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**[DRAFT INVASIVE ALIEN
SPECIES STRATEGY AND
ACTION PLAN]**

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“Mitigating the Threat of IAS in the Insular Caribbean”

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LIST OF ACRONYMS

CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
ED	Early Detection
EDRR	Early Detection and Rapid Response
GMO	Genetically Modified Organism
IAS	Invasive Alien Species
IMO	International Maritime Organisation
IUCN	International Union for Conservation of Nature /The world conservation union
Ja-CHM	Jamaica Clearing-House Mechanism
JCDT	Jamaica Conservation and Development Trust
JIRCG	Jamaica Iguana Recovery Conservation Group
LMO	Living Modified Organisms
NEPA	National Environment and Planning Agency
NGO	Non Governmental Organisation
RA	Risk Analysis
RA	Rapid Assessment
RADA	Rural Agricultural Development Authority
RMP	Risk Management Procedures
RR	Rapid Response
WTO	World Trade Organisation

OVERVIEW

This document is not designed to serve as a comprehensive, all-encompassing strategy. Instead it is intended to identify and outline a strategic direction for the National Environment and Planning Agency (NEPA), Jamaica's environmental regulatory body to develop an effective National Strategy for the prevention, control, management and where possible eradication of invasive alien species (IAS) which threaten the viability of native species. To complete this activity, the document should be reviewed by a multidisciplinary team of specialists, managers, and researchers. This document represents the first step in the creation of an effective strategy as part of a four year regional project to be funded by the Global Environment Facility in 2009.

The strategy is outlined based on the following elements:

1. **Prevention** - Stopping IAS before they arrive.
2. **Early detection and rapid response** - Finding new infestations and eliminating them before they become established.
3. **Control and management** - Containing and reducing existing infestations.
4. **Rehabilitation and restoration** -Reclaiming native habitats and ecosystems.
5. **Public Awareness** – Bringing about behavioural change in the general public.

Strategies for an effective management plan will have many areas of overlap which will include:

1. Partnerships and collaboration.
2. Scientific basis, which includes conducting appropriate research activities to develop scientific information and technology to ensure that assessment and management programs are effective and science based. A scientific basis also includes setting priorities based on risk assessments.
3. Communication and education.

In all cases, the aim will be proactive rather than reactive in the outlined actions, holistic across ecosystems and ownerships, and collaborative with partners and in all cases be based on sound scientific knowledge.

Secondly, national strategies and action plans must enhance coordination and cooperation within and between government agencies to respond more rapidly and effectively to new invasions and pathways of invasion. Coordination will enhance the protection of resource sector industries, including agriculture, fisheries, forestry, customs and regulatory bodies. Lack of capacity and a poor understanding of ‘who-does-what’ can result in slow responses to emerging pathways such as the internet and mail order; the pet and aquarium trade among others. Although responsibilities for environmental protection are shared across agencies, a lack of coordination has meant that these accountabilities have not been fully institutionalized. Globally it has been found that key departments with environment mandates do not have the program capacities they need, while others with the right programs are either not mandated or have inadequate capacity to do the work and Jamaica is no exception.

Thirdly, national strategies and action plans must strengthen existing programs to protect natural resources and resource sector industries (including agriculture, fisheries, forestry) which are under pressure from increased global trade and travel. Taxonomic expertise should be the cornerstone of biosecurity¹ / biosafety protection. However, no agency has full capabilities (capacity and expertise) to neither identify accurately many of the IAS that can be intercepted at Jamaica’s borders, nor to conclusively determine the identity of invasive species already present. The Jamaica Custom’s Department, as the first line of defence, is experiencing growing stress to meet their existing obligations, and will require new resources or the re-allocation of existing resources to respond to existing and new pathways of introduction and environmental obligations in the name of biosecurity. At

¹ **Biosecurity:** The management of risks posed by organisms to the economy, environment and people’s health through exclusion, mitigation, adaptation, control, and eradication.

present the Department has no regulations to deal with IAS and is guided by regulations such as the Plants (Importation) Control Regulations (1997), Wild Life Protection Act (1945), the Natural Resources Conservation Authority Act (1991) and other such regulations and acts which govern the importation of any species.

1.0 INTRODUCTION

1.1 BACKGROUND

Biological diversity faces many threats throughout the world. One of the major threats to native biological diversity is now acknowledged by scientists and governments to be biological invasions caused by invasive alien species (IAS). According to the World Conservation Union / International Union for Conservation of Nature (IUCN), IAS are the second most significant threat to biodiversity, after habitat loss. In their new ecosystems, IAS become predators, competitors, parasites, hybridizers, and diseases of native and domesticated plants and animals. The impacts of IAS are immense, dangerous, and to date usually irreversible. They may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats.

The ways in which IAS are introduced or spread, are called pathways. Introductions can be both intentional (purposeful) or unintentional (accidental) and they can be “authorized” or “unauthorized” (illegal). There are many pathways of introduction (vectors) including ballast water, recreational boating, aquarium trade, pet trade, horticultural trade, “hitchhikers” on commodities, stowaways in various modes of transportation, and disease in wildlife.

For millennia, the natural barriers of oceans, mountains, rivers and deserts provided the isolation essential for unique species and ecosystems to evolve. In just a few hundred years these barriers have been rendered ineffective by major global forces that combined to help alien species travel vast distances, in a relatively short period of time to new habitats and may become invasive. The globalisation and growth in the volume of trade, travel and tourism, coupled with the emphasis on free trade, provide more opportunities than ever

before for species to be spread accidentally or deliberately. Customs and quarantine practices, developed in an earlier time to guard against human and economic diseases and pests, are often inadequate safeguards against species that threaten native biodiversity as well as agriculture. Thus the unintentional ending of millions of years of biological isolation has created major ongoing global problems.

A species is considered invasive if it meets these two criteria:-

1. It is non-native to the ecosystem under consideration, and
2. Its introduction causes or is likely to cause economic or environmental harm or harm to human health.

