



National Invasive Species Strategy for Saint Lucia

Terrestrial Ecosystems



Carried out under the project

Mitigating the Threats of Invasive Alien Species in the Insular Caribbean

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Acronyms and Abbreviations

BIT	Banana Industry Trust
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CISWG	Caribbean Invasive Species Working Group
CISSIP	Caribbean invasive Species Surveillance and Information Program
CSA	Critical Species Assessment
DWCT	Durrell Wildlife Conservation Trust
EU-SFA	European Union-Special Framework of Assistance
FAO	Food and Agricultural Organisation of the United Nations
FCG	Finnish Consulting Group
IAS	Invasive Alien Species
GOSL	Government of Saint Lucia
MALFF	Ministry of Agriculture, Lands, Forestry & Fisheries
MEAs	Multilateral Environmental Agreements
NBSAPs	National Biodiversity and Strategic Plans
OECS	Organisation of Eastern Caribbean States
SPAW	Specially Protected Areas and Wildlife
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations framework Convention on Climate Change

Table of Contents

Introduction.....	4
Terrestrial Invasive Alien Species	5
Terrestrial Ecosystems in Saint Lucia	15
Forest Resources	15
Natural vegetation types	16
IAS Pathways and Vectors	18
Why are terrestrial IAS introductions of concern to St. Lucia?	19
Biodiversity impacts	19
Agriculture	20
Tourism.....	21
Public Health.....	21
Assessment of Saint Lucia’s capacity to manage IAS- National Policy context	22
Legislative and institutional gaps.....	23
Relevant Multilateral Environmental Agreements.....	26
UNCBD Guiding Principles for IAS Management.....	28
Conclusions.....	34
Bibliography	34

Introduction

Invasive alien species (IAS) are species whose introduction and/or spread outside their natural habitats threatens biological diversity (CBD 2009). IAS are recognised as one of the leading threats to biodiversity, considered only second to habitat loss in terms of negative impact. They are imposing enormous costs on agriculture, forestry, fisheries, and other enterprises, on human and animal health as well as ecosystem services. Rapidly accelerating human trade, tourism, transport, and travel – the infamous “four Ts” - over the past century have dramatically enhanced the spread of IAS, allowing them to surmount natural geographic barriers.

Not all non-indigenous species are harmful. In fact the majority of species used in agriculture, forestry and fisheries are alien species. Thus, the initial step in a national programme must be to distinguish the harmful from the harmless alien species and identify the impacts of the former on native biodiversity. For the purpose of this report, only species introduced into Saint Lucia after colonization by Europeans (after *ca* 1500), will be regarded “alien”.

A species introduction is usually vectored by human activity, such as the “four Ts”. If a species’ new habitat is similar enough to its native range, it may survive and reproduce. However, it must first subsist at low densities, when it may be difficult to find mates to reproduce. For a species to become invasive, it must successfully out-compete native organisms, spread through its new environment, increase in population density and harm ecosystems in its introduced range. Ecosystems that have been invaded by an alien species may not have the natural predators and competitors present in its native environment that would normally control population levels. To summarize, for an alien species to become invasive, it must arrive, survive and thrive.

Native ecosystems that have undergone human-induced disturbance are often more prone to alien invasions because there is less competition from native species. For example, imported red fire ants (*Solenopsis invicta*) are more successful in establishing themselves in disturbed areas such as roadsides and agricultural fields and rarely colonize intact closed forests.

IAS occur in all taxonomic groups, including animals, plants, fungi and microorganisms, and can affect all types of ecosystems. Common characteristics of IAS include rapid reproduction and growth, high dispersal ability, phenotypic plasticity (ability to adapt physiologically to new conditions), and ability to survive on various food types and in a wide range of environmental conditions. A good predictor of invasiveness is whether a species has successfully or unsuccessfully invaded elsewhere. St. Lucia, to date, has been relatively unaffected by numerous plants that proved invasive elsewhere.” [CSA, Krauss 2010]

This report sets out to achieve the following:

Scope: This report recognizes that typically IAS become established problems at the national level primarily due to:

- lack of public, political and media awareness of environmental impacts of invasive alien specie

- fragmented or outdated legislation that does not cover the full range of agricultural, environment, marine and public health concerns and
- lack of a strategic approach including poor coordination between key departments and agencies.

Therefore the report sets out a review the presence of terrestrial IAS in St. Lucia, as well as the potential of new species to arrive and threaten terrestrial biodiversity in the country. Identify the various agencies, Government, non-Government, Community-based, donor and volunteer that are either mandated or permitted to contribute to the monitoring of IAS and their impacts. Review national and regional policies, legislative, regulatory and institutional frameworks that facilitate management and control of IAS. Through a detailed needs analysis, identify shortfalls, inadequacies, inconsistencies and weaknesses in the management framework.

Goal: Assess the capacity of St. Lucia to manage invasive alien species in terrestrial ecosystems.

Objectives: Identify legislative, informational and institutional gaps, inadequacies and conflicts that serve as barriers to effective control of IAS in St. Lucia. Assessment will be conducted under the following four strategic interventions

1. Prevention
2. Early Detection
3. Eradication and mitigation of impact
4. Confinement and control

Terrestrial Invasive Alien Species

Invasive Alien Species have been recognized by the Convention on Biological Diversity (CBD) as one of the most significant threats to the environment which is largely driven by human actions. Globalised economic activity and national development priorities have led to increased levels of transportation of people and trade in resources being moved from one location to another. Through this process, Invasive Alien Species (IAS) have been either deliberately or inadvertently introduced to a range of environments. The transportation and introduction of such exotic animals, plants and microorganisms to non native environments has been responsible for significant destructive impact on native species, habitats and ecosystems. The impact of such IAS has led to significant losses in biodiversity and economic activity globally. It is estimated that world wide losses tally approximately US\$ 1.4 trillion annually¹. CBD notes that “invasive alien species have affected biodiversity in almost every type of ecosystem on Earth. As one of the greatest drivers of biodiversity loss, they pose a threat to ecosystem integrity and function and therefore to human well-being.¹” The Caribbean is recognized as one of the World’s biodiversity hotspots with its exceptionally high levels of endemism in plants, mammals, reptiles, amphibians, freshwater fishes and much of the region’s invertebrate fauna is yet to be identified by science. Saint Lucia, likewise has rich levels of endemism in its diverse fauna and flora which has been impacted on by IAS introductions (Table 1).

¹ Secretariat of the Convention on Biological Diversity (2009). Invasive Alien Species: a threat to biodiversity. International Day for biological diversity.

While IAS impacts have been significant in aquatic and terrestrial environs, this report focuses on the impacts of IAS on terrestrial ecosystems and Saint Lucia’s enabling policies, regulations and structures for IAS management. It also identifies areas that are still inadequate for control and management of IAS. Saint Lucia is rich in its tropical biodiversity however it has not been exempted from IAS introductions nor some of their negative impacts as illustrated in following. Such faunal introductions range from the era of the Amerindians who brought dogs, agoutis (*Dasyprocta leporina*) and the Southern Opossum (*Didelphis marsupialis*) to era of European colonization which saw unintentional introduction of the ship rat or house rat (*Rattus rattus*), the Norway rat (*Rattus norvegicus*) and the house mouse (*Mus musculus*). There were some noteworthy deliberate introductions which are implicated for significant biodiversity losses particularly among native birds, reptiles and amphibians. Examples include the cane toad (*Bufo marinus*) and the small Asian mongoose (*Herpestes javanicus*).

Some IAS introductions are plants that were introduced as species of horticultural interest (e.g., Heliconia (*Heliconia wagneriana*) or for potential agricultural economic activity (Lemon grass, (*Cymbopogon citrates*) and Leuceana (*Leuceana leucocephala*). Some of the identified floral IAS pose a potential threat to native habitats however they have had a more demonstrable impact on disturbed habitats.

