

THE NATIONAL INVASIVE ALIEN SPECIES STRATEGY FOR THE REPUBLIC OF MAURITIUS

2008-2017



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EXECUTIVE SUMMARY

Invasive alien species (IAS) are introduced plants, animals and micro-organisms whose establishment and spread threaten ecosystems, habitats or species (including humans). IAS represent a major threat to the economy, environment and society of the Republic of Mauritius. Over the years, a variety of actions have been undertaken to address this threat. However, in spite of some significant successes, the problems posed by IAS appear to be increasing in the country. The negative impacts of IAS are cross-sectoral as are the management solutions. In contrast, traditional approaches to IAS management throughout the world have been sectoral and have focused on “fire fighting” actions. With some notable exceptions, this has been the case in the Republic of Mauritius to date as well.

In an effort to move towards a comprehensive and coordinated approach to addressing IAS issues and in response to international agreements, notably the Convention on Biological Diversity (CBD), the Republic of Mauritius established the National Invasive Alien Species Committee (NIASC) in August 2003. One of the priorities for the NIASC, which comprises of representatives from the agriculture, biodiversity conservation, health, environment and education sectors and the private sector, was the production of a National Invasive Alien Species Strategy for the Republic of Mauritius (NIASS).

The NIASS represents a first step towards a comprehensive and cooperative approach to the management the IAS threat in the country. This initiative recognises the roles and responsibilities of all levels of government in regulating the management of IAS and the importance of the involvement of non-governmental and civil society organisations, the private sector and the general public. The especial importance of regional and international cooperation to enhance actions undertaken at national and local levels is emphasised given the Republic of Mauritius’ status as a Small Island Developing State (SIDS).

This Strategy presents a vision of a nation in which the negative impacts of invasive alien species on the economy, environment and society are avoided, eliminated or minimised. The Strategy serves as a guide to the nation so that all Mauritians are together responsible for avoiding, eliminating or minimising the negative impacts of invasive alien species.

The Strategy comprises of eleven interlinked elements: five hierarchical “Management Elements” and six “Cross-Cutting Elements”. The management elements are those “on the ground actions” that directly address the Strategy’s vision. The cross-cutting elements are enabling actions that must be undertaken if the management elements are to successfully address the Strategy’s vision.

The Management Elements, with their accompanying goal or goals are listed in order of priority based on the maxim that “prevention is better than cure”, in line with CBD Guiding Principle 2.1-2.

1. **Prevention** - to minimise the number of unintended and intended IAS introductions to the Republic of Mauritius;
2. **Early Detection and Rapid Response** - to minimise the number of IAS that go on to have harmful consequences once they are introduced to the Republic of Mauritius;
3. **Eradication** - an agreed framework for eradication priorities in place, eradications undertaken as necessary and results disseminated;
4. **Control and Management** - to contain the distribution and abundance of IAS in the Republic of Mauritius to a long-term acceptable level; and
5. **Restoration** - to undertake ecosystem restoration where necessary in the Republic of Mauritius to achieve long-term ecosystem goals.

The Cross-Cutting Elements, again listed with their goal or goals are:

6. **Legal, policy and Institutional Frameworks** - to have a coordinated policy and management framework that minimises the risk of IAS to the economy, environment and society of the Republic of Mauritius;
7. **Capacity Building and Education** - to make available appropriately skilled personnel from the Republic of Mauritius or elsewhere to implement all aspects of IAS management in the country;
8. **Information Management and Research** - (i) To have a clear understanding of the economic, environmental and social impacts of IAS that have become established in the Republic of Mauritius; (ii) to have ready access to critical information that will support IAS management programmes and (iii) to provide a strong scientific basis for decision-making and resource allocation;
9. **Public Awareness and Engagement** - The general public, decision-makers, scientists and other stakeholders in the Republic of Mauritius should have a high level of awareness of IAS risks and the benefits of IAS prevention and management for the economy, environment and society;
10. **International Cooperation** – (i) The Republic of Mauritius should have access to the necessary information, technical support and other resources it needs to effectively meet its national and international obligations; (ii) Mauritian IAS experiences and lessons learned are effectively disseminated to help IAS initiatives regionally and internationally and (iii) the Republic of Mauritius is not a source of IAS for other countries
11. **Provision of Adequate Resources** - It must be ensured that the IAS management system in place has sufficient human, technical and financial resources for its sustainable implementation.

Recommended actions have been proposed for each of the elements. Decisions on priorities have been guided by criteria which address the degree to which proposed actions serve public objectives, the probability of success, the degree to which the issue of concern threatens the economy, environment, society, or human health, the availability of funding and other resources and the degree to which any proposed actions fulfil international obligations and other strategic goals.