The scope and cost of biological alien invasions is global and enormous, and impacts health, ecological and economic sectors. IAS are found in all taxonomic groups: they include viruses, fungi, algae, mosses, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals. They have invaded and affected native biota in virtually every ecosystem type on Earth. Hundreds of extinctions have been caused or accelerated by IAS. The ecological cost is the irretrievable loss of endemics, native species and ecosystems.

In addition, the direct economic costs of IAS run into many billions of dollars annually. Pimentel et al. (2000) (Table 1) estimates that the consequences of IAS to the American public is \$137 billion each year. Activities to combat the effects of IAS are a significant drain on the national economy. Arable weeds reduce crop yields and increase cultivation costs; weeds degrade catchment areas and freshwater ecosystems; tourists and homeowners unsuspectingly introduce alien plants into natural areas; pests and pathogens of crops, livestock and forests reduce yields and increase control costs.

The aquatic environment has not escaped the impacts of IAS. The discharge of ballast water together with hull fouling has led to unplanned and unwanted introductions of harmful aquatic organisms, including diseases, bacteria and viruses, in marine and freshwater systems. Ballast water is now regarded as the most important vector for trans-oceanic and

inter-oceanic movements of shallow-water coastal organisms. Factors like environmental pollution and habitat destruction can provide conditions that favour alien species.

Table 1: Summary of Indicative Costs of Some IAS

INDICATIVE COSTS OF SOME IAS (COSTS IN US\$)			
SPECIES	ECONOMIC VARIABLE	ECONOMIC IMPACT	REFERENCE
Introduced disease organisms	Annual cost to human, plant and animal health in USA	\$41 billion per year	Daszak et al., 2000
A sample of alien species of plants and animals	Economic costs of damage in USA	\$137 billion per year	Pimentel et al., 2000
Salt Cedar	Value of ecosystem services lost in western USA	\$7-16 billion over 55 years	Zavaleta, 2000
Knapweed and Leafy Spurge	Impact on economy in three US states	\$40.5 million per year direct costs \$89 million indirect	Bangsund, 1999; Hirsch and Leitch, 1996
Zebra Mussel	Damages to US and European industrial plants	Cumulative costs 1988-2000 =\$750 million to 1 billion	National Aquatic Nuisances Species Clearinghouse, 2000
Most serious invasive alien plant species	Costs 1983-92 of herbicide control in Britain	344 million/year for 12 species	Williamson, 1998
Six weed species	Costs in Australia agroecosystems	\$105 million/year	CSIRO, 1997 cited in Watkinson, Freckleton and Dowling 2000
<i>Pinus, Hakeas, and Acacia</i>	Costs on South African Floral Kingdom to restore to pristine state	\$2 billion	Turpie and Heydenrych, 2000
Water Hyacinth	Costs in 7 African countries	\$20-50 million/year	Joffe-Cooke, cited in Kasulo, 2000
Rabbits	Costs in Australia	\$373 million/year (agricultural losses)	Wilson, 1995 cited in White and Newton-Cross, 2000
Varroa Mite	Economic cost to beekeeping in New Zealand	\$267-602 million	Wittenberg et al., 2001

The degradation of natural habitats, ecosystems and agricultural lands (e.g. loss of vegetation cover, soil erosion, pollution of land and waterways) that has occurred throughout the world has made it easier for alien species to establish and become invasive. Many IAS are "colonising" species, such as the *Hedychium gardnerianum* (Wild Ginger), that benefit from the reduced competition and predation that follows habitat degradation.

Global climate change is also a significant factor assisting the spread and establishment of IAS. For example, increased temperatures may enable alien, disease-carrying mosquitoes to extend their range. Public recreational opportunities and experiences have also become severely degraded by rapid infestations of invasive species, in many cases hampering access, reducing recreational quality and enjoyment, and decreasing the aesthetic values of public lands.

Frequently, however, useful information is not widely shared or available in an appropriate format for many countries to take prompt action, assuming they have the resources, necessary infrastructure, commitment and trained staff to do so. In some instances, the information that could alert management agencies to the potential dangers of new introductions is not known as the necessary infrastructure and systems are not in place. Only within the last decade has attempts been made to collate information on both a national and global level.

Few countries have developed the comprehensive legal and institutional systems that are capable of responding effectively to these new flows of goods, visitors and 'hitchhiker' species. Many citizens, key sector groups and governments have a poor appreciation of the magnitude and economic costs of the problem. As a consequence, responses are too often gradually, late and ineffective especially in response to biodiversity threats. It is in this context that the Convention on Biological Diversity (CBD) and the IUCN, among other such initiatives have acknowledged the problem of IAS and are making efforts to combat the problem on a global level.

The physical isolation of islands over millions of years has favoured the evolution of unique species and ecosystems. For millennia, the natural barriers of oceans, mountains, rivers and deserts provided the isolation essential for unique species and ecosystems to evolve. As a consequence, islands and other isolated areas (e.g. mountains and lakes) usually have a high proportion of endemic species and are recognized centres of significant biological diversity. Isolation has also meant island species are especially vulnerable to competitors, predators, pathogens and parasites from other areas. It is important to turn the resultant evolutionary changes of islands into an advantage by improving the capacity of governments to prevent the arrival of IAS with better knowledge, improved laws and greater management capacity, backed by quarantine and customs systems that are capable of identifying and intercepting IAS and this is the bases for the focus of current initiatives at the global level.

1.2 GUIDING PRINCIPLES

The guiding principles on which to implement an effective strategy and action plan for combating IAS should be implemented in Jamaica should be based on the following:-

1. Work within existing international agreements to develop Jamaica's national IAS strategy that is compatible with these agreements.
2. Develop a strategy that is scientifically-based and utilizes the best available knowledge (science-based **prioritization** of invasive species problems).
3. Adopt an adaptive management approach that incorporates and continually improves on policies and practices by learning from the outcomes of operational programs.
4. Co-operate at all levels of government, industry and non-governmental organizations within Jamaica and globally (an improved system of **accountability**).