Some IAS are invertebrates which have had far reaching impacts on public health (e.g. Tiger mosquito (*Aedes aegypti*)) with the spread of dengue fever or on economic activity particularly in the agriculture sector (e.g. Coconut mite, (*Aceria guerreronis*), African giant snail (*Achatina fulica*).

Table 1: Number of native and alien species recorded in St. Lucia according to Daltry (2009a) and Morton (2009).

Taxonomic group	Indigenous		Exotic
	Total	Of which are endemic	
Mammals	10	1 (extinct)	7
Birds	132	5	2
Reptiles	13	7	6
Amphibian	2	1	3
Beetles	> 777	Ca. 144	> 39
Other insects	> 1000		> 160
Higher plants	945	9	289

Ferns and mosses	137		
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Table 2. Main Threats to Forest Animals and Plantsⁱⁱ

Threat/ Species Type	Over- exploitation/ deliberate killing	Alien invasive species	Habitat loss/ degradation	Pollution chemicals) (agro- chemicals)
Trees	xx	xx	xxx	?
Other Plants	x	xx	xxx	?
Invertebrates	x	xxx	xx	xx
Reptiles	x	xxx	xxx	x
Amphibians	-	xx	-	x
Birds	x	xxx	xxx	x
Mammals	x	xx	xx	x

X - indicates level of severity of threat; increasing with increasing number

Table 3: Invasive Alien Species present in Saint Lucia and their current status (*Adapted from CSA, 2010*)

Common name	Scientific name	Status
<i>Terrestrial</i>		
<i>Vertebrates</i>		
Orange winged parrot	<i>Amazona amazonica</i>	Recent escape from captivity? Potentially competing with endemic parrot
Alien anole lizard	<i>Anolis wattsi wattsi</i>	Displacing the native <i>Anolis luciae</i> from urban,

Common name	Scientific name	Status
		<i>suburban and some disturbed secondary forest sites</i>
Alien anole lizard	<i>Anolis extremis</i>	Displacing the native <i>Anolis luciae</i> from urban, suburban and some disturbed secondary forest sites
Cane toad	<i>Bufo marinus</i>	Widespread; severely impacting biodiversity; “World’s Worst 100 IAS”
Feral dogs	<i>Canis lupus familiaris</i>	Widespread; severely impacting biodiversity
Feral goats	<i>Capra aegagrus hircus</i>	Invasive on Dennery island; impacts on vegetation and animal habitat
Rock pigeon	<i>Columba livia</i>	Widespread; severely impacting biodiversity
Opossum	<i>Didelphis marsupialis</i>	Widespread; severely impacting biodiversity
Whistling frog	<i>Eleutherodactylus martinicensis</i>	May have displaced native <i>Eleutherodactylus johnstonei</i>
Feral cats	<i>Felis catus</i>	Widespread; severely impacting biodiversity; one of “World’s Worst 100 IAS”
Indian mongoose	<i>Herpestes javanicus</i>	Widespread; severely impacting biodiversity, one of “World’s Worst 100 IAS”
Alien iguana	<i>Iguana iguana</i>	Localized, expanding in Soufriere area; threat to endemic iguana if two populations meet
Mouse	<i>Mus musculus</i>	
Feral sheep	<i>Ovis aries</i>	Invasive on Dennery island; impacts on vegetation and animal habitat
Rat	<i>Rattus norvegicus, Rattus rattus</i>	Widespread; severely impacting biodiversity, but one of “World’s Worst 100 IAS”
Red-snouted tree frog	<i>Scinax ruber</i>	Invasive
Eurasian collared-dove	<i>Streptopelia decaocto</i>	Escaped from captivity
Feral pigs	<i>Sus scrofa</i>	Widespread and invasive in forest; threatening some rare bird and the endemic fer-de-lance; control effort hampered by constant re-supply

Common name	Scientific name	Status
		through escapes; one of “World’s Worst 100 IAS”
Monkeys	Unknown species	Localized in Desrameaux, Monchy
<i>Invertebrates</i>		
Coconut mite	<i>Aceria guerreronis</i>	Present
Giant African snail	<i>Achatina fulica</i>	Invasive; impacting native molluscs and forage plants
Tiger mosquito	<i>Aedes aegypti</i>	Widespread with on-going severe impact; control attempts by cultural and chemical means
Citrus Blackfly	<i>Aleurocanthus woglumi</i>	Environmental importance of citrus pests??**
Sweet potato whitefly	<i>Bemisia tabaci</i>	IAS of environmental importance or agricultural pests only?
White cedar thrips	<i>Holopothrips iniquilnus</i>	Present
[terrestrial snail]	<i>Huttonella bicolour</i>	Introduced, of peninsular Malaysian origin; impact on Saint Lucia poorly documented
Florida leatherleaf	<i>Leidyula floridana</i>	Introduced slug; impact on Saint Lucia poorly documented
Pink Hibiscus mealybug	<i>Macronellicoccus hirsutus</i>	Invasive, successfully controlled by classical biocontrol
African dung beetle	<i>Ontophagus gazellae</i>	Invasive; threatening endemic dung beetle species
Papaya mealybug	<i>Paracoccus marginatus</i>	Invasive
Citrus leaf miner	<i>Phyllocnistis citrella stainton</i>	IAS of environmental importance or citrus pests only?
Red palm mite	<i>Raoiella indica</i>	Invasive
Mango seed weevil	<i>Sternochetus mangiferae</i>	IAS of environmental importance or mango pests only?
[terrestrial snail]	<i>Streptostele musaecola</i>	Introduced molluscivore; impact on Saint Lucia poorly documented
Brown Citrus Aphid	<i>Toxoptera citricida</i>	Environmental importance or citrus pests only?
Varroa mite	<i>Varroa destructor</i>	Present; invasive
Pancake slug	<i>Veronicella sloanei</i>	Native to Jamaica; introduced in Eastern Caribbean; pest status

Common name	Scientific name	Status
<i>Plants</i>		
Red sandalwood tree; Dalmawi	<i>Adenanthera pavonina</i>	Exotic, but not naturalized; Invasive; Present
Woman's tongue	<i>Albizia lebbek</i>	Present; reported invasive in Caribbean
Giant cane	<i>Arundo donax</i>	Probably extirpated in St. Lucia; belongs to GISD "World's Worst 100 IAS"
Neem	<i>Azadirachta indica</i>	Escaped from cultivation, Asian origin; Risk in disturbed and burnt habitats
Desert date	<i>Balanites aegyptica</i>	Present; reported invasive in Caribbean; of African origin Not listed as present
Basket plant	<i>Callisia fragrans</i>	Recent arrival? Escapes from cultivation, thrives in deciduous seasonal forest; serious potential threat on Pitons
Ylang-ylang	<i>Cananga odorata</i>	Common on Piton Springs –Pacience road; potential threat in lower montane rainforest and riparian systems
Casuarine	<i>Casuarina equisetifolia</i>	Reported invasive but still localized where planted in St. Lucia
Jack in the bush; Fléwi Nwèl	<i>Chromolaena odorata</i>	Present; listed as invasive in Caribbean; Listed as indigenous
Ivy gourd	<i>Coccinia grandis</i>	Invasive of African and Asian origin; Covering indigenous vegetation in mesic areas of Babonneau; risk in disturbed and burnt habitats
Glue; Sip	<i>Cordia oblique</i>	Invasive of Indian origin; Tree of secondary coastal woodlands, savannas and seasonal swamps. Very common in Vieux Fort Beach area; risk in disturbed and burnt habitats
Spiked spiralflag ginger	<i>Costus spicatus</i>	Present; potential threat in lower montane rainforest

