, et al., 2010; Bennett, et al., 2015). The threat that invasive alien species pose to Arctic island ecosystems is thus of growing concern (Meltofte, 2013). Fortunately, Arctic governments and their partners still have the opportunity to act decisively to prevent and mitigate the adverse impacts of invasive alien species that plague much of the rest of the world.

ECOLOGICAL CONTEXT

More than 21,000 species of mammals, birds, fish, amphibians, reptiles, invertebrates, plants, and fungi are native to the Arctic. Highly charismatic species include the polar bear (*Ursus maritimus*), narwhal (*Monodon monoceros*), caribou/reindeer (*Rangifer tarandus*), and snowy owl (*Bubo scandiaca*). The Arctic is characterised by extreme seasonality; many species migrate long distances in order to follow resource productivity, some species by the millions. Although Arctic ecosystems are low in species richness, abundance is often high (e.g. sea birds) (Meltofte, 2013; Fernandez, et al., 2014).

Fig. 1 The Arctic Region. There are varying approaches to defining the Arctic according to geophysical, ecological, or political criteria. For the purposes of this paper, the CAFF delineation of the Arctic is used (including 32 million km^2).

In: C.R. Veitch, M.N. Clout, A.R. Martin, J.C. Russell and C.J. West (eds.) (2019). Island invasives: scaling up to meet the challenge, pp. 679–686. Occasional Paper SSC no. 62. Gland, Switzerland: IUCN.

Invasion pathways of particular concern in the Arctic include: commercial shipping (i.e. introductions via ballast water, hull biofouling); the introduction of organisms and reproductive material through horticulture and aquaculture activities; large-scale tree planting for aesthetics, fuel, windbreaks, and carbon sequestration; transport of contaminated material and equipment for energy development and mineral exploration; and tourism, including recreational hunting and fishing (e.g. through contaminated boats, equipment, and gear). Examples of other anthropogenic pathways include translocated piers, docks and pilings, marine debris and the release or escape of live animals (e.g. from fur farms or the commensal rodents (*Mus* spp., *Rattus* spp.) inadvertently transported to the islands) (CAFF, 2017). Table 1 provides examples of specific pathways of introduction, the species introduced and the implications for the Arctic. At this time, data are insufficient to develop a comprehensive list of non-native species in the Arctic.

SOCIO-ECONOMIC AND POLITICAL CONTEXT

Numerous people, those who reside in the Arctic and many who do not, benefit from the region's natural resources. Approximately four million people live in the Arctic, including indigenous peoples who depend upon subsistence gathering and harvesting of native species as a major source of their daily food intake and as a vital element of their culture. Each year, commercial fisheries harvest millions of tons of native marine organisms valued in the billions of U.S. dollars (Christiansen & Reist, 2013; Sundet, 2014).

Extractive industries (e.g. oil, gas, and minerals) are already well-established in the region and are expanding their activities as melting ice makes access to natural resources more feasible. The increase in rate and numbers of commercial investments in the Arctic is expected to increase the risk of biological invasion into and throughout the region (Emerson & Lahn, 2012; Miller & Ruiz, 2014; Eguíluz, et al., 2016).

Invasive alien species do not respect jurisdictional boundaries. Effective communication and collaboration with neighbouring countries, stakeholders, and trading partners is of paramount importance in the prevention, eradication, and control of invasive alien species in the Arctic. The Arctic Council—a policy framework that includes Arctic Council member countries (known as States), Permanent Participants (Arctic indigenous communities), and Observers (generally, non-member States)—recognises the connection between economic well-being, social stability, and environmental health. The Council actively promotes cooperation, both within the Arctic and globally, to address the environmental changes facing the region (Arctic Council, 2013), ideally through an ecosystem-based approach which balances conservation and sustainable use of the environment (PAME, 2011).