5. Engage the public and encourage universal stewardship.
6. Respect the rights of the people and others and integrate traditional knowledge with other sources of knowledge to address the threat of IAS.

1.3 OBJECTIVES

These guidelines have the following seven objectives.

1. To increase awareness of IAS as a major issue affecting native biodiversity (and agriculture).
2. To encourage the prevention of IAS introductions as a priority issue requiring national and international action.
3. To minimise the number of unintentional introductions and to prevent unauthorised introductions of alien species.
4. To ensure that intentional introductions, including those for biological control purposes, are properly evaluated in advance, with full regard to potential impacts on native biodiversity.
5. To encourage the development and implementation of eradication and control campaigns and programmes for IAS and to increase the effectiveness of those campaigns and programmes.
6. To encourage the development of a comprehensive framework for national legislation and international cooperation to regulate the introduction of alien species as well as the eradication and control of IAS.
7. To encourage necessary research and the development and sharing of an adequate knowledge base to address the problem of IAS worldwide.

1.4 THE JAMAICAN SITUATION

Jamaica has been ranked fifth among islands of the world in terms of endemic plants as highlighted in the country profile section of the CBD website as well as in the National Strategy and Action Plan on Biological Diversity in Jamaica. The country also enjoys a high level of endemism for animal species: 98.2% of the 514 indigenous species of land snails and 100% of the 22 indigenous species of amphibians are endemic to Jamaica. Approximately 27.9% of vascular plants found on the island so far are endemic, and 36.7% of the 60 species of Bromeliads and 26% of the 260 species of Orchids are endemic to the island. Nearly 30.1% of this mountainous country is covered with forests. As a result of the isolation of these species they are particularly susceptible to the threat of invasive species, which in many cases are better competitors than the native biota.

Based on the recognition of the serious impacts of IAS to biodiversity and agriculture an Alien Invasive Species Working Group (AIWG) has been formed whose main objectives are as follows:-

1. To assist with the development of a National Policy and Management Plan on IAS
2. To prepare a list of alien species occurring in Jamaica that are possibly invasive.
3. To identify: -
 - a) the impact of IAS on Jamaica's biodiversity;
 - b) measures for their control and eradication;
 - c) research needs for invasive species.Relevant programmes of research and control shall be promoted.
4. To develop legal guidelines on trade and control of IAS. The guidelines shall list IAS for which special restrictions need to apply under the permit systems of relevant national legislation.
5. To develop an action plan to eradicate invasive species in protected areas.

This group consists of various governmental and non-governmental agencies with a range of expertise. However, this group is not officially recognized by the government.

Governmental and non-governmental agencies of Jamaica have long recognized the impacts (actual and potential) that IAS have had and could have on native biodiversity, human health and economy of Jamaica. However, at current capacity, these agencies are unable to effectively respond to these impacts. In fact, most wide scale efforts have been restricted to raising public awareness on a small scale, with most efforts being concentrated on mitigation of agricultural pests. In majority of the cases, the response has been species specific; for example, the response to the presence of *Maconellicoccus hirsutus* (Pink Hibiscus Mealybug). The extent of these responses needs to be dramatically improved and include the threat to native species if Jamaica is to preserve and conserve its natural resources.

Over the last ten years several projects have been executed to increase the countries capacity to deal with the impact of IAS. The Institute of Jamaica has engaged in the development of an IAS database comprising data retrieved from both governmental and non-governmental agencies as well as the general public. The database is accessible through the website of the Jamaica Clearing-House Mechanism² (Ja-CHM).

The Ministry of Agriculture (MOA) has started activities to oversee the development of a pest database as part of an integrated pest management project. This database will also be accessible by the general public which will be especially beneficial for farmers. A strong monitoring program for certain species such as the *Ceratitis capitata* (Mediterranean Fruit Fly) and *Raoiella indica Herst* (Red Palm Mite) is also in place.

Efforts have been made to develop the taxonomic capacity of various agencies through workshops, but this has mainly served to increase expertise but not necessarily equipping these persons with the necessary tools. These activities have had good success such as with the reduction of the threat of the Lime Swallowtail Butterfly (LSB), *Papilio demoleus*, through quarantine activity and public awareness.

² www.jamaicachm.org.jm

The terrestrial environment is the most extensively studied ecosystem in Jamaica and therefore a wealth of knowledge has been gathered with respect to the spread and impact of IAS. Both governmental and non-governmental organizations have engaged in the management of terrestrial IAS. The Jamaica Iguana Recovery Conservation Group (JIRCG) has had tremendous success in the protection of the rediscovered *Cyclura collei* (Jamaican Iguana). The Jamaica Conservation and Development Trust (JCDT) have also had success with the management of invasive alien plants such as *Pittosporum undulata* (Mock Orange /Wild Coffee) and *Hedychium gardnerianum* (Wild Ginger) which have resulted in forest rehabilitation. Both entities have been able to increase capacity while promoting their conservation activity but rely heavily on volunteer support and require financial support for their sustainability.

Activities have also been carried out to identify and manage harmful aquatic organisms via a ballast water sampling and management workshop facilitated by the University of the West Indies, Mona as part of an ongoing project funded by the Environmental Foundation of Jamaica. The Port Authority of Jamaica is also overseeing activities to allow the country to participate in the GloBallast Programme. These activities have resulted in training of personnel from agencies such as the Port Authority of Jamaica, Marine Police, Jamaica Defence Force Coast Guard, the University of the West Indies-Mona, Urban Development Cooperation, Institute of Jamaica and the NEPA. Both projects aim to assist Jamaica in ratifying the IMO Ballast Water Convention (The International Convention for the Control and Management of Ships *Ballast Water & Sediments*). One of the outcomes of these training activities was the recommendation for the formation of a Task Force for Ballast Water Management

Recently, one of the most eminent treat to the marine environment has been the introduction of the Red Lionfish, *Pterois volitans*. This harmful marine invasive species was positively identified in Jamaica in 2008; initially, only two individuals where found off the north coast. Due to the nature of this predator, these sightings could not be overlooked as they may have a tremendous impact on the marine environment which may result in the ultimate collapse of Jamaica's fisheries. *P. volitans* have been sighted along the coast of

several parishes including St. Thomas, St. Ann, St. James, Westmoreland, Hanover, and Manchester and has been sighted offshore at the Pedro Cays and Bank. As a result, the Ministry of Agriculture through the efforts of the Veterinary Services and Fisheries Divisions have formed a group to monitor the spread and impact of *P.volitans* in Jamaican water. In addition, initial activities have started aimed at mitigating as well as sensitising the government to the likely impacts of the species. NEPA has already started small scale monitoring and removal activities of the Red Lionfish across the island and is also involved in this group.