Common name	Scientific name	Status
Rubber vine; Lèt makak, Zong makak	<i>Cryptostegia madagascariensis</i>	Invasive from Madagascar; Common in Laborie, Micoud and Vieux Fort; Risk in disturbed and burnt habitats; Potential threat to xeric savanna
Lemongrass; Sitonnèl	<i>Cymbopogon citrates</i>	Naturalized of Old World origin; quite rare, but presenting a fire & IAS hazard in critical areas, e.g. Pigeon Island;
Lavender; Lavann	<i>Hedychium coronarium</i>	Invasive of Asian origin; Common; Preference for very wet semi-open spots, especially roadsides and forest rivers; possibly replacing indigenous and very rare orchid <i>Habenaria monorrhiza</i>
Heliconia	<i>Heliconia wagneriana</i>	Planted along forest edge from where it could invade disturbed, burnt habitats and lower montane rainforest
Busy-lizzie	<i>Impatiens balsamina</i>	Present; potential threat in lower montane rainforest
Busy-lizzie	<i>Impatiens walleriana</i>	Present; potential threat in lower montane rainforest
Stalkleaf muraïnagrass	<i>Ischaemum timorense</i>	Naturalized of Asian origin, common in open and semi-open wet areas at lower and middle elevations; Appears to be invasive in Choiseul ravines
Leucaena	<i>Leucaena leucocephala</i>	Exotic, but not naturalized in St. Lucia; Invasive; Planted for charcoal production to protect mangrove
Swordfern	<i>Macrothelypteris torresiana</i>	Naturalized from Africa, Asia and/or Pacific; Probably becoming more common; Terrestrial fern of dark shady roadsides and ravines
Mazapan	<i>Malvaviscus penduliflorus</i>	Present; potential threat in lower montane rainforest
Paper bark tree	<i>Melaleuca quinquenervia</i>	Exotic, but not invasive;

Common name	Scientific name	Status
		Not listed as present: Invasive
Catclaw mimosa	<i>Mimosa pigra</i>	Naturalized; of African origin; Spreading fast; Assumed to be recent arrival; Risk in disturbed and burnt habitats; one of “World’s Worst 100 IAS”
Asian sword fern	<i>Nephrolepis brownii</i>	Invasive of African and Asia origin; Replacing indigenous <i>Nephrolepis rivularis</i> ; Risk in disturbed and burnt habitats
Patchouli	<i>Pogostemon cablin</i>	Present; potential threat in lower montane rainforest
MacArthur palm	<i>Ptychosperma macarthurii</i>	Present in disturbed forest: Union, Morne Fortune; potential threat to semi-evergreen seasonal forest
Royal palm; Palms	<i>Roystonea oleracea</i>	Present where planted; potential threat to semi-evergreen seasonal forest and riparian systems
Mother-in-law’s tongue; Lanng bèlmè	<i>Sansevieria hyacinthoides</i>	Present; potential threat to dry woodland on Pitons
Mother-in-law’s tongue; Lanng bèlmè	<i>Sansevieria trifasciata</i>	Present; potential threat to dry woodland on Pitons
Saltmeadow cordgrass	<i>Spartina patens</i>	Present; potential threat to sandy beach edge
African tulip tree	<i>Spathodea campanulata</i>	Spreading along Union River and elsewhere; potential threat to semi-evergreen seasonal forest; one of “Worlds Worst 100 IAS”
Phillippine Orchid	<i>Spathoglottis plicata</i>	Invasive of Asian origin; Very common and moving into forest
Arrowhead vine	<i>Syngonium podophyllum</i>	Vine still uncommon, present in Millet and Roseau; risk in disturbed and burnt habitats
Maiden fern	<i>Thelypteris extensa</i>	Naturalized from SE. Asia and Indonesia; Quite rare but becoming commoner; Terrestrial on moist, shady roadsides

Common name	Scientific name	Status
Moses-in-the-cradle	<i>Tradescantia spathacea</i>	Escaped ornamental, naturalized? Present in dry rocky hills in the north, a real danger for the Pitons
Wandering jew	<i>Tradescantia zebrina</i>	Invasive of African origin; Escaped ornamental; Very common around Gros Piton trail; very rare elsewhere
<i>Microbes and Viruses</i>		
Citrus Tristeza	Citrus Tristeza Claustrovirus	
Dengue fever virus	<i>DENV</i>	Virus fluctuates seasonally
Witches' broom of cocoa	<i>Moniliophthora (=Crinipellis) perniciosa</i>	Early phase of establishment
Black Sigatoka	<i>Mycosphaerella fijiensis</i>	Early phase of establishment
<i>Freshwater</i>		
<i>Animals</i>		
Marsh snail	<i>Biomphalaria glabrata</i>	Present; host/vector of <i>Schistosoma mansoni</i> ; eradication failed, impact control by focussed molluscicide treatment following survey
Giant river prawn	<i>Macrobrachium rosenbergii</i>	Probably naturalized; introduced for aquaculture form Taiwan; invasiveness unclear
Obscure swamp eel	<i>Ophisternon aenigmaticum</i>	Naturalized; native to North America; invasiveness unclear
Mozambique tilapia	<i>Oreochromis mossambicus</i>	Invasive in fresh and brackish water; introduced for aquaculture in 1970s
Nile tilapia	<i>Oreochromis niloticus</i>	Probably naturalized with ecological impact; introduced for aquaculture in 1970s
Schistosoma parasite	<i>Schistosoma mansoni</i>	Present; eradication failed, impact control by focussed molluscicide treatment following survey
Red-eared slider	<i>Trachemys scripta elegans</i>	Escaped/released from captivity; May impact native terrapins as well as common prey
<i>Plants</i>		
Calathea	<i>Calathea lutea</i>	Large stands at Bexon River; potential threat to riparian habitat
Spiral ginger	<i>Costus scaber</i>	Present, potential threat to riparian habitats

Common name	Scientific name	Status
Umbrella sedge	<i>Cyperus difformis</i>	Invasive of Asian origin; Detected in Cul de Sac swamp in March 2010
Water hyacinth	<i>Eichhornia crassipes</i>	Naturalized; one of “World’s Worst 100 IAS”; popular ornamental clogs drainage canals
Malaysian trumpet snail	<i>Melanoides tuberculata</i>	Apparently introduced to control <i>Biomphalaria glabrata</i> ; also impacting non-target species
Woodrose	<i>Merremia tuberosa</i>	Expanding into Union River; huge vines; potential threat to riparian systems
Golden Flamboyant	<i>Peltophorum pterocarpum</i>	Few specimen in swampy spots and mangroves; potential threat to swamp forest
Java plum	<i>Syzygium cumini</i>	Common on Piaye River; potential threat to riparian systems

Terrestrial Ecosystems in Saint Lucia

Much of St. Lucia's biodiversity-related reports are available on http://www.slubiodiv.org/biodiversity_papers.php and <http://www.bananatrustslu.com/index.php?link=doccentre&project=sfa2003> and shall not be reviewed here in detail.

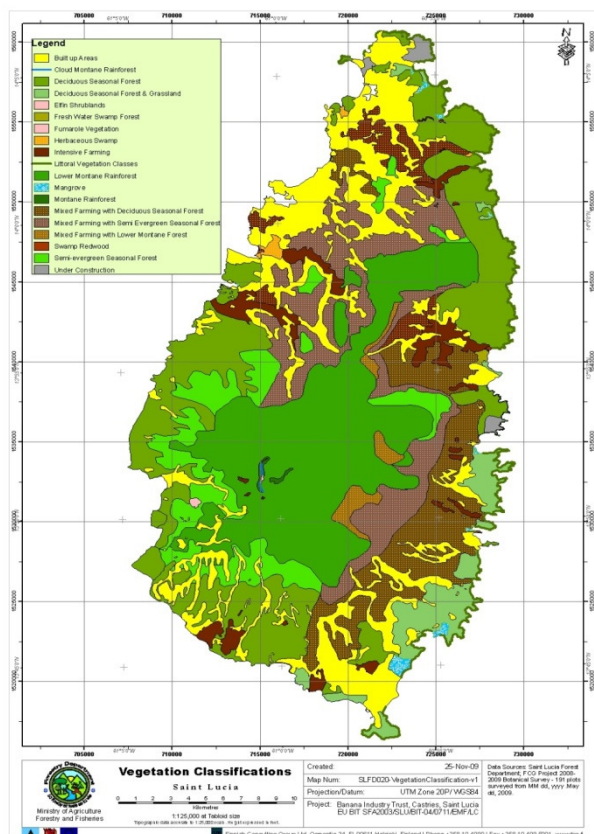


Figure 1. Forest & Vegetation Classifications of Saint Lucia.