The *Arctic Biodiversity Assessment's* findings (Meltofte, 2013; Box 1) have served as the impetus for the Arctic Council's programme of work on invasive alien species. In May 2017, the Council adopted the *Arctic Invasive Alien Species (ARIAS) Strategy and Action Plan* (CAFF, 2017). This document is a call to action voiced by Arctic nations;

The Arctic Biodiversity Assessment

The *Arctic Biodiversity Assessment* (Meltofte, 2013) recognises that there are currently few invasive alien species in the Arctic, and underscores that more are expected with climate change and increased human activity. Authors recommended:

"Reducing the threat of invasive alien/non-native species to the Arctic by developing and implementing common measures for early detection and reporting, identifying and blocking pathways of introduction, and sharing best practices and techniques for monitoring, eradication and control. This includes supporting international efforts currently underway, for example those of the International Maritime Organization to effectively treat ballast water to clean and treat ship hulls and drilling rigs. (Recommendation 9)"

Actions for Arctic Biodiversity: Implementing the Actions of the Arctic Biodiversity Assessment 2013–2021 (CAFF, 2015) sets forth two actions to address Arctic invasive alien species:

Action 9.1 (2015-2017): Develop a strategy for the prevention and management of invasive species across the Arctic, including the identification and mitigation of pathways of introduction of invasions. Include involvement of indigenous observing networks, which include invasive and new species reporting, to assist with early detection.

Action 9.2 (2017-2019): Incorporate common protocols for early detection and reporting of non-native invasive species in the Arctic into CAFF's Circumpolar Biodiversity Monitoring Programme (CBMP).

Table 1 Examples of introduction pathways and impacts.

Pathway	Species	Impact(s)
Escape from fur farms	American mink (*Mustela viso*n)	High predation on native species in Iceland and Scandinavia (Birnbaum, 2013)
Gardening and land reclamation	Nootka lupine (*Lupinus nootkatensis*)	Successful competition against native plants that has changed the ecological structure and function in Iceland (Magnusson, 2010)
Intentional releases into the natural environment for food	Red king crab (*Paralithodes camtschaticus*)	Effective predation of a wide range of marine species in some Norwegian fjords (Oug, et al., 2011)
Intentional releases into the natural environment for hunting	Raccoon dog (*Nyctereutes procyonoides*)	Effective predation of ground-nesting birds and amphibians, and service as a vector of rabies and other pathogens and parasites in northern Scandinavia (Sutor, et al., 2010; Kowalczyk, 2014; Dahl & Åhlén, 2016)

Table 2 Arctic Invasive Alien Species Strategy and Action Plan priority actions.

