UNEP – GEF PROJECT
"MITIGATING THE THREAT OF INVASIVE ALIEN SPECIES IN THE INSULAR CARIBBEAN"
TRINIDAD AND TOBAGO COMPONENT

NATIONAL INVASIVE ALIEN SPECIES STRATEGY FOR TRINIDAD AND TOBAGO

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ABBREVIATIONS AND ACRONYMS

AHB	**Africanized Honey Bees**
IAS	**Invasive Alien Species**
CARDI	**Caribbean Agricultural Research and Development Institute**
CARICOM	**Caribbean Community and Common Market**
CBD	**Convention of Biological Diversity**
CSA	**Critical Situation Analysis**
GDP	**Gross Domestic Product**
GISP	**Global Invasive Species Programme**
H1N1	**Swine Influenza**
IMO	**International Maritime Organization**
IICA	**Inter American Institute for Corporation on Agriculture**
IPPC	**International Plant Protection Convention**
NGO	**Non Governmental Organization**
OIE	**World Organization for Animal Health**
NISS	**National Invasive Species Strategy**
RPM	**Red Palm Mite**
USD	**United States Dollars**
W.H.O	**World Health Organization**

TABLE OF CONTENTS

Chapter 1
Background of Invasive Alien Species

1.0 Introduction

"Invasive species" (often called pests and weeds), are plants, animals and other organisms taken beyond their natural range by people, deliberately or unintentionally, and which become destructive to the environment or human interests (Evans 2003). The movement of plants, animals and other organisms beyond their natural range is rising sharply, due to increased transport, trade and travel. Many species that are introduced to new places by people do not cause problems in their new locations, and many have considerable benefits for economies, including in agriculture, horticulture and forestry. However, invasive species are those that become established and proliferate in ways that threaten biodiversity, natural resources, food security, economic development, human health, and ecosystem services such as water resources, nutrient cycles, erosion and fire regimes, in other words they cause economic harm. They include vertebrates (e.g. rats, goats, cats, mongooses, mynas, fish etc.), invertebrates (e.g. snails, slugs, nematode worms, mosquitoes, beetles and other insects etc.), weedy plants (trees, vines, shrubs, grasses, seaweeds etc.), and pathogens (e.g. fungi, bacteria and viruses that cause plant, animal or human diseases). They affect agriculture, aquaculture, fisheries, forestry and tourism, reduce land values, damage buildings, obstruct waterways, disrupt trade and transportation, and cause or transmit diseases of humans, animals and crops.

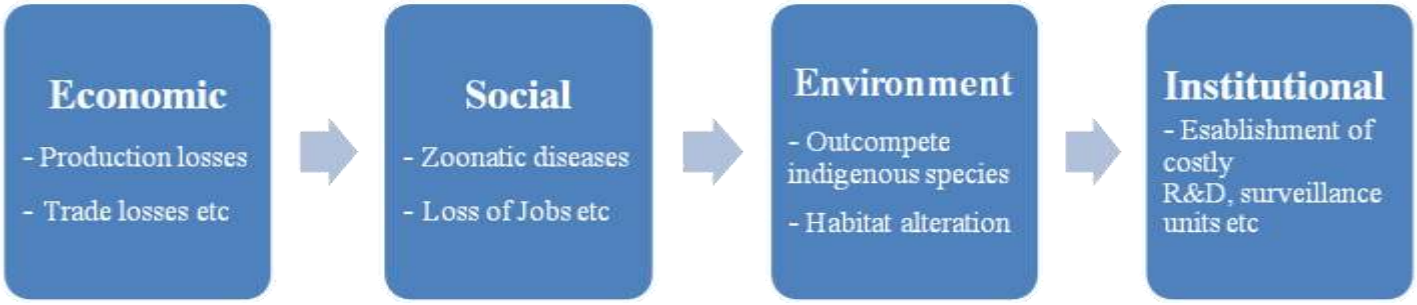
Indigenous species (non alien or native) as well can also cause economic harm. Given the right environmental conditions indigenous species can become invasive thus causing economic harm that is similar to IAS. A recent example of an invasive species in Trinidad and Tobago is the cassava hornworm outbreak in June 2010 that destroyed hundreds of acres of the cassava crop throughout the country. This pest is native to Trinidad and Tobago and has become invasive; however the Red Palm Mite is widely considered an Invasive Alien Species (IAS) in Trinidad and Tobago simply because it is not native (alien) and is negatively impacting the coconut industry.

Introduction of an IAS can either be intentional or unintentional. An example of intentional introduction can be the use of biological control to regulate / manage pest for example,

Cryptolaemus montrouzieri, (ladybird beetle) was intentionally introduced in 1995 to manage the mealy bug problem in Trinidad and Tobago (CARDI 1996). Alternatively, unintentional/accidental introductions may occur when species are transported by manmade vessels across borders. A common example of these includes the accidental introduction of the Asian Green Mussel **(*Perna Verdis*)** in the mid 1990's through ballast water at major ports in Trinidad (Kishore et al 1992).

Figure 1.0 show the range of impacts can be broadly classified into four dimensions which are as follows; (1) economic; (2) social; (3) environment; and (4) institutional.

Figure 1.0: Dimensions of the Impact of Invasive Alien Species



According to Evans (2003) every one in seven alien species (non indigenous or non native) that breach preventative measures in the USA becomes invasive, therefore **not all alien species** have invasive tendencies. Some alien species may become naturalized, that is they have become established in the region but does not cause any harm. Whether these species is native or alien in nature, they can only become invasive when they cause harm to any one of the dimensions mentioned in Figure 1.0 above.

1.1 Global Outlook of Invasive Alien Species

Over 120 000 alien species of plants, animal and microbes that have invaded Australia, Brazil, India, South Africa, the United Kingdom and the United States causing significant economic losses and negatively affecting ecosystems. It is estimated that the total economic cost to these six countries alone was USD$314 billion in per year (Table 1.0).

Table 1.0: Economic Cost of Invasive Alien Species for Selected Countries	
Country	**Total costs (USD Billion)**
Australia	13
Brazil	15
India	116
South Africa	7
United Kingdom	12
United States	116
Total	314

Source: Pimentel et al., 2000

The problem of invasive species has intensified with globalization in the last few years, making it a serious challenge to globalized trade. "Through globalization animals, plants, and microbes can now migrate across the planet to new homes with unprecedented ease which can result in colossal economic losses" (The Economist 2000). Global trade has significantly increased in recent decades, for example the growth in global economic output during the 1980s was greater than that of the mid 20th century (1950's) and the 1990s were even more prolific. The value of total imports increased from about US$192 billion in 1965 to $4.8 trillion in 1995, a 25-fold increase in 30 years. Imports of agricultural products and industrial raw materials, those which have the greatest potential to contribute to the problem of IAS amounted to $850 billion in 1998, up from $55 billion from1965 (Mc Neely 2001).

1.2 Regional Outlook of Invasive Alien Species

Currently there are 552 alien species identified in the Caribbean region alone. The large number of introduced species reported in the region is drawn from a broad range of organism types including many different groups of plants, invertebrates, vertebrates and several fungi /micro-organisms (Kairo et al 2003). The occurrence of IAS problems has increased in recent years, and is likely to further increase in the future, as a consequence of expanding global trade through regional and bilateral agreements such as CARICOM Single Market Economy and increased international movement of humans, biological material and other commodities. This increase in

trade activities provides a new range of pathways for the introduction of alien species that can potentially become invasive.