Forest Resources

Island area: 61,500 ha.; forest cover 48,133.53 ha (Table 1, GOSL 2009). The forest reserve consists of 9186 ha. total, of which 8,933 ha. is composed of the natural forest and 263 ha. under plantation. There is a 4,500 ha. parrot sanctuary within the Government Forest Reserve. Forested private lands (14170 ha.), represents 10% of total private land (GOSL 1993).

Table 4. Vegetation Classifications; Saint Lucia Forestry Department; FCG Project 2008-2009 Botanical Survey; EU BIT SFA2003/SLU/BIT-04/07/11/EMF/LC

Vegetation Classes	Acres	Hectares
Deciduous Seasonal Forests	29308.60	11860.77
Deciduous Seasonal Forests & Grasslands	6243.38	2526.60
Elfin Shrublands	21.57	8.73
Fumarole Vegetation	72.10	29.18
Herbaceous Swamp	365.74	148.01
Mixed Farming Deciduous Seasonal Forest	17410.46	7045.76
Mixed Farming with Lower Montane Forest	1740.96	704.54
Mixed Farming with Semi Evergreen Seasonal Forest	17756.84	7185.94
Elfin Shrublands	21.57	8.73

Fresh water swamp Forest	131.13	53.07
Lower Montane Rainforest	33048.29	13374.17
Mangrove	545.79	220.87
Montane Rainforest	208.66	84.44
Semi Evergreen Seasonal Forest	12033.58	4869.82
Swamp Redwood	31.89	12.90
	118940.55	48133.53

Natural Vegetation types:

Saint Lucia's rugged terrain has led to a variety of vegetative types. Such vegetative types or zones have been described in the past, most notably by Beard (1949). In a recently completed botanical survey, R. Graveson described the principal vegetative types and the dominant species are as follows: (2009, FCG Project 2008-2009 Botanical Survey; EU BIT SFA2003/SLU/BIT-04/07/11/EMF/LC).

Littoral Rock and Cliff Vegetation

Mainly herbaceous, often succulent, low vegetation found on coastal cliffs and the flatter rocky areas behind them.

Littoral Evergreen Forest and Shrubland

Behind sandy beaches, rocky cliffs and pavements, an evergreen forest or shrubland is found, especially on the Atlantic coast.

The harsh conditions caused by wind, salt-spray, often a thin soil and a water deficit even during most of the wet season, favour an evergreen arborescent flora with thick leathery leaves. *Coccoloba uvifera* (wézen, siwiz, sea grape) is commonly present.

Mangrove

Mangrove is an evergreen forest of brackish water. This well-known vegetation class contains only a few widely distributed, salt-tolerant species. In Saint Lucia, Mangroves contain four tree species and are mainly on the Atlantic coast. Dominant species occurring are *Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa* and *Conocarpus erecta*. Several areas have been destroyed over the years (Beard 1949, Portecorp J. and Benito Espinal 1985).

Freshwater Swamp Forest

Freshwater Swamp Forest occurs in flat areas close to sea-level, with a permanent or seasonal freshwater flow and no inflow of salt water. Trees are evergreen and there is a tendency for monotypic (single-species) stands to form. This class varies from the permanently muddy swamp redwood forest beside permanent rivers, to forest behind beaches that rely on seasonal creeks to maintain the water table.

Deciduous Seasonal Forest:

Taller trees tend to lose all their leaves in most dry seasons, but smaller trees and shrubs are evergreen. Notably, there is no moss or cover of ground ferns. Vines and herbaceous ground cover are present, especially in disturbed areas. This forest class reaches 700m on Petit Piton.

Grassland

This vegetation class consists of open areas covered mostly by grasses or sedges, but other herbs and low shrubs are also present. Individual trees or small clumps of trees and taller shrubs may be present. This class is most common near areas of Deciduous Seasonal Forest, usually a result of extreme disturbance to that forest class.

Semi-evergreen Seasonal Forest

This forest type occupies the zone between Deciduous Seasonal Forest and Lower Montane Rainforest. It is characterized by upper canopy trees with rather thin, often broad, and quite often compound leaves, which may lose some, but not all, of their leaves during a dry spell. There are no, or very few, epiphytes, ground ferns and mosses. Elevation ranges from almost sea-level in ravines to the summit of Gros Piton. This zone is most frequently converted for development. Primarily secondary woodland consisting of regenerating forest interspersed with cultivation. White cedar (*Tabebuia pallida*) is a dominant species.

Lower montane rain forest:

This forest type consists of evergreen trees. Trees of all heights are found, without clear divisions into separate canopy layers. There is a great abundance of vines, epiphytes, ferns and mosses. Trees are tightly packed, and can be wide in girth. This class has been recorded from 100-680m above sea level.

Montane Rainforest

This vegetation type occurs on the western side and sheltered eastern slopes of the Mount Gimie Range, including Piton Troumassée, above 650m. Slopes are extremely steep, rainfall is very heavy, there is little wind and landslides are very common. The steepest areas are covered with tree ferns and palms, with canopy height of about 4-6m, with some scattered taller trees on slightly less steep areas.

Cloud montane rainforest:

This rainforest type occurs on high summits, at 700m or higher (but not in the most windy spots) The canopy is about 8m high with occasional much taller trees of *Freziera undulata*. Terrestrial ferns, anthuriums, bromeliads, and epiphytes are very common; moss cover is often several cm thick. Cloud and mist cover, with heavy rainfall, predominate.

Elfin Shrubland

In the windiest spots on the Mount Gimie/ Troumassée ridges and peaks, above 700 metres, a shrubland vegetation class dominates. The canopy is up to 2m tall, but often less, with an occasional slightly taller *Prestoea acuminata* palms. Cloud and mist cover, with heavy rainfall, predominate.

IAS Pathways and Vectors

Invasive Alien Species have entered countries including Saint Lucia through a variety of pathways and a National Invasive Species Strategy should recognize such routes and address them. It is recognized that factors of globalization including increased trade, travel, transportation have played a key part in increasing the likelihood of the movement of exotic species from one region to another and therefore the

likelihood that may become IAS. The CBD notes that both “pathways” and “vectors” are important links to the arrival of IAS which should be realized for successful interception. The “pathway” is any means that allows entry or the spread of a pest. The “vector” is any living or non living carrier that transports living organisms intentionally or unintentionally². It also notes that most vectors are often human-assisted transport mechanisms that move organisms across natural barriers (e.g. mountain ranges, oceans).

Pathways of concern to terrestrial ecosystems include:

1. Domestic and exotic animal release or escape; There has been a historical affinity for humans to own domesticated animals or exotic wild pets. Domesticated livestock animals were historically commonly traded and introduced to various regions globally as livestock to meet the demands for meat production or dairy (e.g. cattle, goats, sheep, pigs, chickens). Some of these species have become feral and invasive leading to damaging consequences on native fauna and ecosystems (e.g. pigs and goats).

There has also been the tendency for pet owners to release pets (domesticated or exotic) into general community or wilderness if they no longer wish to be responsible for them. There is also the reality of some exotic pets escaping into the wild and sometimes establishing viable populations. A variety of exotic birds, reptiles, mammals and amphibians are deliberately released or have escaped into forests, rivers, seas with unforeseen consequences for native fauna and flora.