Arctic Invasive Alien Species Strategy and Action Plan	
1. Inspire urgent and effective action: Raise awareness of the unique opportunity that the Arctic Council and its partners have to inspire the urgent and effective action necessary to protect the Arctic from invasive alien species.	
1.1	Promote and, as needed, develop targeted communications and outreach initiatives to raise awareness of the urgent need and unique opportunity to protect the Arctic region from the adverse impacts of invasive alien species;
1.2	Encourage Arctic States and non-Arctic States (including Arctic Council Observer States), working collaboratively with Permanent Participants, to implement effective programmes for preventing the introduction and controlling the spread of invasive alien species through domestic actions and/or international agreements and relevant guidelines, such as the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and the IMO *Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species* (Biofouling Guidelines);
1.3	Promote and coordinate the Arctic Council's work on invasive alien species with relevant scientific, technical, and policy-making bodies and instruments; and
1.4	Encourage the integration of the outputs of the Arctic Council's work on invasive alien species into international efforts and legal and institutional frameworks, especially planning and coordination mechanisms, including at the national and sub-national levels, where appropriate.
2. Improve the knowledge base for well-informed decision making: Improve the capacity of the Arctic Council and its partners to make well-informed decisions on the needs, priorities, and options for preventing, eradicating, and controlling invasive alien species in the Arctic by improving the knowledge base.	
2.1	Identify and assess: a) the invasive alien species and pathways that pose the greatest risk of biological invasion into, within, and out of Arctic ecosystems; b) the Arctic ecosystems, livelihoods, and cultural resources most vulnerable to biological invasion; and c) the current and projected patterns and trends of introduction and impacts of invasive alien species in the Arctic;
2.2	Produce a series of topic-specific assessments of invasive alien species issues in the Arctic considering scientific, Traditional Local Knowledge (TLK), technical, environmental, economic, socio-cultural, legal, and institutional perspectives;
2.3	Improve the collection of information on the occurrence and impacts of Arctic invasive alien species, taking advantage of new technologies for early detection, and integrate this information into circumpolar, regional, and community-based observing networks, monitoring programmes, (in particular the Circumpolar Biodiversity Monitoring Programme), and associated information systems such as (the Arctic Biodiversity Data Service); and
2.4	Facilitate full, timely, and open sharing of data and other information relevant to Arctic invasive alien species prevention and management through the Arctic Biodiversity Data Service and the CAFF Web portal.
3. Undertake prevention and early detection/rapid response (EDRR) initiatives: Protect Arctic ecosystems and human well-being by instituting prevention and early detection/rapid response programmes for invasive alien species as a matter of priority.	
3.1	Collaborate with industries, such as, tourism, energy, fisheries, mining, and shipping, and other stakeholders, as relevant, to develop and implement a wide range of biosecurity measures for points of entry and along priority pathways to reduce the initial transfer of species;
3.2	Encourage the establishment of new, or strengthen existing, surveillance, monitoring, reporting, and rapid response programmes necessary to ensure EDRR at points of entry. Consideration of TLK and community-based monitoring programmes should be encouraged;
3.3	Encourage the development and sharing of tools to enable EDRR for invasive alien species that may pose a substantial threat to the Arctic;
3.4	Actively facilitate the eradication of invasive alien species from island ecosystems throughout the Arctic as well as the recovery of native island species and habitats that have been impacted by those invasive alien species;
3.5	Develop guidance for the use and transfer of native and alien species to and throughout the Arctic environment, and identify opportunities to foster ecological resistance and resilience to environmental change;
3.6	Collect information on best practices and assess whether there is a need for the International Maritime Organization to develop Arctic specific guidance for minimising the threat posed by ballast water and biofouling as vectors for the transfer of aquatic invasive alien species from shipping; and
3.7	Foster development of the innovative research, tools, and technologies needed to advance invasive alien species prevention and EDRR capacities in the Arctic region, including through support from funding programmes.

it establishes near-term priorities for securing the future of the Arctic. These priority actions (Table 2) span terrestrial, freshwater, and marine ecosystems and take environmental, cultural and economic factors into consideration. Some of the priority actions apply to the Arctic Council as a whole, while others are best addressed at the working group level or through national implementation. The Conservation of Arctic Flora and Fauna (CAFF) and Protection of the Arctic Marine Environment (PAME) working groups of the Arctic Council hope that each Arctic State, working collaboratively with its partners, will integrate the actions from the *ARIAS Strategy and Action Plan* into national plans and employ the priority actions. This would enable the advancement of relevant decisions made under the auspices of other multi-lateral fora and instruments (e.g. the Convention on Biological Diversity and the International Maritime Organization).

The effective implementation of these priority actions will, of course, depend upon securing the resources necessary to implement them as a matter of urgency and upon collaboration with Permanent Participants, non-Arctic States (including Arctic Council Observers), regional and local authorities, industry and all others who live, work, and travel in the Arctic. Recognition by States, authorities and external organisations that collaborating with the Arctic Council provides a collective and highly desirable benefit will also be crucial. CAFF and PAME will coordinate implementation under the overall direction of the Senior Arctic Officials, drawing on other Arctic Council working groups and partners as needed. Progress reports will be submitted by CAFF and PAME to the Senior Arctic Officials and Arctic Council Ministers every two years.

Although only one of the priority actions set forth in the *ARIAS Strategy and Action Plan* (CAFF, 2017) is explicitly focused on islands, all of the action items are relevant to protecting island ecosystems. Invasive alien species issues are inherently context-specific; they change through time and across landscapes. These particular measures will need to be tailored to particular pathways, populations of non-native species, localities, type and scale of impact, and the available resources.