According to Stein and Flack (1996) island states are especially vulnerable to IAS. Island species often have small populations and are unique when compared to continental species due to the isolation of islands throughout the prehistoric past. This isolation has been provided by the natural barriers of oceans that have enabled these unique species and ecosystems to evolve. Hence most island species are ill-equipped to defend against aggressive invading alien species.

While the isolation of islands has proven to be a weakness in the ability of island species and ecosystems to be resilient against biological invasion, it can be used as an advantage by improvement of the capacity of governments of island states to prevent the arrival of IAS through better knowledge, improved legislation and greater management capacity, supported by quarantine and customs systems that are capable of identifying and intercepting IAS. It is relatively easier for island states to manage IAS compared to continents where countries are separated by borders. For example the case of the eradication programme of the Carambola Fruit Fly in South America (1999-2004), one major limitation among participating countries was cooperation among partners across borders. The lack of cooperation by French Guiana delayed and hampered certain aspects of the project thus contributing to the re- establishment of the fruit fly in Suriname and Guyana (IICA 2004). Once proper measures and protocol are implemented IAS impacts on island states can be mitigated, if not then it can have serious impact on agricultural production and biodiversity.

Through globalization IAS can develop new pathways by which these pests can transfer from island to island. This has happened in the past where the Pink Hibiscus Mealy bug was first present in Grenada 1996 and within months it had spread throughout the Caribbean. Today, IAS poses a greater risk to the Caribbean region therefore preventative measures must be implemented to protect all twenty four (24) island states. Within recent years, IAS in the Caribbean region has caused serious problems to; (1) human health for example multiple deaths caused H1N1 virus (2) biodiversity, for example decimation of native fauna species (reptilian) caused by the Indian mongoose (3) agriculture, through loss of production yields via unintentional introduction of the tropical bont tick that caused a decline in ruminant production.

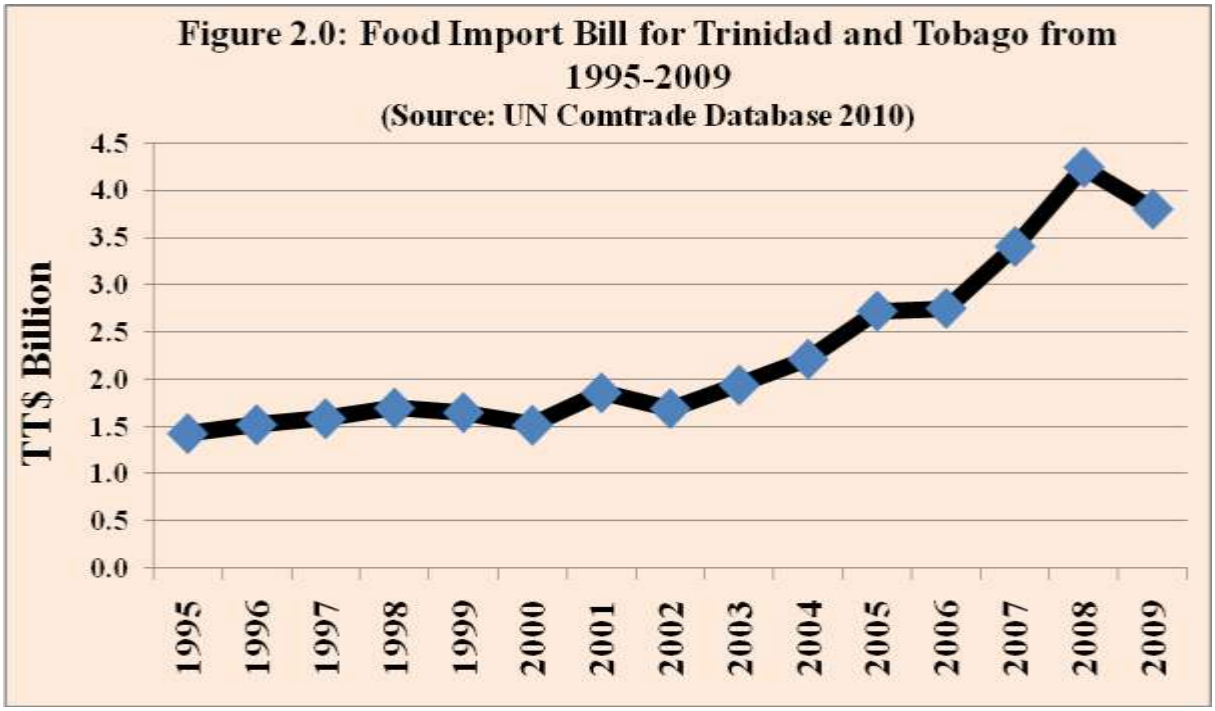
These IAS introductions (whether intentional or unintentional) have led to a negative impact on the biodiversity, agriculture and human health throughout the Caribbean.

1.3 Invasive Alien Species in Trinidad and Tobago

The Republic of Trinidad and Tobago is the southernmost islands of the Caribbean chain, located 11 kilometers (7 miles) northeast of the Paria Peninsula of Venezuela. The island of Trinidad is 30 km (19 miles) from Tobago. The total land area covered by the twin island state is 5,128 km^2 (1,980 $mi^{2)}$ (Trinidad covers 4,828 km^2 (1,864 mi^2) while Tobago covers 300 km^2 (117 mi^2) (CIA 2010). The total population is approximately 1,333,388 (World Bank 2010).

The close proximity of Trinidad and Tobago to the South American mainland, aided by the illegal trade and smuggling of exotic animals heightens the IAS problem. In fact, swarms of Africanized honeybees migrated across to Trinidad in 1979 from Venezuela and to date they still continue to fly into Trinidad threatening human lives and livestock. Another recent example is the introduction of the Black Sigatoka disease (2002) which has impacted negatively on the agricultural sector of Trinidad and Tobago. Reports indicate that the possible means of introduction was linked through the illegal importation of banana and plantain propagation material from the South America mainland (Fortune et al 2004).

Trinidad and Tobago is a signatory to different trade agreements throughout the region and as a result trade among CARICOM countries have increased. As mentioned earlier, this increase in trade has created avenues for the introductions of alien species that can potentially become invasive. Recently, Trinidad and Tobago has experienced a surge in the frequency of introductions with respect to IAS; these pests include the Citrus Black Fly, Citrus Leaf Miner, Black Sigatoka Disease, the Red Palm Mite, Coconut Moth and the Giant African Snail, this coincides with the increase in the importation of agricultural commodities which has the greatest potential for the entry of IAS. In fact, the importation of agricultural commodities has increased by 200% over the past 15 years (Figure 2.0). This is strong evidence that Trinidad and Tobago needs implement more stringent measures to limit these harmful introductions.