2. Hitchhikers; A variety of organisms hitchhike in or on machinery equipment, wooden pallets, unprocessed timber, shipping containers or even animals as they are flown or shipped from one place to another. Species have also entered airplane cabins, cargo holds, packing materials and airplane parts. Plants and or associated pathogens have arrived inadvertently as seeds or seedlings transported on soiled machinery.
3. Plants introductions : Historically plants have been moved from one place to another to meet a range of human needs (e.g. timber, horticulture, fuel, food, forage, fibre). Some of these species have escaped into the non native environs and become IAS.
4. Biological control: biological control is a pest control strategy which makes use of living natural enemies, antagonists or competitors and other self –replicating biotic entities. Exotic species are often used to control pest species and as such they can become invasive alien species themselves. Because of the associated risk involved, biological control requires adequate legislation and regulations and a risk analysis needs to be conducted before approval of such a strategy for pest management.
5. Tourists and luggage: The tourism industry has enjoyed unprecedented growth with the ease of modern travel. It is the major economic sector in Saint Lucia followed only by agriculture in

² Secretariat of the Convention on Biological Diversity (2009). Invasive Alien Species: a threat to biodiversity. International Day for biological diversity.

revenue generation. However, it has been noted that many travelers bring home plant materials or live animals from their travels. Some of the plant materials may have soil contaminated with invasive organisms which may be devastating to native ecosystems or the agriculture sector. Thus it is important to have an efficient and effective quarantine service with adequate public awareness programmes to inform the public and travelers.

Why are Terrestrial IAS introductions of concern to St. Lucia?

Invasive alien species are of particular concern to Saint Lucia due to the risk posed by the potential ability of some species to arrive, survive and thrive in our small tropical island context causing negative impacts to the island's biodiversity and /or socio-economic circumstances.

Biodiversity impacts

Due to its relative distance from continental regions of North and South America, its small size and marine isolation in the archipelago of the Caribbean, most species would not have survived such natural barriers to arrive on the island. As such, the species in their associated ecosystems which have done so, have adapted to a particular environment that has not been particularly prone to major competition or depredation. Largely because of this relative isolation, islands have been particularly vulnerable to the impacts of IAS and several extinctions have been noted where IAS have been implicated.

An example is the deliberate introduction of the small Asian mongoose to a number of Caribbean islands which has had notable impact on native fauna. This species is regarded as one of the worst invasive species and its impact has been recorded across the Caribbean region. In Saint Lucia, the Forestry Department in partnership with Durrell Wildlife Conservation Trust (DWCT) in 2005 conducted trapping exercises of the mongoose to reduce depredation pressure on the Saint Lucia Iguanaⁱⁱⁱ. In Jamaica it has impacted on terrestrial crabs, insects, amphibians, snakes, lizards, ground nesting birds ; in Puerto Rico (arthropods, amphibians, reptiles and mammals) and US Virgin islands (iguanas, Ameiva ground lizards, Alsophis snakes, marine turtle eggs, and birds; in the Lesser Antilles, its impacted on the mountain chicken (*Leptodactylus fallax*).^{iv}

It is believed that the absence of some of the endemic reptiles from the main land of Saint Lucia is due to the introduction of the mongoose. The fact that Saint Lucia racer (*Liophis ornatus*) and the Saint Lucia whiptail (*Cnemidophorus vanzoi*) only occurred naturally on the islets of the Maria Islands strongly suggests that they may have been wiped out on the mainland by the mongoose.

Rats were introduced to the island during the period of colonization and have expanded throughout the range of habitats on the island to at least 550 m elevation. Both the Norway rat (*Rattus norvegicus*) and the Roof rat (*R. rattus*) are notorious globally for the devastating impact on native fauna and flora, particularly on islands. However, the presence of the Saint Lucia racer (*Liophis ornatus*) and the Saint Lucia whiptail on the Maria Islands in the absence of rats is another indicator of the value of sustaining IAS from such reserves. The Forestry Department in association with partner organization , DWCT in its

efforts to conserve such endangered wildlife have conducted rat eradication exercises on islands such as Praslin and Rat Island to facilitate whiptail translocation efforts.

Feral pigs are currently widespread within the protected forest reserve and adjacent unprotected rainforests and farming areas across the island. Feral pigs are regarded as one of the most important pests of our generation. They have substantial deleterious impacts on a range of important environmental, economic, human health and social values. Frequently cited environmental impacts include: predation of native plant and animal species; disruption of trophic webs; weed and pathogen transmission, and erosion and water quality deterioration. Economic impacts are largely incurred by primary producers and include damage to produce and infrastructure, lost production potential, and the cost of control. The successful introduction of a serious exotic veterinary disease, such as foot and mouth disease, to the local pig population would be an economic catastrophe given our already low production potential. Feral pigs may also serve as amplifiers and vectors for important human diseases such as Japanese encephalitis and leptospirosis^v.

Agriculture

Invasive alien species can also result in disruption of socio-economic activity, particularly where exotic pathogens are introduced. Such microbes can impact on the island's economic activity in the agriculture sector (e.g. Black sigatoka (*Mycosphaerella fijiensis*). This leaf spot disease of banana plants is reported to reduce fruit production by as much as 50 percent. The agricultural sector has also been hit by a number of invertebrate invasive alien species which required mobilizing substantial resources in curbing their impacts on agricultural production (e.g. Pink hibiscus mealybug , coconut mite).

Tourism

A number of IAS have had impacts on general public health and the notably volatile tourism industry (e.g. Avian and swine influenza). In 2007, there were 903 million international tourist arrivals globally³. On average, Saint Lucia receives approximately 250,000 visitors per year in tourist stayover and about 400,000 visitors in the cruise ship sector^{vi}. Through this volume of visitors lies a means for IAS to arrive intentionally or inadvertently and the increased likelihood of survival and spread of such species.

Public Health

The public health sector is also vulnerable to IAS and related pathogens. The Tiger mosquito (*Aedes aegypti*) continues to be widespread vector in Saint Lucia and the wider Caribbean for the dengue fever since its appearance in the 1950's. An outbreak in 2001 recorded 295 cases^{vii} and 149 cases in 2007^{viii}. There is a growing concern about a high possibility for increased dengue transmission in the future under projected changing climatic conditions in the region.

Schistosomiasis, also known as bilharzias, is a disease associated with the freshwater fluke parasite (*Schistosoma spp.*) which are closely associated with freshwater snails (which serves as vectors for the parasite) that has had an extensive history in Saint Lucia. This disease is considered the second most

³ Secretariat of the Convention on Biological Diversity (2009). Invasive Alien Species: a threat to biodiversity. International Day for biological diversity.

socioeconomically devastating parasitic disease after malaria for its impact in the developing world. A major campaign was conducted in Saint Lucia against this disease in the 1950's and 1960's with substantial progress, however, Saint Lucia reported 13 cases in 2003.

Assessment of Saint Lucia's Capacity to Manage IAS- National Policy Context

“The main threats to biodiversity and the ecosystems are invasive species where feral pigs, species from the pet trade that have found themselves in the wild and pests and diseases of external origin are impacting the biodiversity sector.” (4th National Biodiversity Report)

The passage of the Wildlife Protection Act (1980) which replaced the Wild Bird Ordinance of 1885 is recognized as the last major policy activity to significantly address wildlife management in Saint Lucia. This Act was particularly timely in its passage after the island's wildlife resources suffered the ravaging effects of Hurricane Allan. However it is woefully outmoded and needs to reflect current conservation management concerns and modalities that are of importance at national, regional and international levels including the issue of Invasive Alien Species (e.g. Convention on Biological Diversity, Convention on International Trade in Endangered Species of Fauna and Flora). In 2009, efforts were undertaken to revamp the legislation and drafts have been submitted to the Attorney General's Chambers for consideration.