IMPLEMENTING PRIORITY ACTION

ARIAS Strategy and Action Plan priority action 3.4 calls for the Arctic Council and its partners to "actively facilitate the eradication of invasive alien species from island ecosystems throughout the Arctic as well as the recovery of native island species and habitats that have been impacted by those invasive alien species". The ARIAS Strategy and Action Plan Steering Committee identified this item as a priority because:

1. Island species and ecosystems are well documented as being particularly vulnerable to the impacts of invasive alien species (per previous discussion in this paper). Of particular concern are seabird species that have evolved in the absence of persistent, successful nest-site predators such as the commensal rodents.
2. The level of biological invasion on Arctic islands is relatively low. Due to a lack of other confounding variables, the likelihood for native species/ecosystem recovery following the eradication of invasive vertebrates is high.
3. There are already several examples of successful invasive vertebrate eradications from Arctic islands (Croll, et al., 2015; Jones, et al., 2016; Brooke, et al., 2017). Lessons learnt from these initiatives can be readily applied to future efforts.

To date, efforts to eradicate invasive alien species in the Arctic have been undertaken domestically by the jurisdictional governing body. Priority action 3.4 sets a new precedent for invasive alien species management and creates new opportunities for collaboration, funding, and planning across the region.

The United States Arctic Invasive Species Working Group (coordinated by the National Invasive Species Council (NISC) Secretariat: <www.invasivespecies.gov>) is exploring opportunities to collaborate with domestic and international partners to develop and begin to enact an implementation plan for priority action 3.4. As a minimum, this will include measures to:

1. Identify relevant data available in the Arctic island context and make the data available through open-access information systems, including the Threatened Island Database (TIB) and Biodiversity Information Serving Our Nation (BISON) information system.
2. Summarise the available data to generate information on current knowledge and identify gaps in key information (data gaps).
3. Develop and execute a strategy for filling data gaps.
4. Create a prioritisation schema for determining which island eradications will take precedence and why.
5. Using the schema, determine priorities for the eradication of invasive vertebrates from Arctic islands based on available information and with input from the Arctic Council members and other relevant stakeholders.
6. Based on these priorities, develop an implementation plan, including a co-financing strategy, and secure the additional resources necessary to address these priorities.
7. Implement the eradication plan for the priority island(s) identified in step 5.
8. As appropriate, develop and implement a recovery plan for native island species and habitats of concern. The recovery plan should include a monitoring programme to enable early detection and rapid response to any future invasions.

Invasive alien species have only recently become an issue of concern in the Arctic. Relatively few baseline data on species presence and impacts are available in either the continental or island context. In implementing priority action 3.4, there is a need to start with the basics: assembling/collecting baseline data and evaluating the current status and trends of invasive alien species according to island, species and pathway specific parameters. These assessments are necessary to enable governments to set priorities: which islands, where, why, and how? The findings generated by these assessments can be coupled with data on changes in human activity patterns and climate to generate projections of potential future conditions and thus strengthen and expand the programmes of work necessary to minimise the risk of impending impacts to Arctic island ecosystems (see Hendrichsen, et al., 2014; McGeoch, et al., 2016, for general discussion on assessment needs).

Unfortunately, data collection, sharing, and standardisation is a substantial challenge to filling information gaps in the Arctic. To the best of our knowledge, no one has previously assembled data on invasive alien species occurrence on Arctic islands, although some relevant data can be accessed as subsets of data contributed to national and regional biodiversity information systems [e.g. Global Biodiversity Information Facility (GBIF)]. Where information is unavailable via publicly accessible databases or published literature, information will need to be actively solicited from other available sources, including

experts in the field, institutional and/or scientific networks, and traditional local knowledge.

Islands, in general, offer stronger benefits to eradication projects given their high biodiversity, high vulnerability and generally lower risks of reinvasion (compared to non-island ecosystems) that tend towards lasting eradication success (Helmstedt, et al., 2016). However, eradication projects and similar conservation initiatives are proportionately more expensive on islands than other geographical areas due to their typically restricted access and lack of infrastructure, a reality exacerbated in the Arctic (Martins, et al., 2006; Donlan, et al., 2014). Limited resources, cross-jurisdictional collaboration, and evolving techniques/technologies define our capacities to carry out eradication projects. This makes it very important to strike the right balance between the biological need for eradication and the feasibility and sustainability of operations when prioritising locations (Saunders, et al., 2011; Martinez-Abrain & Oro, 2013). Defining clear objectives and measures of performance will be vital in order to effectively and efficiently maximise the limited available funding. Consequent restoration efforts, the second half of priority action 3.4, contribute to the need for an innovative, flexible and integrated portfolio of eradication actions and strategic planning tools. Both restoration capabilities and eradication technical abilities have made exponential progress over the last decades, and yet accurate inclusion of economic costs when prioritising project scope remains a challenge due to its complexities and data gaps that require assumptions and estimates (Donlan & Wilcox, 2007; Carrion, et al., 2011; Veitch, et al., 2011).