The number of IAS in Trinidad and Tobago is unknown but the destruction throughout all dimensions is widespread therefore strategies/preventative measures must be developed to avoid further introductions and mitigate impacts. For example, since 1979 in Trinidad, Africanized honey bees (AHB) were responsible for sixteen (16) human deaths directly related to bee stinging incidents and the loss of hundreds of animals, comprising of livestock and pets. As recently as 2009, another IAS, the H1NI virus commonly known as Swine Flu, resulted in the death of five (5) persons from two hundred and eleven (211) reported cases (WHO 2010).

Whilst the impacts of IAS on human health (the social dimension) is well documented such as the case of the AHB and H1NI virus, economic assessments and proper documentation of all IAS needs to be conducted. Little impact assessment has been conducted for pests like the RPM, Black Sikatoga disease, Diamond Back moth and the Asian Green Mussel (just to name a few) even though their presence cause losses to agricultural and industrial stakeholders annually.

The impact of IAS can be severe therefore implementing measures to prevent further introduction as well as managing established IAS is crucial for boosting agricultural production, economic development, protecting natural biodiversity and preserving human health. Therefore,

Trinidad and Tobago has to develop a National Invasive Species Strategy (NISS) to protect its population as well as agricultural producers. This strategy is proposed in chapter 2.

1.4 Rationale for the National Invasive Species Strategy

The purpose of the NISS is to provide a framework to effectively manage potential as well as established IAS in Trinidad and Tobago. With the ever increasing impacts of IAS coupled with a surge in trading activities, Trinidad and Tobago is required to protect its borders. A review of the Critical Situation Analysis (CSA) document 2008, for Trinidad and Tobago revealed that there are gaps in the efforts in controlling the IAS problem. These gaps include:

1. Shortage of staff at the major pathways.
2. Lack of funds to develop and implement IAS.
3. Heavy dependence on Customs to report attempted entry of plant/animal products (centralized system).
4. Inefficient communication between ports and main office.
5. Inefficient implementation of legislation by relevant authorities.
6. Lack of cooperation among stakeholders.
7. Insufficient research and development.
8. Lack of policies and outdated legislation which specifically relates to the management of IAS (prevention, monitoring or control).
9. Inadequate knowledge base.
10. No national emergency protocol.
11. Gaps in institutional coordination.
12. Constraints on risk and assessment tools.
13. Poor infrastructure for IAS activities.

Trinidad and Tobago has insufficient resources to tackle existing invasive species problems, which hinders governmental and non-governmental bodies wishing to mobilize solutions. A lack of knowledge and access to information has been identified as major problems preventing countries from moving forward with solutions to invasive species problems at a national and regional level. Similar constraints apply to the establishment of effective mechanisms for

preventing the introduction of invasive species. It is imperative that these issues are addressed as soon as possible to prevent further exposure of the Caribbean to IAS.

1.5 International Obligations

Trinidad and Tobago is a signatory to several regional and international trade agreements. These trade agreements are shown in Table 2.0. These agreements allow for trade creation between Trinidad and Tobago with the regional and international community, this will potentially benefit the trading partners through the generation of greater economic activity and a higher standard of living.

Trinidad and Tobago is also a signatory to different biodiversity agreements within the international community which express intent to control IAS. These include; Article 8 (h) of the Convention of Biological Diversity (CBD), International Plant Protection Convention (IPPC), Organization des Epizooties (OIE) and the International Maritime Organization (IMO). Many other countries are signatories to these trade and biodiversity agreements. They have allocated/ reallocated significant resources and changed their policies to meet the obligations of these agreements; likewise Trinidad and Tobago is required to do the same. If Trinidad and Tobago fails to adopt similar invasive alien species initiatives/approaches, it could result in international repercussions affecting trade, travel or international relationships with our global partners in the long run.

Table 2.0:Trinidad and Tobago Trade Agreements, 1947-2008

Agreement/Partner(s)	Date of Signature
WTO members	01 March 1995 (Contracting Party to GATT 1947 since 23 October 1962)
CARICOM members	04 July 1973 Revised treaty: 5 July 2001
CARICOM-Costa Rica	09 March 2004
CARICOM-Dominican Republic	22 August 1998
CARIFORUM-European Community	15 October 2008
CARICOM-Colombia	24 July 1994
CARICOM-Venezuela	13 October 1992
Venezuela (bilateral agreement)	04 August 1989

1.6 Policy Statement

The Government of Trinidad & Tobago is committed to preventing the introduction of, as well as the control and management of potential and existing IAS, which threaten native biodiversity, natural resources, food security, economic development and human health. This will be undertaken through public awareness, enhanced cooperation between relevant stakeholders, improved surveillance systems at ports of entry and the development of a national emergency protocol.

Chapter 2
National Invasive Species Strategy

This Strategy is primarily targeted at government agencies as well as private stakeholders. It aims to engage not only nature conservation agencies but also all sectoral agencies with responsibility for activities relevant to IAS prevention or management. The strategy also recognizes the range of stakeholders involved in the movement and use of alien species (industry and trade, transporters, retailers, resource managers, the public) and the contribution that competent non-governmental organizations (NGOs) can make to prevention, detection and mitigation.

2.0 Objective

The Strategy promotes the development and implementation of coordinated measures and cooperative efforts throughout the region to minimize adverse impacts of invasive alien species (IAS) on Trinidad and Tobago's biodiversity, economy and human health and wellbeing.

Specific objectives are to:

1. Increase public awareness and information about IAS issues and ways to mitigate these threats
2. Prevent the introduction of new IAS.
3. Reduce the impact of existing IAS.
4. Where feasible, restore species, natural habitats and ecosystems that have been affected by biological invasions (e.g Palm trees in the Nariva Swamp).

2.1 Scope

The Strategy applies to:

1. Terrestrial, freshwater/aquatic and marine environments under the jurisdiction of the Government of the Republic of Trinidad and Tobago, it also provides guidance for

activities carried out in areas beyond national jurisdiction (e.g. international or bi lateral trade agreements).

2.2 Components of a Strategy for Invasive Alien Species

When developing an IAS strategy is it imperative that policy makers understand the key components that make up a strategy. It is important to note that one component without the other is likely to be ineffective thus a strategy will be unsuccessful if one component is absent. In other words, all components that make up a strategy are interrelated:

1. **Building Management Capacity.**
2. **Building Research Capacity.**
3. **Promote Information Sharing.**
4. **Strengthening Legislation.**
5. **Risk Analysis/Assessment.**
6. **Public Awareness.**

The actions recommended for each component must be undertaken before the action plan (Chapter 3) can be implemented, this acts like the foundation that supports the action plan. These components are further discussed below.

2.2.1 Building awareness and support

In Trinidad and Tobago, the public, decision-makers have limited understanding of the different threats posed by IAS. This makes it difficult to mobilize relevant agencies and other stakeholders, particularly for introductions that **do not affect human health or major economic interests**. Therefore the raising of awareness and commitment is essential for the development of shared responsibility and to encourage private efforts and voluntary compliance.

Recommended actions

1. Plan and implement vigorous information and communication campaigns on IAS issues for different target audiences (general public, schools, local authorities, government

agencies). **Agencies Responsibility;** EMA, IMA, Ministry of Food Production, Land and Marine Affairs (Extension Training and Information Services Division) and NGO's.