The Forestry Department has the mandate for conserving Saint Lucia's wildlife resources and its work has been driven by interaction and consultation with the public. In 1999, the Department commenced a series of activities with the objective of developing a national wildlife policy on the management of terrestrial wildlife resources to guide the development of a wildlife management plan. This policy initiative was regarded as particularly timely due to the need to balance national development objectives with the maintenance of the natural resource base which is crucial to achieving sustainable development. This National Wildlife Policy initiative identified Invasive Alien Species (IAS) as critical but also noted the following;

- **Stakeholder participation:** To date consultations have largely involved traditional partners and stakeholders. There remains a need to identify and involve the non-traditional actors in the process. This should include wildlife conservation models involving the private sector
- **Factor in current environmental policies and mobilizing political will:** Need to identify other policies outside of the forestry policy framework, which have direct impact on the forestry sector (e.g. trade policy, agriculture policy, national land policy, climate change policy). There is a need to identify strategies to mobilize political will.
- **Incentives:** The policy should also include a mix of incentives in the form of taxation, subsidies for persons that own land with critical habitat areas or farm or live near government forest areas).
- **Wildlife disease management:** Establish protocols regarding potential exotic pandemic diseases spread by wildlife (e.g. West Nile virus, Avian Influenza).
- **Invasive Alien Species:** Establish protocols concerning potential IAS wildlife management issues.

Legislative and institutional gaps:

Legislation

Wildlife Protection Act (9/1980): This Act provides for the protection, conservation and management of wildlife in St. Lucia. All wildlife, whether resident or migratory, indigenous or alien, except fish, frogs or crustaceans in private ponds, are property of the State and may only be hunted as provided for under the Act. Certain species are designated as “protected wildlife”, “partially protected wildlife” or “unprotected wildlife”. The Act provides for the declaration of closed seasons to protect species of wildlife, and the Minister responsible for wildlife may declare any area of land or water or territorial sea to be a wildlife reserve. The Act provides for the appointment of Wildlife Protection Officers. The Minister under this Act may also grant licences for the hunting and taking of wildlife in a wildlife reserve, for the import or export of wildlife into or from St. Lucia, to keep wildlife in captivity etc. The Act establishes a variety of penalties for the hunting, taking or injuring any wildlife, for trapping or poisoning any wildlife, for the destruction of any nest, or for carrying any weapon into a wildlife reserve. The possession of any wildlife without a permit is also an offence.

The exotic pet trade has recently been on the increase in Saint Lucia and with it, the inherent risk of IAS introduction. Exotic birds such as psittacines (i.e. parrots, parakeets, and macaws), finches, and snakes are enjoying rising popularity. However, the Forestry Department has been cautious in allowing exotic wildlife into St. Lucia for the pet trade. This is due to a number of risks associated with the trade which includes disease, and ecological threat (through accidental release), predation on or out competing with native species and spread of disease to wild populations.

Forest Soil and Water Conservation Ordinance Cap 25 of 1946: This Act is intended to provide for the conservation of forests, soil and water resources. It provides for the appointment of a Chief Forest Officer and charges him with the responsibility to manage Crown lands and to generally administer the provisions of the Act. Under this Act a Forest officer may grant written permits for the removal of timber from a particular area. Any movement of timber without a written permit is an offence. The Act provides for the establishment of forest reserves on any Crown lands, and protected forests on private lands. The Act also deals with unlawful occupation of Crown Lands and the unlawful trespass of livestock onto any such land.

The Act does not cover the potential risk from introducing exotic species for timber or other forestry related purposes as potential IAS threats which require risk assessment. In fact, several species already introduced by the Department have been identified as being invasive by nature (e.g. *Casuarina equisetifolia*, *Leucaena leucocephala*)

St. Lucia National Trust Act (16 of 1975): This Act provides for the establishment of the St. Lucia National Trust which has responsibility to promote and preserve submarine and subterranean area of beauty or natural or historic interest to preserve the natural aspect, features, animals and plant life. The National Trust may acquire and manage land for the purposes of the Act. The National Trust has to

pursue a policy of preservation. Police officers or officers or servants of the Trust have powers of arrest against persons in breach or suspected to be in breach of the by-laws.

The Act does not make reference to Invasive Alien Species issues but refers to management of feral livestock on properties administered by the Trust.

Environmental Protection Levy Act (15 of 1992): This Act provides for the imposition and collection of an environmental protection levy on goods imported into St. Lucia, and is intended to cover the cost of eventual disposal of the product. Goods on which this levy is imposed include motor vehicles (3 years and under, over 3 years), tyres, motor cycles and bicycles, used refrigerators and freezers, goods made of plastic or glass etc. The money collected from this levy goes to the Consolidated Fund and is to be used to defray the cost of protecting the environment and for the preservation and enhancement of the environment. This legislation does not take IAS issues in to consideration.

<i>Policy /Legislation</i>	<i>IAS coverage</i>	<i>Gap</i>
Forest Bill [DRAFT 2009]	<p>It does refer to “cattle” or “livestock” which are therein defined as horses, mules, asses, goats, sheep and swine;</p> <p>It seeks:</p> <p>(a) the protection and conservation of native flora and fauna; and</p> <p>(b) the conservation of biological diversity and related habitats.</p> <p>Minister may by</p> <p>Regulations prohibit or regulate in any protected area -</p> <p>the pasturing of cattle; and (the pasturing or straying of livestock;</p> <p>the entry of any dogs, cats and other feral animals.</p>	<ul style="list-style-type: none"> • Does not make direct reference to IAS or definition of IAS beyond livestock or feral domesticated animals. • Does not factor in potential threat of introduction of IAS tree species or risk to designated forest reserves. • Legislation is limited to Forest Reserves and designated Protected Areas
Wildlife Protection Act	Refers to "alien wildlife" meaning any species of wildlife not indigenous to Saint Lucia;	Species considered as “indigenous” under Schedule 1 have been introduced in recent colonial past (e.g. Southern opossum (<i>Didelphis marsupialis</i>))

	<p>“wildlife” means any species of the following groups living beyond the control of man—</p> <p>(a) mammals;</p> <p>(b) birds and the eggs thereof;</p> <p>(c) frogs and the eggs thereof;</p> <p>(d) reptiles;</p> <p>(e) fishes, their fry and eggs; and</p> <p>(f) crustaceans;</p>	<p>Very restrictive definition of wildlife which omits all flora, invertebrates, fish. It also omits <i>eggs</i> of reptiles. Thus vulnerable to IAS introduction of such species.</p> <p>Legislation speaks strictly to frogs. It does not say Amphibians. If it did then introduced alien Cane toads (<i>Bufo marinus</i>) would be protected.</p>
	Separate classification of protected wildlife for Birds	Includes birds which are considered as IAS including “Dwarf Cowbird” (<i>Molothrus barbadensis</i>), Cattle Egret (<i>Bubulcus ibis</i>)
	Schedule 3 for Unprotected Wildlife includes some of the major IAS species particularly dangerous to island biodiversity	<p>Determines that Mice (<i>Musculus spp</i>)</p> <p>Rats (<i>Rattus –species</i>)</p> <p>Mongoose (<i>Herpestes auropunctatus</i>)</p> <p>This list excludes birds, invertebrates, amphibians and reptiles and feral species which are IAS</p>
		Does not adequately cover the wildlife pet trade which is a major source of IAS introduction
Forest Soil and Water Conservation Ordinance Cap 25 of 1946	<p>Governs management of Forest Reserves and declared protected Forests</p> <p>Addresses presence of feral livestock in reserves</p>	Does not directly address IAS introductions by plants or animals in Forest reserve or risk of introduction by adjacent properties
St. Lucia National Trust Act (16 of 1975);	Sec. 16. 1 (<i>m</i>) prohibiting any person without lawful authority from turning out any cattle, sheep or other animals and for authorizing any officer of the Trust to remove therefrom any cattle, sheep or other animal being thereon in contravention of the by-laws;	Does not directly address IAS introductions by plants or animals in Trust properties or risk of introduction by adjacent properties
Plant Protection Act (1988)		
Animal disease and importation Act (1956)		
National Conservation		

Authority Act (1999)		
Quarantine Act (1944)		

Institutional gaps

The sectors and agencies deemed most vulnerable to IAS introductions should be readily prepared to address IAS threats. However, most do not IAS mitigative response plans developed and protocols to respond to such threats. The recent release of an infected stock of lumber at one of the seaports illustrates the need for established protocols which are adhered to. The current system on seaports and airports relies on the availability of plant and animal quarantine inspections to occur which is taxed by limited human resources, facilities and equipment on sites. The elements of prevention, containment and control can be readily breached.