Three priority levels have been established:

- 1. Critical** refers to actions that are essential to the successful implementation of the IAS Strategy and should be initiated as soon as possible, within one year of the endorsement of the IAS Strategy.
- 2. High Priority** actions are essential to the successful implementation of the IAS Strategy and should also be initiated as soon as possible but in many cases their implementation is contingent upon prior actions being undertaken. These *prior actions* are classified as critical.
- 3. Medium Priority** actions are in some cases contingent upon the undertaking of high priority actions. In other cases, it is deemed that they would be of value but are not essential to the successful implementation of the IAS Strategy.

The NIASS provides a high level overview of the actions needed to minimise the negative economic, environmental and human health impacts of invasive species in the Republic of Mauritius for the next ten years (2008-2017). It is essential that the actions recommended in this plan are laid out in detail in a follow-up IAS Action Plan and that this Action Plan is accompanied by SMART (Specific, Measurable, Attainable, Realistic and Time bound) indicators. This Action Plan will cover a period of five years (2008-2012) with an independent review during year three. This will provide the basis for a consultative revision of the plan so as to facilitate an adaptive management approach and an optimal attainment of goals and objectives.

INTRODUCTION

The Problem of Invasive Alien Species

Invasive alien species (IAS)¹ are introduced plants, animals and micro-organisms whose establishment and spread threaten ecosystems, habitats or species (including humans). IAS are costing the economy of the Republic of Mauritius many millions of Rupees annually, represent the main threat to the country's unique biological biodiversity and have severe negative impacts on the health of the nation.

The subsequent impacts on global biodiversity are also important with the islands of the Republic of Mauritius being part of a "biodiversity hotspot" - locations that contribute disproportionately to global biodiversity relative to their aerial extent (Myers *et al.*, 2000).

IAS are a small sub-set of all alien species, many of which are of enormous benefit to humanity. All significant food crops and domesticated animals in the Republic of Mauritius are alien species. Most of these species are not invasive. However, some beneficial species can also be invasive. A significant challenge to those working with such species is balancing conflicts of interest – maximising benefits while minimising negative consequences. The minimisation of negative consequences is especially important given the fact that the native biodiversity of Mauritius is among the most threatened in the world.

IAS are a form of biological pollution. In contrast with non-living pollution (e.g. oil spills), IAS are by definition capable of replicating and their negative impacts can increase over time unless appropriate management measures are undertaken (figure 1). Typically the impacts of physico-chemical pollution incidents start at their maximum level and decrease over time. The impacts of biological invasions are small initially, often latent and then grow over time. These impacts have the potential to persist indefinitely if remedial action is not taken.

¹ A Note on Terminology

Different terms are used for alien species generally (non-indigenous, non-native, exotic, foreign, new) and for the subset that cause damage (pest, weed, harmful, injurious, invasive, environmentally dangerous). There are marked differences in use of terms in different sectors. Sanitary and phytosanitary instruments use "pest" and "weed" terminology, backed by clear definitions, and do not distinguish by source or origin: this means they also cover native pests. The International Plant Protection Convention (IPPC) uses the term "quarantine pest" to distinguish by source and by level of damage. Biodiversity-related multilateral environmental agreements usually refer to "alien" or "exotic" species in combination with harm/invasiveness criteria to identify those species that should be subject to controls. This generally excludes native species that become invasive (Council of Europe/UNEP, 2002). In this Strategy the term IAS is used to cover all alien pests, weeds, harmful, injurious, invasive, and environmentally dangerous organisms.

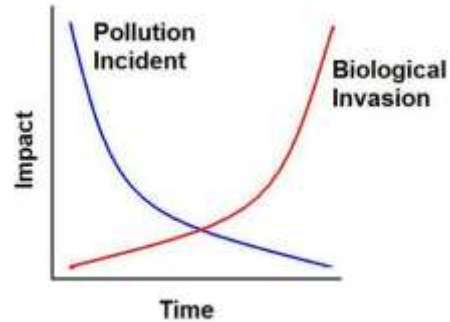


Figure 1. Contrasts between the impacts of a typical pollution incident and biological invasion over time.

Islands, where native species have evolved in relative isolation are particularly vulnerable to IAS. The problem of IAS is increasing worldwide with growing levels of transport, trade, travel and tourism (McNeely 2001).