The National Strategy and Action Plan on Biological Diversity in Jamaica (NEPA, 2003) identified that the legislative framework of Jamaica does not comprehensively protect ecosystem diversity, species diversity or genetic diversity and by extension, the impact of IAS. It was stated that new legislative framework is needed that recognizes the components of biodiversity and ensures its sustainable use and protection. One of the recommendations arising from that strategy (NEPA, 2003) was the re-evaluation and development of several pieces of legislation that are relevant to the conservation of biodiversity and its sustainable use. These included the review of the Forest Act (1996); the creation of a new Wild Life Protection Act, a new Fisheries Act and a new Watershed Act and the creation of regulations under The Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000). A review of the Wild Life Protection Act of 1945 identified IAS as one of the gaps and as a result, drafting instructions are being prepared to develop a new act which would address the management of IAS in Jamaica amongst others. As part of these drafting instructions two schedules were created (schedules 7 and 8) pertaining to IAS present in the country and potential threats, respectively. As the spread of IAS increases each year, these schedules need to be reviewed and updated.

The strategy proposed that the following strategic directions should be taken to address IAS in Jamaica: -

- Undertake research and assessments of introduced species that now threaten Jamaica's biodiversity, with a view to identifying appropriate measures to reduce further impacts.

- Develop guidelines for the eradication and monitoring of IAS.
- Require mandatory risk assessment of species prior to granting an import permit and institute management assessments for importation.
- Improve management and strengthen enforcement capacity to implement quarantine control measures in order to control unintentional introductions at ports of entry.
- Develop contingency plans and action programmes to ensure rapid eradication of newly established and undesirable alien species.

This strategy seeks to expand on these recommendations.

2.0 STRATEGY AND ACTION PLAN

This national strategy encompasses four program elements and one cross-cutting element:

- 1. Prevention.**
- 2. Early Detection and Rapid Response.**
- 3. Control and Management.**
- 4. Rehabilitation and Restoration.**
- 5. Public Awareness**

2.1 PREVENTION

Preventing the introduction of alien species is the most cost-effective and most preferred option of highest priority. Efforts should be made to develop rapid action plans to prevent the introduction of potential IAS if appropriate, even if there is scientific uncertainty about the long-term outcomes of the potential alien invasion. To prevent spread, every alien species, to be introduced to the environment, should be treated as potentially invasive unless convincing evidence indicates that this is not so and should remain as such until proven otherwise. Since the impacts on biological diversity of many alien species are

unpredictable, any intentional introductions and efforts to identify and prevent unintentional introductions should be based on the '*precautionary principle*³'.

Vulnerable ecosystems such as mountains, freshwater and coastal areas should be accorded the highest priority for action, especially for prevention initiatives, and particularly when significant biodiversity values are at risk.

IAS act as "biological pollution" agents that can negatively affect development and quality of life. Hence, as part of the regulatory response to the introduction of IAS, one recommendation is to employ the "polluter pays" principle where "pollution" represents the damage to native biological diversity. Intentional introductions should only take place with authorisation from the relevant agency or authority. Authorisation should require comprehensive evaluations based on biodiversity considerations (ecosystem, species and genome). Therefore responsibility would have to be institutionalised to make this effective. It is also recommended that standardised risk analysis (RA) and risk management procedures (RMP) be developed, perhaps based on the RA and RMP developed under the Cartagena Protocol of the CBD. Preventive measures must consider the source and the destination of the invasion.

The intentional introduction of an alien species should only be permitted if the positive effects on the environment outweigh the actual and potential adverse effects. The intentional introduction of an alien species should only be considered if no native species is considered suitable for the purposes for which the introduction is intended. The intentional introduction of an alien species should not be permitted if experience elsewhere indicates that the probable result will be the extinction or significant loss of biological diversity.

³ The **precautionary principle** is a moral and political principle which states that if an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action

2.1.1 Intentional Introductions - Recommended Actions

1. Establish an appropriate institutional mechanism such as a 'biosecurity' agency or authority as part of legislative reforms on invasive species. This is a very high priority, since at present, the legislative framework does not specifically address invasive species and one is currently being drafted to address Biosafety. Thus, addressing intentional introductions in a holistic manner, considers all organisms likely to be introduced and their effect on all environments.

In many countries this is usually the responsibility of the agriculture sector; this however have been proven to be ineffective as the administrative and structural arrangements are usually inadequate to deal with the entire range of incoming organisms, the implication for the environments into which they are being introduced, or with the need for rapid responses to emergency situations. It is therefore recommended that this responsibility be placed with the NEPA which would be responsible for coordinating the necessary activities with the other relevant agencies.

2. Give utmost importance to effective evaluation and decision-making processes. Carry out an environment impact assessment and risk assessment as part of the evaluation process before coming to a decision on introducing an alien species.
3. Require the intending importer to provide the burden of proof that a proposed introduction will not adversely affect biological diversity.
4. Include consultation with relevant organizations within government, with NGOs and, in appropriate circumstances, with neighbouring countries, in the evaluation process especially when dealing with marine organisms and for use in aquaculture. This would feed into the development of a regional strategy which is essential to the management of aquatic IAS.
5. Where relevant, require that specific experimental trials (e.g. to test the food preferences or infectivity of alien species) be conducted as part of the assessment

process. Such trials should be mandatory for biological control proposals and appropriate protocols for such trials should be developed, periodically updated and adhered. Regional approach is also recommended where countries are facing similar threats could pool resources to carry out risk assessment activities. This approach could prove to be more economical for the region and would result in a reduction in the risk associated with trade. This would also be the approach to the development and improvement of international instruments and practices relating to trade that affect intentional and unintentional introductions. Efforts of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to address the implications of IAS should be considered and similar national regulation of trade developed.