The weak links with other line agencies can cause compromises in addressing the threat of IAS introductions. Ministry of Physical Development, Environment and Housing and other associated referral line Ministries (e.g. MALFF) should review submitted development proposals for IAS potential issues and request that EIAs for such developments consider any potential risk of IAS introductions. Construction sites have had soiled equipment on site which has led to the introduction of exotic grasses on a location.

Certain areas deemed for development are within or are in close proximity to sensitive ecosystems or habitats of endangered species yet, no pet restriction orders or other suitable IAS management restrictions are considered in development plans.

Relevant Multilateral Environmental Agreements

St. Lucia has signed the following Multilateral Environmental Agreements (MEAs) relating to wildlife conservation and terrestrial biological diversity which in their associated principles or articles address IAS concerns:

- United Nations Convention on Biological Diversity (CBD);
- Protocol on Specially Protected Areas and Wildlife (SPAW) under the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention);
- The St. George's Declaration of Principles for Environmental Sustainability in the OECS.
- International Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES);
- Convention Concerning the Protection of the World Cultural and Natural Heritage;
- United Nations Framework Convention on Climate Change (UNFCCC)
- United Nations Convention to Combat Desertification (UNCCD)
- Ramsar Convention on Wetlands

Very few of these conventions are directly supported by national legislation, however, there are a range of supporting strategy documents (e.g. National Biodiversity Strategy and Action Plans (NBSAPs) and other plans and policy documents which are developed to govern national implementation of these MEAs. As

such, these plans should incorporate appropriate IAS management strategies as outlined by the related MEA.

UNCBD Guiding Principles for IAS Management

The following Guiding Principles for IAS management as set out by the UN Convention on Biological Diversity are applied to Saint Lucia's context for appropriate recommendations and strategic responses.

Guiding principle 1: Precautionary approach

The **precautionary approach** in principle 1 refers to the Rio Declaration and the preamble of the CBD, which lays down that "... where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat".

In Saint Lucia such an approach would entail measures such as:

- Public education campaign on IAS for policy makers as well as general public
- Promote awareness of biological, socio-cultural and economic values of national biodiversity
- Identification of potential or current IAS threats which threaten above values
- Development of an Early Detection and Rapid Response mechanism (EDRR)

Guiding principle 2: Three-stage hierarchical approach

A **three-stage hierarchical approach** to minimize the risk and spread of invasive alien species gives preference to the **prevention** of their introduction. In the event of an introduction, **early detection and rapid action** (e.g. eradication) are recommended. If this fails, the third stage is **containment and control**.

The Convention on Biological Diversity states that each Contracting Party under Article 8 (h) shall "as far as possible and as appropriate ...**Prevent** the introduction of , control or eradicate those alien species which threaten ecosystems, habitats or species".

In general, for effective **Prevention** the following strategies are proposed for terrestrial ecosystems:

- Regulate imports of non-native fauna and flora
- Develop and circulate information materials on IAS threats and mechanisms to mitigate impacts
- Establish regulations and identify agencies to implement laws pertaining to monitoring imports at air and sea ports.
- Treatment of all waste materials from international travelers to ensure destruction of possible infesting organisms, prior to disposal in public landfills.
- Increase information on IAS in public circulation in order to garner support from travelers and the general public.
- Conduct an in depth risk analysis on the introduction of exotic animals and plants
- Undertake a precautionary approach to the import of non-native species.

- Monitor the import and export of wild species of flora and fauna by requiring relevant trade permits, including CITES, Health, etc.
- Establish an emergency response plan for deliberate and or accidental introduction of IAS.

In circumstances where the IAS has already been introduced to the island, then the third stage of **containment and control** becomes relevant. As such CBD notes that **eradication** is generally more “environmentally sound and ethical than long-term control”. As such, eradication may involve “the sustained use of toxins, trapping or shooting”. Such measures are deemed to be particularly effective for containment at the onset of an IAS release into the environment. Control can involve increased environmental risks and more animal deaths than a short eradication campaign. However, conditions for success include:

- Proper planning
- Commitment to complete eradication
- Removing the target species faster than they reproduce
- Preventing re-invasion

Successful implementation of these measures requires close cooperation and coordination between all stakeholders including government agencies, NGOs, private sector and communities.

Guiding principle 3: The Ecosystem Approach^{ix}

Principle 2 of the ecosystem approach states that *Management should be decentralized to the lowest appropriate level.*

- This lowest appropriate level in the context of IAS management places an emphasis on participatory based management approaches involving local communities impacted on by IAS issues (e.g. alien iguana eradication in Soufriere). This approach should recognize the capacities of such community groups, sharing of information with them in the appropriate format and implementing good governance arrangements that facilitate consultation and transparency in decision making. The use of local knowledge and traditional practices should also be factored into the process.
- This approach also acknowledges the need for inter-sectoral cooperation to address IAS matters (e.g. partnerships with private sector and / or intergovernmental agencies).

And Principle 3 of the ecosystem approach recommends that measures to deal with invasive alien species should, as appropriate, be based on the ecosystem approach. This approach may be described as a strategy to protect complex and dynamic plant, animal and micro-organism communities and their non-living environment, which together interact as functional units, through integrated management of land, water and living resources.

Guiding principle 4: The role of states

This guiding principle calls for states to recognize that activities within their jurisdiction or under their control, such as intentional and unintentional introductions, may pose risks to other states. Guiding principle 4 stipulates that **states should take actions** to minimize the spread and impact of invasive alien species. Such measure may include among others:

- Identification of invasive alien species or species that could become invasive as well as providing information on such species to other states.
- Implement an IAS risk analysis before allowing introduction of exotic species
- Identify a IAS focal point and regional information exchange system
- Establish mechanisms to enable the exchange of information between all relevant stakeholders. Create an electronic database and facilitate uploading of information by focal points in the various agencies.
- Identify commodities that pose a significant risk for IAS
- Establish clear quarantine policies and procedures

Guiding principle 5: Research and monitoring

This guiding principle states that it is important for states to **conduct research on and monitoring of** invasive alien species in order to increase the knowledge about such species and their status in the country. This constitutes a major gap in Saint Lucia which requires support by means of institutional strengthening through:

- Human resource training in IAS research and management
- Procurement of equipment
- Capacity developed for data collection, storage and analysis (i.e. Data management)
- Publication of results and information dissemination in appropriate form and fora

Guiding principle 6: Education and public awareness

Guiding principle 6 attributes importance to public awareness in the management of invasive alien species. It recommends that states should **promote education and public awareness** of the causes of invasion and the risks associated with the introduction of alien species. In cases of mitigation measures, such as control or containment programmes, this should be done in a way to involve local communities and appropriate interest groups.

St. Lucia as part of the OECS is obligated under the St. Georges Declaration to implement Principle 7 which addresses ***Broad-based Environmental Education And Awareness*** and states:

“The public of the region have the right to information, training and education on environmental management in forms which they can easily understand and obtain at minimal costs. In particular, information on the practices and products which have a negative impact on the natural and cultural environment and on public health, will be shared.”