2. Where appropriate, incorporate IAS into education and public awareness programmes on environmental issues (native species and habitat conservation, protected areas, wildlife trade). **Agencies Responsibility;** UWI, EMA, IMA, Ministry of Housing and the Environment (Forestry and Wildlife Division) and Ministry of Food Production, Land and Marine Affairs (Horticultural Division)

3. Develop partnerships with key stakeholders (e.g. professional associations for tourism/travel, hunting, fishing, forestry, horticulture, pet trade; NGOs) to produce and disseminate information and guidance to those using or affected by IAS. **Agencies Responsibility;** National Steering Committee and Research Division.

4. Support the holding of workshops and conferences on IAS. **Agencies Responsibility;** National Steering Committee and Research Division.

2.2.2 Collecting, managing and sharing information

Improving information can build overall national capacity to identify and manage IAS threats. Stakeholders with relevant expertise should cooperate to generate precise updated information that is rapidly and openly accessible. Sharing of information is important because answers to a problem may be available elsewhere in the region or in another part of the world. This prevents time wastage through "reinventing the wheel". Many websites carry information on introduced species. However, there is no mechanism to link sites across jurisdictional lines or to ensure that the information is accurate for potentially problematic species. Existing information resources are also limited taxonomically and geographically. These factors make it harder to find and use information in a timely way (e.g. for early warning and rapid response).

2.2.2.1 Species listing

A starting point for a national knowledge base is to identify alien species recorded and established on national territory and to prioritise them for research, prevention and management purposes.

Recommended actions

1. Develop a database and regularly update (at least every 2-3 years) comprehensive national lists of alien species in all taxonomic groups recorded in their territory. Lists include information on date of introduction, means of arrival/pathway, range, population size, impacts recorded and, based on risk analysis, classification of species as harmful, low risk or in some cases beneficial. **Agencies Responsibility;** Ministry of Food Production, Land and Marine Affairs (Plant Quarantine, Animal Production and Health Unit), Ministry Of Public Utilities and the Environment (Forestry and Wildlife Division) and IMA.

2. Establish a review procedure that allows for rapid inclusion of newly-detected alien species. **Agencies Responsibility;** Ministry of Food Production, Land and Marine Affairs (Plant Quarantine and Animal Production and Health Unit) and IMA.

2.2.3 Exchange of information: towards a regional information system

A regional system that incorporates information sharing with neighbouring countries, trading partners and regions with similar ecosystems can be used to facilitate identification, early warning and all other activities associated with IAS. An information system should quickly locate documents and provide electronic access to sources of information relating to IAS where necessary.

Recommended actions

1. Develop a coordinated internet-based regional data network, building on existing regional information resources. **Agency Responsibility;** National Information and Communication Technology Company Limited (iGovTT).

2. Link national databases to global and regional information networks where these exist (e.g. USDA National Invasive Species Information Center, GISD etc). **Agencies Responsibility;** National Information and Communication Technology Company Limited (iGovTT).
3. Assign a team of experts, particularly for taxonomy, that can advise on technical IAS issues. **Agencies Responsibility;** Ministry of Food Production, Land and Marine Affairs (Research Division), UWI, UTT.

2.2.4 Cooperation among Countries

Trinidad and Tobago should recognise the risk that activities within their control may pose to other countries as a potential source of IAS, thus take appropriate individual and cooperative actions to mitigate these risk. This is particularly important for Trinidad and Tobago given its close proximity to the South American continent (Venezuela) and the rise in trade (legal and clandestine) of biological agents with other Caribbean countries coupled with its integrated coastline, as species introduced into the territory of one country can easily spread to neighbouring countries or the entire region.

Recommended actions

1. Establish general mechanisms for bilateral information exchange, notification and consultation. Contact may be bilateral (between biosecurity agencies/national plant quarantine etc). **Agency Responsibility;** National Information and Communication Technology Company Limited (iGovTT).

2. As a priority, develop harmonized measures to prohibit the introduction of IAS into the environment deemed as problematic at the regional level. **Agencies Responsibility;** NGO's (CABI, CISWIG etc)

3. Develop standards and recommended best practices for **regional pathway management** to minimize risks of unintentional introductions. **Agencies Responsibility;** NGO's (CABI, CISWIG etc)

2.2.5 Strengthening policy, legal and institutional frameworks

2.2.5.1 Leadership and coordination

IAS involves a wide range of social, economic and environmental interests, including trade, health, agriculture, forestry, aquaculture, tourism and recreation. However, Caribbean countries including Trinidad and Tobago often have fragmented arrangements for IAS prevention and management. **Sectoral departments and agencies within Trinidad and Tobago operate under different policies and mandates therefore it can be difficult, even within government, to identify those with responsibility for IAS issues.** This can hamper efficient communication among the different Ministries and states within the region.

As part of an integrated approach to biosecurity, stakeholders need to determine leadership on IAS issues and support closer coordination between sectors and different levels of government. The objective should be to minimise policy conflicts and inefficient use of information and resources so that to make best use of existing capacity and expertise (e.g. Plant quarantine offices, customs, etc).

Recommended actions

1. Establish a national biosecurity authority (or equivalent interministerial mechanism) to lead, coordinate and oversee the efforts of other agencies and sub national governments dealing with IAS. It should have powers to:

    - lead the policy and legal review process
    - lead the development of a national strategy/action plan on IAS

- designate competent scientific authorities to provide technical advice on applications for introductions, contingency plans for rapid response and mitigation measures and applications for reintroductions

- coordinate input from different agencies to regional and international policy-making and programmes.

Agency Responsibility; Ministry of Housing and Environment (Environmental Policy and Planning Division).

2. In relevant departments and agencies, designate a lead official to oversee IAS-related implementation, to be represented on the authority and liaise with other branches of government.

3. Communicate the contact details of the biosecurity authority/IAS focal point to the relevant stakeholders.

Agencies Responsibility; Ministry of Food Production, Land and Marine Affairs (Research Division and National Steering Committee).

2.2.6 Legal review and development

To support implementation of international commitments, legal frameworks need to provide a basis for prevention, detection and management across different taxonomic groups, ecosystems and pathways. Countries often have many different laws for this purpose (plant, animal health and quarantine; etc.).

Recommended actions

1. Review existing procedures to manage the movement, trade, possession and establishment of alien organisms. The review should produce practical recommendations, set priorities and identify appropriate organisations to take forward any measures.

2. Promote use of terminology consistent with the definitions used in the CBD Guiding Principles and, for other terms, with those used in the GISP Guidelines.

3. Loss caused by IAS. As a priority, ensure that national legislation defines "alien"/"native" with reference to ecological parameters rather than political boundaries and that "into the wild/environment" is not interpreted in a restrictive sense.

4. Ensure that roles and responsibilities are clearly assigned to named agencies, including for enforcement, and identify areas where management capacity and training need to be improved.

Agency Responsibility; Ministry of Legal Affairs (The Law Revision Commission).

2.2.7 Precaution and risk analysis

Risk assessment is an effective tool in mitigating invasive alien species threats; it can be used to answer several different questions. Some of these are border control/quarantine questions, such as:

- Someone proposes to introduce a new ornamental plant or crop species. Do you permit it to enter?

- What pathways need managing to prevent known pests in a neighbouring country from entering your island?