6. Ensure that the evaluation process allows for the likely environmental impacts, risks, costs (direct and indirect, monetary and non-monetary) benefits and alternatives, have been identified and assessed by the regulatory agency. This agency is then in a position to decide if the likely benefits outweigh the possible disadvantages.
7. Regardless of legal provisions, encourage exporters and importers to meet best practice standards to minimise any invasive risks associated with trade, as well as containing any accidental escapes that may occur.
8. Improve quarantine and border control regulations and facilities at ports of entry and train staff of the Jamaica Custom's Department in collaboration with other relevant agencies such as the Ministry of Agriculture and NEPA to intercept unauthorised intentional introductions.
9. Develop criminal penalties and liability for the consequent eradication or control costs of unauthorised intentional introductions which should be incorporated into the Wild Life Protection Act.
10. Ensure that provisions are in place, including the ability to take rapid and effective action to eradicate or control, in the event that an unauthorised introduction occurs,

or that an authorized introduction of an alien species unexpectedly or accidentally results in a potential threat of biological invasion.

2.1.2 Unintentional Introductions - Recommended Actions

Unfortunately, it is difficult to control unintentional introductions that occur through a wide variety of ways and means. They include the most difficult types of movement to identify, control and prevent. Therefore identifying the pathways of potential introduction is the only effective way of minimizing the impact. The most noted pathways include international and national trade and tourism routes. Recommended actions to reduce the likelihood of unintentional introductions are:

1. Identify and manage pathways leading to unintentional introductions. Important pathways of unintentional introductions include: national and international trade, tourism, shipping, ballast water, fisheries, agriculture, construction projects, ground and air transport, forestry, horticulture, landscaping, pet trade and aquaculture. The Caribbean Pathway Analysis carried out by a team of scientists of the U.S. Department of Agriculture under the direction of the Caribbean Invasive Species Working Group (CISWG) should be used as a guide, as the aim of the analysis is to identify, describe, and evaluate pathways for the movement of exotic plant pests into and within the Greater Caribbean Region.
2. Develop collaborative industry guidelines and codes of conduct, which minimise or eliminate unintentional introductions.
3. Examine regional trade organizations and agreements to minimise or eliminate unintentional introductions that are caused by their actions.
4. Explore measures such as:
 - a. The elimination of economic incentives that assist the introduction of IAS;
 - b. recommendation of legislative sanctions for the introduction of alien species unless no fault can be proved; and

- c. dissemination of all available information on IAS, by country or region, for use in border and quarantine control, as well as for prevention, eradication and control activities should be centralized and easily accessible.
5. Assist in the implementation of appropriate initiatives to reduce the problems associated with IAS arising from ballast water discharges and hull fouling. These include: the development of ballast water management practices; development of national ballast water programmes; strengthen research, sampling and monitoring regimes; dissemination of relevant information to port authorities and ships' crews on ballast water hazards. This would be in collaboration with the Port Authority of Jamaica to support and develop any ballast water activity already taking place, especially as it relates to Jamaica formalising its role as one of the lead countries participating in the IMO Ballast Water Convention (International Convention for the Control and Management of Ships' Ballast Water and Sediments) in the region.
6. Improve quarantine and border control regulations and facilities at ports of entry and the training of the staff of the divisions of the Ministry of Agriculture, the Jamaica Custom's Department and the Port Authority of Jamaica to intercept the introduction of IAS. Quarantine and border control regulations should not be based solely on narrow economic grounds that primarily relate to agriculture and human health, but, in addition, on the unique biosecurity threats (threat of LMO⁴/GMO⁵ and similar threat to biodiversity).
7. Put in place appropriate fines, penalties or other sanctions to apply to those responsible for unintentional introductions through negligence and bad practice when infractions occur.
8. Draft regulations for the compliance of companies potentially dealing with transport or movement of living organisms in anticipation of the development of a national

⁴ Living Modified Organisms

⁵ Genetically Modified Organism

biosecurity regime. Engagement of the private sector is important to ensure compliance.

9. Regulations requiring environmental impact assessment of such projects should require an assessment of the risks associated with unintentional introductions of IAS especially considering reforestation and landscaping. Therefore guidelines for risk assessments need to be developed and incorporated within current regulatory guidelines as it pertains to the importation of goods.
10. Development of a process to take rapid and effective action, including public consultation, should unintentional introductions occur.
11. According to Wittenberg et al. 2001 and Shine et al. 2000, priority lists of potential IAS should be developed as this is an effective method of dealing with IAS issues. Efforts should be placed into creating 3 such lists:
 - a. Black list: species known to be invasive and so destructive that their introduction should be prohibited.
 - b. White lists: species known on the basis of stringent criteria to have such a low probability of invasion that they can be introduced.
 - c. Grey lists: the great majority of species whose probability of becoming invasive is unknown.

The suggested amendments to the Wild Life Protection Act include two schedules; these should be further expanded upon and divided into the categories mentioned above.

Whether the introduction is intentional (authorized or unauthorised) or unintentional (accidental), work should be done with Animal and Plant Health Inspection experts through the Ministry of Agriculture and other partners to conduct pathway and species risk assessments for terrestrial and aquatic pests (plants, animals, insects, and pathogens) to

identify priority invasive species for regulatory action. In collaboration with partners, build awareness of invasive species and their potential impacts.