The recently concluded IAS awareness baseline survey concludes that ...“television, radio and internet were the most important information sources for environmental issues in St. Lucia and should all be employed by a multimedia campaign. Television enjoys the widest audience so that IAS television programmes should be designed to have general appeal. Radio is most suitable to reach the mature generation and should lean towards traditional values”^x.

- Ministry of Agriculture, Lands, Forestry and Fisheries (MALFF) coordinates many of the lead agencies responsible IAS response and management. As such the MALFF should coordinate with other government bodies, private sector companies, communities and non government organizations in promoting public education and awareness.
- Use of various forms of media (i.e. newspapers, television, radio, internet)

Guiding principle 7: Border control and quarantine measures

This guiding principle recommends that states should **implement border controls and quarantine measures** to minimize the risks of introduction of alien species that are or could become invasive. The quarantine measures should be based on risk assessment, and existing appropriate government bodies should be strengthened as necessary to implement the measures.

- Closer coordination and planned response to IAS threats is needed between local customs, St. Lucia Air and Sea Ports Authority (SLASPA), MALFF, plant and animal quarantine personnel
- Public education campaign conducted at air and sea ports
- Adequate training of personnel provided for IAS inspection, identification and intervention
- Adequate equipment and facilities for inspection, identification and disposal of identified IAS

Guiding principle 8: Exchange of information

Provisions regarding information exchange on alien species are laid down in principle 8. It recommends the **development of information systems** in regard to relevant biological information on alien species as well as the dissemination of information. Information on import requirements for alien species should be made available to other states.

- Establish a national IAS database that links with sub regional, regional and international information systems where available (e.g. such a database may be established as under the NBSAP).
- Identification and sharing of information on priority IAS threats of national concern in regional IAS initiatives (e.g. Caribbean Invasive Species Working Group,(CISWG) and its affiliated Caribbean Invasive Species Surveillance and Information Program (CISSIP)
- Sharing of implemented strategies in IAS risk reduction, IAS management measures implemented and results obtained

Guiding principle 9: Cooperation, including capacity building

This guiding principle points out that a state's response to minimizing the spread and impact of invasive alien species not only may be applied internally within the country but also may require **a bilateral or multilateral approach with other countries**. Cooperative efforts may include the development of programmes to share information and the establishment of bilateral or multilateral agreements to regulate

trade in certain alien species, as well as cooperation in research and its funding. **Capacity-building programmes** for states that lack expertise and resources are advocated. Such programmes may involve technology transfer and the development of training programmes.

- St. Lucia as part of the OECS is obligated under Principle 13 of the St. Georges Declaration in its efforts to sustain the flora and fauna and the ecosystems of the region.... “must prevent the introduction of alien and modified species which may have a negative impact on the environment and their health.” As such efforts should commence at the national and sub regional level to establish cooperative efforts at IAS management and eradication.
- As a party to regional and international MEAS which may include IAS concerns, St. Lucia and other member states of the OECS should seek support for its capacity building to address IAS concerns

Guiding principle 10: Intentional introduction

Guiding principle 10 provides recommendations regarding the **intentional introduction of alien species** into countries or into new ecological areas within a country. The principle recommends that such intentional introductions should take place only after they have been evaluated and authorized. A **risk assessment** should be part of the evaluation and the authorization should be based on the precautionary principle. Furthermore, principle 10 recommends that the burden of proof that a proposed introduction is unlikely to threaten biological diversity should be with the proponent of the introduction or be assigned as appropriate by the recipient state.

- A core team consisting of the relevant expertise should constitute a review panel for the proposed intentional introduction of an alien species as part of a risk analysis approach. Such expertise may be sourced from technical government agencies (e.g. Forestry Department, Fisheries Department, Veterinary Unit, Plant Quarantine etc.) and non governmental institutions(e.g. CABI, Durrell Wildlife Conservation Trust, SLNT), qualified regional or international academic institutions (e.g. UWI).

Guiding principle 10 also notes that “Decisions concerning intentional introductions should be based on **the precautionary approach**, including within a risk analysis framework, set forth in principle 15 of the 1992 Rio Declaration on Environment and Development, and the preamble of the Convention on Biological Diversity”.

Guiding principle 11: Unintentional introduction

This guiding principle recommends that every state should have in place **provisions to prevent unintentional introductions** of invasive alien species. Such provisions could incorporate legislative measures and the establishment or strengthening of institutions. Guiding principle 11 also mentions the most common pathways for unintentional introductions, such as agriculture, forestry, shipping or tourism. It recommends that environmental impact assessments of such activities should consider unintentional introductions of invasive alien species and that risk assessments should be carried out for these pathways, where appropriate.

- The sectors deemed most vulnerable to unintentional introductions should have IAS mitigative response plans developed and protocols to respond to IAS threats
- Such plans should factor in measures regarding **prevention, containment and control**.
- The planning and private construction sector should also be aware of the associated IAS risk in development schemes which propose importing exotic flora for landscaping, and potential hitchhiking IAS on construction materials (e.g. wooden pallets and lumber).
- Ministry of Physical Development, Environment and Housing and other associated referral line Ministries (e.g. MALFF) should review submitted development proposals for IAS potential issues and request that EIAs for such developments consider any potential risk of IAS introductions.
- Certain areas deemed for development that are within or are in close proximity to sensitive ecosystems or habitats of endangered species may require pet restriction orders and other suitable IAS management restrictions.

Guiding principle 12: Mitigation of impacts

Guiding principle 12 (as well as the three following guiding principles) deals with the mitigation of impacts once the establishment of an invasive alien species has been detected. **Mitigation measures**, which should be initiated at the earliest possible date, may include **eradication, containment or control** programmes that are safe to humans, the environment and agriculture, as well as ethically acceptable to stakeholders. Principle 12 also recommends that, consistent with national policy or legislation, an individual or entity responsible for the introduction of invasive alien species should bear the costs of control measures and biological diversity restoration where their failure to comply with the national laws and regulations is established.

- Institutional responses to conduct the required mitigation measures should be based on the collaboration which produced the plans

Guiding principle 13: Eradication

- This guiding principle recommends dealing with the introduction and establishment of invasive alien species by **eradication**, where feasible. Eradication is best carried out in the early stages of an invasion, and community support is often essential for the success of an eradication campaign.

Guiding principle 14: Containment

Containment, or **limiting the spread**, of alien invasive species may be an appropriate strategy where eradication is not feasible.

Guiding principle 15: Control

In cases where eradication and/or containment have failed, control measures are the last step in efforts to minimize the impact of alien invasive species. Guiding principle 15 recommends that **control measures** focus on reducing the damage caused by invasive alien species as well as reducing their number. This principle highlights the use of integrated management measures.

It should be noted that for both principles 14 and 15, proposed strategies require:

- Establishing the biological and ecological parameters for the IAS to be controlled. (e.g. habitat requirements, population parameters, reproductive behavior)
- Mapping of distribution and impacted regions
- Determining a suitable control measures (e.g. biological control, trapping, shooting, pesticide or insecticide applications)
- Monitoring of impact of applied measures and maintenance of remedial measures

Conclusion

Invasive alien species along with habitat destruction is recognized as the most significant threat facing biological diversity. IAS coupled with the projected impact of anthropogenic induced climate change pose a serious challenge to a Small Island Developing State like St. Lucia. The risk is significant to its environment, economic, and social development with its small, open and vulnerable economy. As such IAS management merits a proactive response that places the emphasis on **prevention** by; establishing the necessary political will; promoting public and media awareness of environmental impacts of invasive alien species; addressing the fragmented or outdated legislation that does not cover the full range of agricultural, environment, marine and public health concerns; establishing a strategic approach and proper coordination between key departments and agencies; building the necessary human, equipment and technical capacity to respond to IAS threats.

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