While questions about managing established introduced species include:

- Let us assume there are fifty (50) introduced plant species in Trinidad and Tobago, and we know the top 10 invaders. But which of the many plants in people's gardens might become the next problem?

Risk assessment is a vital tool used to predict impacts of a species before they take place, so you can decide to refuse permission to bring a species into the country, or you can decide to try to eradicate a species that is already there, which has not yet become a problem but probably will in

the future if it is left unmanaged. So Risk assessment = species prioritization and prediction, it allows you to evaluate invasiveness and impact of a species, or risk of impact, before a problem gets bad, and allows for action to be taken while it is still affordable.

Recommended actions

1. Ensure that legal frameworks support the application of the precautionary approach to IAS decision-making, within a risk analysis framework that takes account of possible impacts on native biodiversity and ecosystem function.

2. Prohibit intentional introductions without prior authorisation and apply risk analysis to pathway management and mitigation decisions to minimise impacts.

3. In cooperation with relevant organisations, support the development of common decision-making criteria and risk standards regarding the movement of IAS through trade pathways.

   Agencies Responsibility; Ministry of Food Production, Land and Marine Affairs (Plant Quarantine, Fisheries Division and Animal Production and Health Unit).

2.2.8 Compliance and enforcement

Conventional approaches to liability are often not useful to biological invasions, because it is difficult to prove and accurately determine the cause. National frameworks therefore need to support a mix of voluntary and regulatory measures for compliance and to promote innovative measures for greater accountability.

Recommended actions

1. Identify or develop voluntary codes of conduct: in consultation with relevant stakeholders, review their effectiveness and consider whether binding measures are needed.

Agencies Responsibility; Ministry of Food Production, Land and Marine Affairs (Plant Quarantine, Fisheries Division, Horticultural Division, and Animal Production and Health Unit), Ministry of Housing and the Environment (Wildlife Section, Forestry Division).

2. Establish offences for unauthorised introductions, movement or holding of IAS, whether intentional or resulting from negligence, and establish meaningful penalties. **Agency Responsibility;** Ministry of Legal Affairs (The Law Revision Commission).

2. Establish administrative sanctions for establishments that breach conditions for the keeping or breeding of alien organisms (e.g. withdrawal of permits, temporary or permanent closure, confiscation of the organisms etc). **Agencies Responsibility;** Ministry of Food Production, Land and Marine Affairs (Fisheries Division, Horticultural Division), Ministry of Housing and the Environment (Wildlife Division).

3. Consistent with the polluter-pays principle, develop measures to allocate the costs of recapture, eradication or control to the person responsible for an unlawful introduction or escape as well as a system for compensation for environmental damage. Responsibility; Ministry of Legal Affairs (The Law Revision Commission).

2.2.9 Research and Monitoring

Mitigating the impacts caused by IAS require a good understanding of the species ecology, distribution, patterns of spread, and response to management. Existing knowledge levels and capacity to predict the consequences of introducing a given IAS are recognized as inadequate. This should not delay action, but further monitoring and research should be urgently carried out to support management programmes and provide a stronger scientific basis for decision-making and allocation of resources. Given the transboundary nature of IAS issues, regional networks of research groups should be encouraged and mechanisms for effective information sharing should be established.

Recommended actions

1. Support existing research and monitoring procedures to identify gaps, overlaps and ways to improve coordination and practical outputs (between different national research institutes as well as in the region).

2. Prioritize research that directly supports prevention and minimization of impacts.

   Indicators for priority research topics include:

   - Risk analysis of different pathways.
   - Methods to predict and prevent invasiveness of alien species before they are introduced.
   - Develop revolutionary methods to prevent, control and eradicate IAS.
   - Develop revolutionary methods to detect newly arrived IAS.
   - Identify patterns of spread of established species.
   - Assessment of the impacts of IAS on biodiversity, including genetic diversity.
   - Evaluation of economic and public health implications of biological invasions.
   - Evaluation of effectiveness of mitigation measures.

3. Support basic research on ecology and biology of IAS.

4. Establish or expand monitoring systems for pathways, vectors, vulnerable points (entry and exit) of IAS.

5. Support the integration of national data into a national and if possible a regional list of IAS that is regularly updated and circulated.

   Agencies Responsibility; Ministry of Food Production, Land and Marine Affairs (Research Division), IMA, UWI and UTT.

2.2.10 Building Capacity

The ability to manage IAS in Trinidad and Tobago depends on competent national and regional institutional structures and ready access to adequate infrastructure, equipment, skills, and accurate up-to-date information. Compared to the scale of the problem, there is a lack of trained personnel, strategic planning, infrastructure and equipment, and technical, taxonomic and information backup, for managing invasive species in Trinidad and Tobago. IAS personnel are often isolated from their colleagues not only within other agencies and countries but also from the information and skills necessary to plan and achieve their management objectives. Much information on the biology, impacts and control of invasives is in unpublished **local reports** or **even unwritten**. Training, information services, networking and skill sharing are thus of great importance for the effective management of IAS in Trinidad and Tobago.

Recommended actions

1. Establish and maintain a system of technical advice and support based on a national or regional group of invasive species experts and their expertise.

   Agencies Responsibility; Ministry of Food Production, Land and Marine Affairs (Research Division), IMA, UWI and UTT, CISWIG.

2. Review and strengthen staffing capacity in key agencies (e.g. Ministries, NGO's) **Agency Responsibility;** Ministry of Housing and the Environment (Environmental Policy and Planning Division).

3. Establish and maintain national resource centres for specific IAS services (e.g. bio-control, risk analysis, information management).

4. Establish and maintain national and territorial invasive species committees, with multi-stakeholder representation and focal points.

5. Review training that has been delivered in recent years and identify important gaps and target groups.

6. Produce guidelines for a range of training methods and content for different target groups, including formal courses, participation in demonstration projects, etc.

7. Design and implement a national IAS training plan, incorporating repeat training at intervals.

8. Review national and regional IAS management facilities and produce long-term development plans.

Agency Responsibility; Ministry of Food Production, Land and Marine Affairs (Research Division), IMA and NGO's.

9. Strengthen essential national and/or regional facilities such as inspection and quarantine stations and rapid response centres.

10. Develop and promote links to national, regional and international institutions providing facilities unavailable within Trinidad and Tobago such as biocontrol or rapid-response facilities.

Agency Responsibility; Governmental Agencies (Plant Quarantine, Customs, Animal Production and Health) and NGO's (may include CABI, IICA, FAO, CARDI etc).