Funds should be identified to conduct a national research risk assessment to identify high-priority exotic species and work to develop techniques to deal with these high-priority pests. A coordinated program of site-specific and general monitoring around critical points of entry, protected areas, and urban and agricultural ecosystems is essential for early detection. A core capacity of diagnostics, taxonomic expertise and innovative taxonomic research are critical to accurately identify invasive species once they are detected and distinguish them from native or long established species.

The Global Invasive Species Programme has developed tools for the prevention of the introduction of IAS. These tools include:-

- Public information.
- "Early warning", the capability to predict potential new invasion sites for an invasive species, and/or predict potential new invasive species for a region or site.
- Risk assessments and environmental impact assessments.
- National and international regulations on prevention measures and their enforcement with inspections and fees.
- Treatment of imported commodities, through fumigation, immersion, spraying, heat and cold treatment, and pressure.
- As a last resort, trade restriction or prohibition consistent with the World Trade Organisation (WTO) Sanitary and Phytosanitary Agreement.

2.2 EARLY DETECTION AND RAPID RESPONSE

Next to prevention, early detection is a very effective mitigation strategy to minimise the impact of IAS once released into the environment. Efforts should be made in developing an early detection regime for species that can be found on the proposed 'black list'. Species found on this list would require a different strategy to detect their presence, which is

usually dependent on taxonomic capabilities. Therefore, as suggested before, efforts should be made to strengthen the taxonomic analysis capabilities of agencies.

A strong component of this activity is public education. The role of the public would be instrumental in bringing attention to the necessary authorities, the presence of any new species. Hence, a national campaign should be developed to educate the public on the impact of new species on native biodiversity. The public should also be informed about the relevant agency which should be contacted in such an event.

Once detected, the spread and impact of IAS should be assessed using sound scientific techniques and a decision made as to which mitigation strategy should be used. These may include eradication (eliminating the IAS completely); containment (keeping the IAS within geographic barriers); or suppression (reducing population levels of the IAS to an acceptable threshold {section 2.3}). A critical first step in a mitigation programme is to determine the management goal. The goal may be to eradicate the IAS, or to reduce it to a certain level. Questions that should be answered in the development of an EDRR include the following:-

1. What is the species of concern, and has it been authoritatively identified?
2. Where is it located and likely to spread?
3. What harm may the species cause?
4. What actions (if any) should be taken?
5. Who has the needed authorities and resources?
6. How will efforts be funded?

The cost of eradication increases dramatically the longer a species is able to establish itself. An immediate response is therefore more cost-effective and more likely to succeed than action after a species has become established. Thus the development of an early detection and rapid response (EDRR) is recommended. There are three components of EDRR – Early Detection (ED), Rapid Assessment (RA), and Rapid Response (RR).

1. Early Detection (ED) - In order to conduct EDRR, IAS populations must first be found. Specimens have to be identified, and mapped. These essential initial efforts require resources, planning, and coordination. Invasive species are often detected by chance, but they can also be detected by trained individuals through targeted invasive species surveys and by monitoring specific areas, especially if this is conducted in managed protected areas. Area monitoring, taxonomic resources and species surveys provide the information needed to construct accurate distribution maps. Maps and other ecological/biological information are critical to planning and response actions. Therefore, invasive species monitoring, mapping, and taxonomic resources and capabilities need to be strengthened.
2. Rapid Assessment (RA) encompasses actions necessary to determine the appropriate response, including the current and potential range of the invasive species' infestation(s). The RA process identifies the invasive species control options, timing and overall strategy for actions and provides reliable information to the public. Advanced planning that anticipates invasions and takes into account ownership / responsibility issues greatly expedite efforts.
3. Rapid Response (RR) is a systematic effort to eradicate or contain invasive species while infestations are still localized. It is critical to quickly mobilize resources to intensely control an infestation before it becomes more widely established. Currently RR efforts are led by the Ministry of Agriculture in response to agricultural pests. This needs to be expanded to include threats to native biodiversity. Invasions can rapidly overwhelm local resources. The ability to share resources, form strategic partnerships, and have "ready" access to plans, funds and technical resources are critical components.

It should be noted that an EDRR is essential as early eradication is more cost-effective than any measure that requires continuous expenditure over long periods of time. On the other hand, eradicating the last few individuals might be exceedingly expensive. To make eradication a cost-effective method, a rapid response programme needs to be in place along with all appropriate pre-approved governmental permits, trained personnel and funding.

2.2.1 Early detection and rapid response- recommended actions

1. Develop an EDRR for both flora and fauna with consideration to type of habitat/ecosystem;
2. Identify the highest priority of known and potentially introduced IAS that should be subjected to the most intensive monitoring (i.e. update the proposed schedule 7 and 8 of the new Wild Life Protection Act);
3. Maximize the use of existing information sources and develop, over time, suitable surveillance/monitoring schemes for known and potentially IAS;
4. Work closely with relevant conservation or taxon-specific experts, especially organizations responsible for the management of protected areas, to develop ways to maximize detection, surveillance and monitoring capacity;
5. Develop protocols for surveillance and monitoring of species identified as potentially invasive;
6. Maintain the central database on non-native species distribution hosted by the Ja-CHM. This is an established method of capturing information on non-native species from any source. The database is easily accessible and ensures that information from museums, government laboratories, local authority pest controllers, universities and members of the public can be easily entered and accessed;
7. Develop data gathering and recording methodology to obtain data on occurrences of IAS as well as pathway of introductions;
8. Invest in taxonomic training and making taxonomic expertise more widely available across agencies;
9. Identify appropriate means of securing adequate resources and capacity to carry out rapid responses to contingencies;

10. Designate responsibility among agency for rapid responses to different taxa and in different circumstances; and,
11. Develop a general contingency plan to include a risk assessment, mechanisms for flow of information and a protocol for rapid approval of emergency action.

2.3 CONTROL AND MANAGEMENT

If control and management is the desired response instead of eradication, a decision needs to be made as to what level should the population be reduced and how will it be maintained at such a level? It is better to concentrate on quantifying and reducing the damage caused by IAS, instead of concentrating on merely reducing numbers of IAS. Monitoring and control after initial efforts are necessary and restoration of affected systems is an important consideration.