To date, no comprehensive invasive alien species eradication prioritisation scheme has been developed for Arctic islands. Recent studies on the prioritisation of islands for invasive alien species eradication projects have highlighted and critiqued approaches to the removal of invasive alien species on a given island from multi-taxa and single-species perspectives. Helmstedt, et al. (2016) highlight the importance of including cost analyses and consideration of high-risk options or targeted, logistical options when weighing the risks and benefits of eradication (Game, et al., 2013; Joseph, et al., 2009). Helmstedt, et al. (2016) point to the value of learning from successes and failures, as well as targeting combinations of invasive alien species, and emphasise three main factors when determining the conservation benefit of various portfolios of action: ecological benefit, economic cost and feasibility of each eradication action. In addition, the study outlines the importance of cost calculations across combined portfolios of action in order to determine cost-sharing opportunities.

In the context of the Arctic islands project outlined above, detailed assessments of invasive alien species eradication options, cost-sharing opportunities and logistical feasibility will need to be conducted once the choice of candidate islands has been narrowed down with the view of maximising potential ecological and social benefits. Table 3 provides an overview of relevant prioritisation criteria to be considered during project planning and implementation. These criteria are not listed according to priority. The level of importance will be assigned during the schema development process.

Translating priorities into action on the ground can be challenging, but it is a reasonable goal when local communities, national and local government agencies, and landowners value the benefits that can be realised from the eradication of invasive alien species from islands. A key strategy to successful implementation will be the development of a "top down/bottom up" approach, where policy, regulatory, and financial support is in place, and the local island communities, landowners and agencies begin investing in the work on the ground. Implementation can be realised when the "demand" finds the resources, support and policies to move forward.

Restoration of island ecosystems is only achievable if adequate and robust funding mechanisms are in place. Projects and programmes tend to be expensive with a large upfront investment required, but the financial return on investment can be high (see Walsh, et al., this 2019). With greater demands and competition for government resources, projects tend to be funded one island at a time. Managers typically rely on blending funding from multiple grant programmes and through partnerships with non-governmental organisations, private foundations and/or philanthropy. This partnership approach to funding projects can be inefficient, and the opportunity to investigate partnerships to co-finance and implement programmatic portfolios is being considered (see Stringer, et al., 2019). Adequate financing is critical to ensure long-term sustainability and protection of the investment to respond to new introductions and facilitate active and passive restoration.

CONCLUSION

Invasive alien species impacts in the Arctic region have global implications. Arctic biodiversity is an irreplaceable asset. To envision the Arctic as ecologically, culturally and economically sustainable necessitates a focus on the factors that threaten the region's environment and human well-being. Thus, eradicating invasive alien species from Arctic island ecosystems will have cumulative benefits. If these islands are protected from invasive alien species, they may have a greater ability to resist and be resilient to other potential stressors. The achievements made through the adoption of the *ARIAS Strategy and Action Plan* present a unique opportunity for collaboration, innovation and collective action across the Arctic at all levels of governance, from regional to local community scales. Governments and their partners need to work together to make the eradication of invasive alien species from Arctic islands feasible, reduce the risks of future island invasions through commerce and other pathways by cooperating in prevention and management efforts across all shared ecosystems, and address the various factors that make island ecosystems particularly vulnerable to the adverse impacts of invasive alien species.

ACKNOWLEDGEMENTS

The authors extend their gratitude to the members of the ARIAS Strategy and Action Plan Steering Committee, the United States Arctic Invasive Species Working Group, and the CAFF and PAME Secretariats for the multi-year discussions that have facilitated the work proposed here. This paper draws heavily on the ARIAS Strategy and Action Plan which is a product of the Arctic Council's CAFF and PAME Working Groups. The views expressed in this publication are solely those of the authors and do not necessarily reflect the views of the United States Government, the U.S. Department of the Interior, or the National Invasive Species Council.