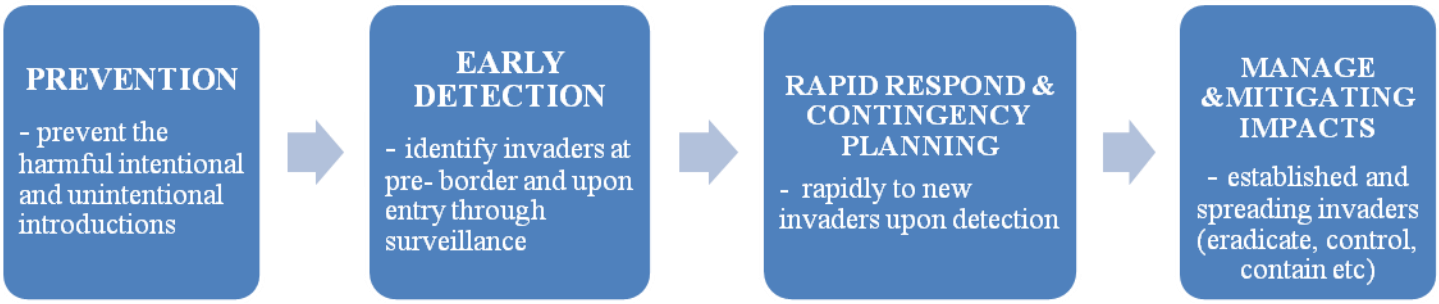
Chapter 3
National Invasive Species Action Plan

The development of a National Invasive Species Action Plan (NISAP) for Trinidad and Tobago is imperative given that IAS has caused significant losses in the past. This chapter presents the NISAP for Trinidad and Tobago.

The NISAP encompasses four strategic goals which are as follows:

1. **Prevention of new invasions**; stop invasive species before they arrive.
2. **Early detection of new invaders**; find new infestations and eliminate them before they become established.
3. **Rapid response and contingency planning to new invaders**; develop a protocol to respond quickly to IAS before they become established.
4. **Management of established and spreading invaders**; develop a long term plan for containment, eradication, and control of IAS (Figure 2.0). It is important to note that prevention is the most important and cost effective goal in mitigating the impacts of IAS in the long term.

Figure 2.0: Strategic Framework for Managing Invasive Alien Species



Purpose National Invasive Species Action Plan

To propose a framework for enhanced cooperation and effective actions to safeguard agriculture, natural biodiversity and human health in Trinidad and Tobago from the serious threat and negative impacts of IAS.

3.1 Preventing unwanted introductions

Preventing harmful introductions before they occur is the most effective means to avoid or minimize risk. Investments in prevention are cost effective; it avoids significant long-term economic costs. A surveillance strategy that includes pre-border and border inspection and interception is essential to (i) verify authorized introductions (ii) detect illegal introductions, and (iii) detect unintentional introductions through key commodities, pathways, and vectors. At the same time, countries currently have and are increasingly looking toward pre-border activities that aim to intercept IAS at their source or point of origin. Adopting a proactive approach will ultimately result in fewer unintended introductions, and fewer intentional introductions with unintended consequences.

3.1.1 Prevention at source: managing exports and pathways

Measures to reduce unintentional introductions will involve the use of pathways analysis to determine the means by which introductions occur, such as commodities, and transportation vectors, along with risk analysis and technical measures to minimize the risk of introductions through these pathways. Prevention efforts should increasingly focus on the country of origin (not only Trinidad and Tobago own borders) to reduce further the risks of introducing of IAS. Measures to reduce risk should be applied to the vector (means) and pathway (route) of movement, including surveillance of exit and entry points.

Recommended actions

1. Promote compliance with available international standards and certification procedures for exported biological material and packaging (as developed by IPPC, OIE, IMO etc.)

2. Communicate regularly with trading partners, particularly those with similar biogeographical and climatic conditions, to identify and address risks, provide feedback and, as appropriate, support capacity-building for prevention and risk assessment.
Agency responsible: Ministry of Food Production, Land and Marine Affairs (Research Division, Animal Production and Health Unit) and IMA.

3. Enact national measures consistent with the IMO voluntary guidelines and support the conclusion of the draft IMO International Convention for the Control and Management of Ship's Ballast Water and Sediments. **Agency responsible:** Institute of Marine Affairs

4. Promote development of new standards and codes, in cooperation with international standard setting organizations and/or professional trade and transport bodies, to reduce the risk of exporting living organisms as hitchhikers (contaminants). In particular:

    - Support the application of IPPC Guidelines for Regulating Wood Packaging Material in International Trade to other categories of risk goods;

    - Support the ongoing work of the International Civil Aviation Organization[1] (for which Trinidad and Tobago is a member state) to develop common measures to minimize IAS movements through civil air transportation.

    Agency responsible: Ministry of Food Production Land and Marine Affairs, Research Division

5. Monitor potential vectors and pathways (including passenger baggage and postal services) and develop programmes to minimize associated risks in partnership with competent agencies, trade/transport bodies and NGOs.

6. Cooperate with tourist operators and airport/port authorities/coast guard to develop a **Code of Conduct** to minimize movement of biological material by tourists: disseminate

[1] http://www.cbd.int/invasive/collaboration.shtml?org=icao

information materials as part of awareness-building as well as to "clamp down" on clandestine trade with neighbouring countries.

Agency responsible: Customs and Excise Division

3.1.2 Prevention on arrival: border control and quarantine measures

For international trade and transport, border control is the point at which countries should screen intentional introductions and take steps to minimize unintentional introductions. It requires a framework of rules, trained staff, reference lists of species and risky goods, technical procedures and surveillance protocols. Trinidad and Tobago has long established Customs and Excise, Coast Guard, Plant Quarantine and Animal Production and Health Unit which play a key role in border control and IAS prevention. However, the expanding volume of goods and passenger traffic entering and moving within the country by air and sea makes it impossible to inspect all imported material. At national and regional level, there is a need to prioritize available resources and manpower, build capacity in some key areas (taxonomy) and facilitate the application of import standards and protocols.

Recommended actions

1. Implement training and capacity-building programmes for quarantine, customs, coast guard and other border officials and promote increased cooperation between relevant authorities at the national and regional level.

2. To minimize unintentional introductions, target inspections at high-risk vectors and risk goods and verify that technical risk reduction measures have been carried out consistent with international standards and codes of practice (e.g. filtration, separation and sterilization of ballast water; spraying aircraft cabins; heat treatment and fumigation of timber; plant and animal health measures).

   Agency responsible: Ministry of Food Production Land and Marine Affairs, Research Division and IMA.

3.1.3 Regulating intentional introductions

IAS regulation is important to prevent the entry of unwanted biological agents therefore to facilitate this stakeholders may screen permit applications and develop a national listing system. Develop **a listing system for alien species are as follows:**

- **Create a black list**: species whose introduction is strictly prohibited (no risk assessment to be carried out). This should include species/groups of species well known to be problematic for native biodiversity and has little or no beneficial uses.

- **Create a white list**: species classified as beneficial or low risk following a risk assessment.
- Introduction of specimens of these species may be authorized without restriction or under conditions.

- **Create a Grey (holding) list:** any species not included in the black or white list must be subject to risk assessment prior to introduction.

Agency responsible: Ministry of Food Production Land and Marine Affairs, Research Division, Plant Quarantine, Forestry Division, Horticultural Division and Animal Production and Health Unit.

3.1.4 Minimizing unwanted introductions within the country

In addition to pathway management, specific measures should target sectoral activities that can facilitate the unwanted introduction, establishment and spread of AS within a country.

Recommended actions

1. Adapt licensing rules for containment facilities to minimize risks arising from escape or release of specimens of IAS. Facilities concerned may include botanic gardens,

greenhouses, garden centres, zoos, animal-breeding establishments, fish farms and animal retail establishments.

Agency responsible: Ministry of Food Production Land and Marine Affairs, Forestry Division (Wildlife Section), Horticultural Division, Fisheries Division and Emperor Valley Zoo.