The management control objective should also specify the geographic areas for attention, in priority order. Once the objective has been agreed upon among all interested parties, a plan needs to be devised for achieving the objective(s), involving research, surveys, identification of control options, implementation, monitoring, and follow up.

Specific circumstances for control are so variable. It is only possible to give broad guidelines of generally favoured methods (specific methods are better than broad spectrum ones). Methodologies that may be employed are biological, physical or chemical control techniques or a combination of these (Box 1). The choice of control methods should be socially, culturally and ethically acceptable, efficient, non-polluting, and should not adversely affect native flora and fauna, human health and well-being, domestic animals, or crops.

Box 1 : Control of IAS

CONTROL OF IAS:

Many methods are available for controlling IAS, as detailed in Wittenberg et al (2000).

These tools can be applied individually or in various combinations. Given the high complexity of the ecology of invasive species and habitats affected, control measures need to be applied with the fullest possible scientific understanding.

- **Mechanical control:** Involves directly removing the species by hand or with appropriate machines such as harvesting vehicles (e.g., for water hyacinth) or firearms (e.g., for large mammals), or traps (for animals).
- **Chemical control:** Involves the use of herbicides, insecticides, and rodenticides that primarily affect the target species, are delivered in a way that avoids the potential problem of resistance developing over time, and do not accumulate in the food chain. The development of pesticide-resistant strains of pests, diseases and weeds may reduce the effectiveness of the chemical management option for their control.
- **Biological control:** Involves the intentional use of populations of natural enemies of the target IAS or other methods that include, for example, mass release of sterile males of the target species, inducing resistance in the host against the IAS that is attacking it, or releasing a natural enemy to control the IAS. It is essential to ensure that the species used for biological control does not in turn become itself invasive.
- **Habitat management:** Involves measures such as prescribed burning, grazing, and other activities.
- **Integrated pest management (IPM):** Involves a combination of the methods described above, based on ecological research, regular monitoring, and careful coordination. IPM is likely to achieve the best results in many situations.

Biological control agents may sometimes be the preferred choice compared to physical or chemical methods, but require rigorous screening prior to introduction and subsequent monitoring. The time taken to have the agent approved may make this method not cost effective. Physical removal can be an effective option for clearing areas of invasive alien plants. Chemicals should be as specific as possible, non-persistent, and non-accumulative in the food chain. Persistent organic pollutants, including organochlorine compounds should not be used. Control methods for animals should be as humane as possible, consistent with the aims of the control.

2.3.1 Control and management - Recommended actions

1. Prioritize the IAS problems according to desired outcomes. This should include identifying the areas of highest value for native biological diversity and those most at risk from IAS. This analysis should take into account advances in control technology and should be reviewed periodically.

2. Draw up a formal control strategy that includes identifying and agreeing to the prime target species, areas for control, methodology and timing. Such strategies should be available for public review.
3. Consider stopping further spread as an appropriate strategy when eradication is not feasible, but only where the range of the IAS is limited and containment within defined boundaries is possible. Regular monitoring outside the containment boundaries is essential, with quick action to eradicate any new outbreaks.
4. Evaluate whether long-term reduction of IAS numbers is more likely to be achieved by adopting one action or a set of linked actions (multiple action control). The best examples of single actions come from the successful introduction of biological control agent(s). These are the 'classical' biological control programs. Any intentional introductions of this nature should be subjected to appropriate controls and monitoring. Exclusion fencing can be an effective single action control measure in some circumstances. An example of multiple action control is integrated pest management which uses biological control agents coupled with various physical and chemical methods at the same time.
5. Develop a management plan for the control of feral animals which considers the inclusion of relevant stakeholders such as farmers, fishers and other such groups.
6. Increase the exchange of information between scientists and management agencies, not only about IAS, but also about control methods. As techniques are continuously changing and improving, it is important to share this information to other relevant management agencies for use. One method of doing this is by suggesting that all agencies input all relevant data into the National IAS database such as the one hosted by the Ja-CHM.

2.4 REHABILITATION AND RESTORATION

Owing to the fact that each invasion characteristic is unique, specific habitat restoration and rehabilitation programs need to be designed at the appropriate level. The application

of appropriate habitat restoration and rehabilitation concepts to invasive insect, animal, or pathogen problems is also a critical component of a fully functional invasive species program. Successful eradications and some control programmes can significantly improve the likely success of re-introductions of native species, and thereby provide opportunities to reverse earlier losses of native biological diversity. An eradication operation that successfully removes an IAS, or a control operation that lowers it to insignificant levels, usually improves the conditions for native species that occupy or previously occupied that habitat.

It is recommended that the re-introduction guidelines developed by IUCN be used to develop a proper strategy and action plan for the re-establishment of native flora and fauna. The guidelines of 1995 were developed to provide "...direct, practical assistance to those planning, approving or carrying out re-introductions." These guidelines elaborate requirements and conditions, including feasibility studies, criteria for site selection, socio-economic and legal requirements, health and genetic screening of individuals, and issues surrounding the proposed release of animals from captivity or rehabilitation centres.

The socio-economic considerations should consider the importance of community and political support, financial commitment and public awareness. This makes it cost-effective to combine consultation over the eradication objective with proposals to re-introduce native species. It has the added advantage of offsetting the negative aspects of some eradication (killing valued animals) with the positive benefits of re-introducing native species (restoring heritage, recreation or economic values).

2.4.1 Rehabilitation and restoration - Recommended Actions

1. Compile, highlight, and share information amongst relevant agencies and organisations on existing restoration and rehabilitation successes around the world about invasive species.
2. Develop and implement government policy that incorporates the best available science on using native or desired non-native species for restoration and rehabilitation.