In spite of these impacts, IAS issues are still poorly understood by Mauritian decision makers and the general public. The consequences of individual IAS such as chikungunya, rats and white grubs are well known, as their specific impacts are overtly manifested in terms of pest action or disease. However, there is little recognition that specific management actions can be undertaken within an overall IAS management framework.

Over-abundant Native Species

Native species can in some instances become invasive. However, this is an exceedingly rare occurrence in the Republic of Mauritius. Some of the management actions appropriate to alien species, such as prevention and early detection and rapid response, are not applicable to over-abundant native species. Over-abundant native species are not addressed in this Strategy which covers invasive *alien* species only.

The Invasion Process

Transport, trade, travel and tourism activities provide vectors and pathways for live plants, animals and micro-organisms. Pathways are the *corridors* by which species move between locations (e.g. shipping and air routes) while vectors are the *physical means* by which species move or are transported along pathways (e.g. ship and aeroplane) to areas outside their natural range.

The three main phases in the invasion process are introduction, establishment and spread. Introduction refers to survival during and after the journey. Once present in a new environment the introduced species may persist and reproduce successfully until it naturalises i.e. establishes a self-sustaining population. Populations in new suitable environments with abundant resources usually grow rapidly until they overexploit their resources (reflected in the damage they cause). They may then crash to some lower level determined by the new abundance levels of their resources. Whether these populations are

relatively stable or fluctuate widely depends on their interactions with their food supply and on the effects of host resistance, predators and diseases.

Some new populations may spread rapidly across the landscape, but others may show a time lag phase where the founder population is not initially invasive but remains around the point of establishment for a few years, decades or even centuries before some changes in the environment, or possibly its genome, allow it to spread.

Although a time lag is a general feature of the invasion process, there are some organisms, (e.g. some human, plant and animal diseases) which have virtually no time lag at all and the large scale effects of their invasiveness can be seen almost immediately if no remedial action is taken.

In terms of invasive species management, it is often most cost effective to prevent the arrival of IAS, or to deal with newly arrived species, before they establish and have any impacts. If left too late, IAS management can be very time and labour intensive and expensive.

Predicting whether an established new species will become invasive is uncertain and a precautionary approach (eradicating the founder population if possible) should be considered.

The Root Causes of Invasive Alien Species Problems and Mainstreaming

All IAS problems are the direct or indirect result of decisions made by individuals or groups of individuals operating within the prevailing economic, political and social systems. If IAS issues are to be addressed seriously they need to be incorporated into these mainstream systems ('mainstreamed'). They cannot be treated as add-ons to be considered only when particular invasions reach emergency proportions.

The production of this National Invasive Alien Species Strategy for the Republic of Mauritius, with its emphasis on a comprehensive and coordinated approach to addressing IAS issues, represents a significant step in this mainstreaming process.

The Republic of Mauritius

The main islands of the Republic of Mauritius (figure 2) are Mauritius (1865 km²) and Rodrigues (109 km²). Mauritius is situated in the South West Indian Ocean just north of the Tropic of Capricorn at 20° south and 57° east. It is 2,000 km off the east coast of Africa and 855 km east of Madagascar. Rodrigues is situated 574 km east of the main island. Rodrigues has 18 islets, all inside its lagoon and Mauritius has 49 islets inside and outside its lagoon. Mauritius has a population of 1.2 million and Rodrigues 35,000. Several outlying islands (the 'Outer Islands'), with small or transient populations also belong to the Republic of Mauritius. The twin islands of Agalega, situated some 1,000 km to the north of Mauritius, have a total land area of 2,600 hectares. Agalega has a population of about 300 inhabitants and its economy is based primarily on coconut exploitation. St. Brandon is an archipelago comprising of a number of sand-banks, shoals and islets. It is situated some 430 km to the north-east of Mauritius and is mostly used as a fishing base.



Figure 2. The location of the main islands of the Republic of Mauritius.

IAS Status and Trends in the Republic of Mauritius

Originally uninhabited, the islands that now make up the Republic of Mauritius had been impacted by IAS even before the first documented arrival of people and the associated physical destruction of habitats that began in the late 16th Century. It is likely that black rats (*Rattus rattus*) had colonised Mauritius from ship wrecks or from passing ships and were probably already present in Mauritius when the Dutch took possession of the island in 1598. By this time it is thought that they had already caused the extinction of several species of reptile and other groups that had evolved in the absence of ground dwelling mammals. These extinctions can be attributed solely to IAS in view of the fact that the habitat for these species was essentially intact at this time (figure 3).