2. In the forestry sector, control and monitor the use of alien species to detect unusual mortality, disease, or insect outbreaks and to avoid adverse ecological impacts. Develop and implement standards (risk assessment) for the selection of species for planting and the reduction of threats from alien tree species.

Agency responsible: Ministry of Food Production Land and Marine Affairs, Forestry Division, Ministry of Health, Insect and Vector Unit.

3. Cooperate with horticultural trade bodies to identify potentially invasive terrestrial and aquatic alien plants. Promote initiatives to raise awareness amongst gardeners and landscapers of associated risks and ways to minimize them. Develop legal measures to phase out sale and use in the environment of high-risk plant species.

Agency responsible: Ministry of Food Production Land and Marine Affairs, Horticultural Division.

4. Work with the national hunting organizations to identify risks associated with introduction of alien game species for restocking, if applicable.

5. For aquaculture and mariculture, recognizing the difficulty of avoiding escapes from fish farms, promote implementation of existing best practice (FAO Code of Conduct for Responsible Fisheries (1995). Work with relevant stakeholders such to develop a code of conduct to:

- phase out farming/trade of alien fish species that are known to have significant negative impacts on natural systems and native species;

6. For ornamental fish and aquaria, apply standards and procedures to public aquaria to reduce risks of escape when tanks are emptied and work with relevant stakeholders to promote awareness-building and best practice amongst dealers, retailers and the general public.

Agency responsible: Ministry of Food Production Land and Marine Affairs, Fisheries Division

7. For aviculture (keeping and breeding birds), apply strict rules to minimize escape risks (general prohibition on setting them free; wing-clipping or 'pinioning' of birds in roofless enclosures; licensing requirement for all establishments keeping captive non-native birds; a registration and marking system so that the birds' origin can be identified in the event of their escape).

8. Apply generic operating rules to pet and animal retail establishments. These may include:

- an obligation for retailers to inform their customers of good practice, legal regulations and the penalties for violation;

- a prohibition on trade in and possession of alien species assessed to be capable of surviving in the environment of the country/sub region concerned and potentially harmful to native biodiversity;

- a recovery system for animals their owners wish to get rid of (instead of releasing in the wild).

Agency responsible: Ministry of Food Production Land and Marine Affairs, Forestry Division (Wildlife Section).

3.1.5 Prevention of natural spread

Trinidad and Tobago is located very close to the South American continent as a result IAS can spread easily across into Trinidad. Natural expansion of an IAS established in these neighbouring countries is particularly critical because (1) it means that the ecological conditions are suitable for IAS establish, (2) it may be more difficult to contain the natural spread of a species than to prevent its introduction. Predicting the patterns of spread of established IAS can allow timely responses. An important component of regional responsibility requires individual countries to circulate information (Trinidad and Tobago and other Caribbean/South American with similar geographical and climatic characteristics) territories and periodical surveys of the IAS established in these countries to increase the efficiency of control before arrival.

Recommended actions

1. Produce, update and circulate maps of distribution for the main IAS.
2. Develop predictions of patterns of spread.

Agency responsible: Ministry of Food Production Land and Marine Affairs, Survey and Mapping Division

3. Ensure that information is rapidly and effectively circulated to neighbouring countries or relevant institutions (IPPC,OIE, IMO etc).

Agency responsible: Ministry of Food Production Land and Marine Affairs, Research Division, Plant Quarantine, IMA, Animal Production and Health Unit. Ministry of Health, Insect and Vector Unit.

4. Give priority to the eradication and/or containment of established alien species that could potentially spread outside the state's territory.

3.2 Early detection

The counterpart to prevention at source (before a species crosses a biogeographical barrier) is prompt detection and intervention post-barrier. Early detection is essential because of the need for rapid action before significant populations are established. Procedures need to target the arrival of unintentionally or unlawfully introduced species which slip through the prevention barriers.

3.2.1 Monitoring and surveillance

Surveillance (activities aimed at identifying alien species new to the country) is a critical element of prevention: without effective surveillance, early detection will mostly cover larger species and remain unreliable. Surveillance should be coordinated by the biosecurity authority and be adequately resourced.

Surveillance efforts should focus on high-risk sites such as:

- main entry points for commercial/tourist arrivals (airports, ports, harbours and yatch marinas etc.)
- areas adjacent to facilities where alien species are kept in captivity or containment (botanical gardens, fish farms etc.);
- areas of high economic importance that is vulnerable to IAS that are within the region
- Surveys should also target different taxonomic groups (plants, mammals, insects, pathogens, etc).

Agency responsible: Ministry of Food Production Land and Marine Affairs, Research Division, Plant Quarantine, Animal Production and Health Unit. Ministry of Health, Insect and Vector Unit, Customs and Excise Division

A network of professionals and volunteers should be established to rapidly report observations of potential incursions to the biosecurity authority or competent agency. The authority should have access to taxonomic experts to support rapid identification of species.

Recommended actions

1. Support the development of a database for the rapid identification of IAS, the database should incorporate taxonomic information of IAS such clear descriptors and photographs to aid identification, as well as description and photos of similar species to avoid confusion or misidentification.

2. Design an Early Warning System for surveillance in-country and communication with neighbouring countries and, where appropriate, trading partners.

3. Organize regular surveillance of areas vulnerable to invasions from RA.

Agency responsible: Ministry of Food Production Land and Marine Affairs, Research Division, Plant Quarantine, Animal Production and Health Unit.

4. Develop information materials to assist farmers, gardeners, birdwatchers, foresters, fishermen, hunters, divers, hikers and photographers to participate in detecting new arrivals. As appropriate, provide landowners and occupiers with a list of the highest-risk species and introduce reporting requirements.

Agency responsible: EMA, IMA, Ministry of Food Production, Land and Marine Affairs, Research Division, Extension Training and Information Services Division and Wildlife Unit.

3.3 Rapid response and contingency planning

There is only a limited period of time in which eradication is a practicable option, before the invasive species reaches a certain population level and/or range expansion. Luckily however,

small islands such as Trinidad and Tobago have a much higher probability of successful eradication programmes compared to mainland (large land masses such as South America).
To reduce the time between documenting an introduction and implementing a response, contingency plans should be developed for eradicating specific taxa (e.g.: plants, invertebrates, marine organisms, fresh-water organisms, fresh-water fishes, reptiles, amphibians, birds, small mammals, large mammals).

Recommended actions

1. Ensure that all competent authorities (including local authorities and protected area authorities) have clear powers and duties to remove alien species that have been unintentionally or unlawfully introduced or have become invasive following a lawful introduction.

   Agency responsible: Ministry of Legal Affairs, Laws Revision Commission.

2. Establish contingency plans to ensure adequate funds, material and equipment for rapid response to new invasions. Ensure that staff at the appropriate level/sector is trained to use the control methods selected.

   Agency responsible: Ministry of Food Production, Land and Marine Affairs, Plant Quarantine, Animal Production and Health Unit. Ministry of Finance, Budget Division.

3. Cooperate at the regional level on research and development of emergency response materials.

   Agency responsible: Ministry of Food Production, Land and Marine Affairs, Research Division, IMA, UWI, UTT and NGO's.