3. Work with partners to develop an infrastructure for producing, purchasing, and warehousing seed supplies and other native and desirable non-native plant materials on a regional basis.
4. Prioritize and develop native plant stock that is resistant to invasive insects and pathogens.
5. Take actions when and where possible during project implementation to protect intact ecosystems and restore degraded ones.
6. Use ecological assessments to identify better ways to restore ecosystem functions.
7. Produce and use resistant plant stock from local origins for restoration and rehabilitation.
8. Use research and other means to increase information and the knowledge base about native species, plant resistance, the role of intact ecosystems, restoration ecology⁶, disturbance ecology⁷, and invasive species.
9. Synthesize multi-scale monitoring results and assess effectiveness of restoration action.
10. Develop establishment methods, species-habitat relationships, genetic range, and other information for natives.
11. Refine establishment techniques and explore opportunities to use native plants when re-establishing native communities.

⁶ **Restoration ecology** is the study of renewing a degraded, damaged, or destroyed ecosystem through active human intervention

⁷ **Disturbance ecology** - temporary change in average environmental conditions that causes a pronounced change in an ecosystem which can provide suitable conditions for the establishment of IAS.

12. Collaborate with academic organizations as well as marketing and behaviour change consultants to develop educational outreach materials and demonstration areas that illustrate landscape designs and management techniques that facilitate native plant species use and resistance to non-native species.
13. Work with partners to increase outreach to nurseries regarding desired native and non-native species.
14. Develop appropriate guidance documents on effective rehabilitation and restoration practices for protected area managers.
15. Develop web-based or other information and technology transfer tools to communicate disturbance ecology, identification of area specific native species, establishment methods of suitable natives, species habitat (native community) relationships, and genetic range. This should include the expansion of the distribution of the newsletter produced by NEPA "*Aliens of Xamayca*" nationally and regionally.

2.5 PUBLIC AWARENESS

An important factor that spans all elements of an IAS strategy is the need to clearly communicate information and ensure that it is understood. Targeted national public education initiatives will be essential for responding to key pathways of invasion where consumer choice and individual actions are the drivers of IAS problems in both urban and rural communities. These initiatives should emphasize methods of informing and gaining the acceptance of the magnitude and urgency of the IAS problem. Education, communication, and interpretation programs can be used to inform the public on how they can assist in helping to prevent, identify, detect and control invasive species.

Mitigation activities should include public consultations which would help to ensure the success of any invasive activity and should promote partnerships in their implementation (i.e. community based strategies). These could be in the form of stewardship activities

which have been proven to be effective especially when the target is the youth of the community. Public-private partnerships to manage IAS should be encouraged.

Priority should be given to providing data and information on IAS to the public, particularly travellers, in accessible formats and through readily available portals or networks.

Communication between and within agencies will foster relationships and partnerships which is necessary in order to effectively communicate the problem as it needs to be fully understood by all persons involved. This will also help decision makers to include IAS management into annual corporate / operation plans and thus allocate budgetary funding.

2.5.1 Public awareness - Recommended Actions

Active public engagement is critical to successful invasive species management which would lead to an informed public that supports ongoing actions to reduce the threat of IAS and key stakeholders who are actively engaged in the implementation of IAS solutions. It is recommended that to attain these desired outcomes the following should be explored:

1. Identify the specific interests and roles of relevant sectors and communities with respect to IAS issues and target them with appropriate information and recommended actions. Specific communication strategies for each target group will be required to help reduce the risks posed by IAS. The general public is an important target group to be considered.
2. Make easily accessible, current and accurate information widely available as a key component to raise awareness. Target different audiences with information in electronic form, manuals, scientific journals and popular publications as well as institutionalise the updating of a central national database, such as the IAS database hosted by the Ja-CHM, to share best practices and experiences.
3. Target importers and exporters of goods, as well as of living organisms as key target groups for information/education efforts to bring about behavioural changes via

better awareness and understanding of the issues, and their role in prevention and possible solutions.

4. Develop guidelines to be followed by private sector organisations such as plant nurseries and pet shops.
5. Develop a coordinated campaign with the involvement of all relevant stakeholders to raise awareness of how much human travel contributes to IAS problems.
6. Encourage operators in the tourism sector to raise awareness on the problems associated with IAS. Work with such operators to develop industry guidelines to prevent the unintentional transport or unauthorised introduction of alien plants (especially seeds) and animals into ecologically vulnerable habitats and ecosystems (e.g. rivers, mountain areas, nature reserves, isolated forests and inshore marine ecosystems).
7. Train staff from quarantine, border control and other relevant facilities to be aware of the larger context and threats to biological diversity, in addition to practical training for aspects such as identification and regulation.
8. Build communication strategies into the planning phase of all prevention, eradication and control programmes. By ensuring that effective consultation takes place with local communities and all affected parties, most potential misunderstandings and disagreements can be resolved or accommodated in advance.
9. Infusing IAS issues and actions that can be taken to address them, in appropriate places such as educational programmes and schools.
10. Promote the adaptation of the drafting instructions for the amendments to the Wild Life Protection Act.
11. Ensure that national legislation applicable to the introduction of alien species, both intentional and unintentional, is known and understood, not only by citizens and

institutions, but also by foreigners importing goods and services as well as by tourists.

3.0 REFERENCE:

3.1 DOCUMENTS

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3.2 WEBSITES

<http://www.iucn.org/>

<http://www.issg.org/database/welcome/>

4.0 APPENDIX

A. LIST OF AGENCIES

1. Forestry Department
2. Institute of Jamaica
3. Jamaica Customs Department
4. Ministry of Agriculture
 - i. Fisheries Division
 - ii. Plant Quarantine Division
 - iii. Plant Protection Unit
 - iv. Rural Agricultural Development Authority
 - v. Veterinary Services
5. Nature Preservation Foundation
6. Office of the Prime Minister
 - i. Environmental Management Division
 - ii. National Environment and Planning Agency
 - iii. National Commission on Science and Technology
7. Port Authority of Jamaica
8. Scientific Research Council
9. The Nature Conservancy
10. University of the West Indies
 - i. Centre for Marine Sciences
 - ii. Department of Life Sciences
11. Urban Development Cooperation