Post Script Since completion of this paper, the National Invasive Species Council Secretariat and Island Conservation collaborated in the production of an analysis of available non-native species data and developed a preliminary prioritisation schema for Arctic islands. That report, *Data Matters: informing the eradication of invasive species on islands*, is available on the Council's website <https://www.doi.gov/sites/doi.gov/files/uploads/data_matters_island_conservation_report.pdf> and through Island Conservation (Gregg.howald@islandconservation.org).

Table 3 Preliminary factors for consideration in any prioritisation scheme for the Arctic.

Factor	Considerations
IUCN Red Listed species	This includes migratory bird species and should consider the current and trend status of the IUCN Red Listed species, the threat level by the target invasive, and the IUCN Red Listed species' historical recovery status.
Direct and indirect benefits	This is particularly important in understanding how to maximise project-wide benefits that may span varying islands and island systems, species, or stages in the invasion process. Direct benefits include eliminating the threat or degradation posed by the invasive alien species to targeted native ecosystems or species. Indirect benefits may include eliminating the threat or degradation posed to non-targeted ecosystems and species such as those not listed on the IUCN Red List or in other policy.
Direct and indirect consequences	Eradication projects can have significant negative and unintended impacts to native species from the techniques or technologies used, failure of control measures, or greater disruptions to ecosystem equilibriums from the removal of an established invasive alien species. It is important to assess the possibility and probability of potential consequences specific to the prioritisation scheme's target goals. Where other factors outweigh foreseen consequences, mitigation or prevention activities will need to be considered in overall cost and feasibility planning.
Reinvasion potential	The risks of anthropogenic reinvasion vary between islands depending on which pathways they connect to, their geographical proximity to other land masses such as those within swimming distance, the extent of environmental degradation or negative impacts post eradication that affect the feasibility of reestablishment, among others. This component has significant impacts on the sustainability and projected costs of a project.
Biological and ecological vulnerability and resiliency	Biological and ecological vulnerabilities serve as high conservation value components and contribute to project feasibility. Vulnerabilities include islands that come in contact with pathways and the islands' ecological resiliency capacities to biological invasion and reinvasion which impact additional prevention and restoration initiatives.
Impacts on Arctic inhabitants	This consists of not only the direct and indirect economic impacts that disrupt or limit subsistence living and local economies, but also the cultural/spiritual aspects of Arctic life that depend on natural resource identity and use. These considerations in a prioritisation scheme should make use of Traditional Local Knowledge.
Opportunities for community management	Utilising community management opportunities has the potential to not only cut costs and fill knowledge gaps, but also engage local managers and community members in complementary conservation practices such as early detection and rapid response efforts and restoration projects.
Costs and impacts on economies	This consideration needs to extend beyond the direct monetary losses to include the indirect impacts on economies and labour resources (e.g. reduced yields from natural resources, prevention of future yields, alterations and reductions in ecosystem services, and market/non-market value losses (Colautti, et al., 2006).
Feasibility and technology	Feasibility needs to include both the probability of successful eradication and the sustainability of that success. Technology feasibility/availability will differ between islands, species, and ecosystems and need to be assessed and prioritised per project proposal.
Political will of jurisdiction	Sustained political will plays a significant role in the success of any government funded project. When considering a potential site location, island system, or species, it will be important to assess the political will at each level surrounding the project's target and objectives.
Gaps in knowledge	The Arctic has relatively fewer studies regarding native species, invasive alien species, island vulnerabilities, and future risks of biological invasion that go beyond generalisations on warming climates and increasing pathways. It is important that these data gaps are recognised throughout the prioritisation process and adjusted for, where possible.
Climate change impacts	Climate change impacts the vulnerability and susceptibility for biological invasion, reinvasion, and establishment and should be taken into consideration for the long-term feasibility of an eradication project. Together, these two issues can result in exacerbated impacts to ecosystem function and biodiversity (Mooney & Cleland, 2001; Hellman, et al., 2008; Rahel & Olden, 2008).

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