3.4 Managing and Mitigating Impacts

Prevention can reduce new introductions, but not halt them. When an alien species is unintentionally or unlawfully introduced or an introduced species becomes invasive, precaution dictates that:

- eradication programmes should be considered first. Eradication is the most coherent solution in terms of biodiversity conservation and can be more effective, cost effective and ethical than other management alternatives (control, containment, do-nothing).

- where a science-based assessment shows that eradication is no longer feasible, containment should be considered, particularly for species that could spread to neighbouring countries.

- where eradication and containment are not feasible or appropriate, permanent control should be considered on the basis of a long-term cost/benefit analysis.

3.4.1 Eradication

Eradication should not be attempted unless:

- it has a legal basis public and political support and adequate funding; and
- it is ecologically feasible i.e. low risk of harming of non-target species.

Eradication programmes should be subject to risk assessment covering impacts, reversibility of effects and risk of re-invasion. They should provide for the use of different techniques to ensure that individual organisms surviving the primary campaign are destroyed, and monitor effort, costs and results to allow for corrections. Species-based priorities for eradication should be (1) species representing a major threat to native biodiversity (2) species already established in the wild, causing reversible effects on native ecosystems, and (3) species for which eradication is most feasible.

Recommended actions

1. Establish priority lists of IAS to eradicate, including species known to be harmful to native biodiversity.

2. Prioritize areas for eradication, based on a classification of natural value, degree of disturbance and feasibility of success.

3. Implement and fund eradication programmes, subject to prior risk assessment and public consultation.

4. Notify and consult with neighbouring countries about proposed eradication of transboundary populations: seek to develop joint programmes with other countries affected.

Agency responsible: Ministry of Food Production, Land and Marine Affairs, Plant Quarantine, Animal Production and Health Unit. Ministry of Health, Insect and Vector Control Unit.

3.4.2 Containment

Containment may have one or more specific aims, namely to:

- contain the species' presence within defined geographical boundaries;
- prevent its spread to neighbouring countries;
- postpone its population growth in order to develop more effective eradication techniques

Recommended actions

1. Establish priority lists of IAS for containment, as appropriate in collaboration with neighbouring countries for which the same species are problematic.

2. Implement containment programmes for priority IAS.

Agency responsible: Ministry of Food Production, Land and Marine Affairs, Plant Quarantine, Animal Production and Health Unit. Ministry of Health, Insect and Vector Control Unit.

3.4.3 Control

The aim of control is to reduce density and abundance of an IAS in order to keep its impact to an acceptable level in the long term (once eradication is not feasible). Before starting a control programme a cost/benefit analysis should be realized, desired outcomes should be clearly defined and appropriate monitoring of the results should be planned. Control methods should be selected with regard to their efficiency, selectivity and the undesired effects they may cause.

Recommended actions

1. Conduct costs and benefits analysis of IAS control programmes.

2. Initiate new IAS control programmes after a long-term cost/benefit analysis, with defined aims and adequate monitoring arrangements.

3. Identify IAS problems that could be addressed through coordinated control by neighbouring countries/sub regions (e.g. marine organisms in shared coastline) and develop appropriate programmes.

   Agency responsible: Ministry of Food Production, Land and Marine Affairs, Research Division, Plant Quarantine, Animal Production and Health Unit. Ministry of Health, Insect and Vector Control Unit.

3.5 Restoration

Sometimes, control of an IAS is followed by rapid and adequate recovery of the native ecosystem or of the economic or cultural value affected by the target species. But in some cases, populations of native species may fail to recuperate or other unforeseen adverse consequences may occur, such as invasion by other introduced species. In such cases additional intervention may be required to assist the recovery of native biodiversity or to ensure recovery of economic or other values. This may include specific restoration projects for individual native species, or management of additional invasive species.

Recommended actions

1. Ensure that all IAS management programmes are accompanied and followed by long-term monitoring and evaluation of outcomes.

2. Where further intervention is identified as necessary to achieve full recovery of biodiversity or other values following invasive species management, design and implement restoration projects or follow-up invasive species management projects as required.

   Agency responsible: Ministry of Food Production, Land and Marine Affairs, Research Division, Plant Quarantine, Animal Production and Health Unit and Forestry Division.

REFERENCES

Africanized Honeybee Factsheet. Undated. http://www.caripestnetwork.org/vtt/docs/datasheets/hymenoptera/africanized_honeybees.pdf. (Accessed September 24, 2010)

Kishore R., Agard J., and B. Bayne. 1992. *Perna viridis* (Linnaeus, 1758): First record of the Indo-Pacific green mussel (Mollusca: Bivalvia) In the Caribbean. Caribbean Marine Studies 3:59-60.

Caribbean Chemicals and Agencies limited. 2010. Caribbean Chemicals Combats Cassava Hornworm Outbreak. http://caribbeanchemicals.com/news/?tag=cassava-hornworm (accessed October 14, 2010)

Caribbean Agricultural Research Development Institute.1996. Regional action programme for control of the pink mealy bug. Greneda. http://www.nalis.gov.tt/Agri/mealybug.html (accessed: November 15, 2009).

Environment Canada. 2004. An Invasive Alien Species Strategy for Canada. http://www.ec.gc.ca/eee-ias/98DB3ACF-94FE-4573-AE0F-95133A03C5E9/Final_IAS_Strategic_Plan_smaller_e.pdf. (Accessed September 10, 2010)

Evans, E. 2003. Economic Dimensions of Invasive Species. http://www.choicesmagazine.org/2003-2/2003-2-02.htm (accessed November 12, 2010).

Kairo, M.T.K.; Ali, B.; Cheesman, O.; Haysom, K and Murphy, S. 2003 Invasive Species threats in the Caribbean Region. CAB International.

McNeely, J.A., H.A. Mooney, L.E. Neville, P. Schei, and J.K.Waage (eds.) 2001. *A Global Strategy on Invasive Alien Species.* IUCN Gland, Switzerland, and Cambridge, UK. http://www.gisp.org/publications/brochures/globalstrategy.pdf (Accessed September 22, 2010).

M.P. Fortune, S. Gosine, S. Chow, A. Dilbar, A.St. Hill, H. Gibbs and N. Rambaran. 2004. First report of black sigatoka disease (causal agent *Mycosphaerella fijiensis*) from Trinidad. http://www.ndrs.org.uk/article.php?id=010002. (Accessed September 24, 2010

Piero.G and Shine.C 2004. European strategy on invasive alien species. http://www.cbd.int/doc/external/cop-09/bern-01-en.pdf (Accessed January 15, 2011

Stein, Bruce A. and Stephanie R. Flack .1996. America's Least Wanted: Alien Species Invasions of U.S. Ecosystems. http://www.natureserve.org/library/americasleastwanted2003.pdf. (Accessed September 22, 2010).

Republic of Trinidad and Tobago Biodiversity Clearing House. 2005. Legal Framework for the Protection of the Biological Diversity of Trinidad and Tobago. http://www.trinbagobiodiversity.gov.tt/legislative-framework/index.htm. (Accessed November 10, 2010)

World Health Organization. 2010. H1NI Flu Count. http://www.flucount.org/. (Accessed September 10, 2010)