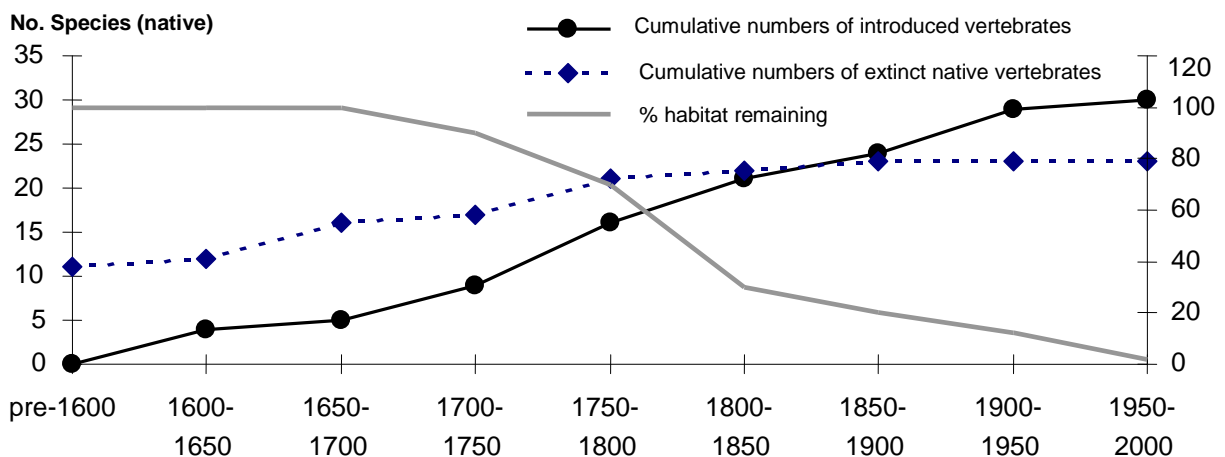


Figure 3. Cumulative habitat loss, vertebrate introductions and extinctions on Mauritius

Introductions accelerated after the first Dutch landing. Javanese macaques (*Macaca fascicularis*) are mentioned in 1606 and Java deer (*Cervus timorensis*), wild pigs (*Sus scrofa*) and goats (*Capra hircus*) had been introduced to Mauritius before 1648 to provide food for passing sailors (Cheke 1987). The last recorded sighting of the dodo (*Raphus cucullatus*) was in 1662. The extinction of the dodo, the world's first documented extinction, was ultimately caused by introduced species such as rats, cats, monkeys and pigs which preyed on the dodo's eggs and young.

Mauritius was extensively settled during the French period (1721-1810). The French created botanical and acclimatisation gardens in order to establish useful and beautiful plants for the new colony (Rouillard and Guého 1999). Unfortunately, it was a period in which many of the alien plants, that were to become major long-term threats to Mauritius' native forests, were introduced. Some notable introductions during the French period were Chinese guava (*Psidium cattleianum*) originally from Brazil, false acacia (*Leucaena leucocephala*) from Central America and ravenal (*Ravenala madagascariensis*) from Madagascar. The brown rat (*Rattus norvegicus*) and the Indian house shrew (*Suncus murinus*) were accidental introductions during the French period.

The British ruled Mauritius from 1810 – 1968. Species introductions, whether by organised acclimatisation societies, on an *ad hoc* basis or accidental, continued under the British. Vieille fille (*Lantana camara*) and privet (*Ligustrum robustum* subsp. *walkeri*) were among the plant species introduced during this period that would become serious invaders. Amongst the pest animal species introduced during this period were the giant African landsnail (*Achatina fulica*) some time in the mid-late eighteenth century, the Indian wolf snake (*Lycodon aulicus*), which was well established by the late 1870s and the lesser Indian mongoose (*Herpestes javanicus*) which was introduced in 1900 (Jones 1996).

The snail was introduced as a food item but the locals did not show much interest. The mongoose was introduced to control rats. Apart from an apparent initial effect, the introduction did not achieve its goal. Another naïve attempt at biological control was the introduction of the little toad (*Bufo gutturalis*) from South Africa in 1922 (Greathead 1971) as a predator of the cane grub (*Phytalus* (= *Clemora*) *smithii*) which had become a serious pest of sugar cane in 1911. The introduced toad is thought to be one of causes of the increasing rarity of Mauritius' native landsnails (Griffiths 1996). The situation might have been even worse had the cane toad (*Bufo marinus*) established, having been introduced to Mauritius on at least two occasions.

Not all biological control attempts in Mauritius have been unsuccessful. Some have had very positive consequences for Mauritian native biodiversity. The highly successful biological control programmes launched against black sage (*Cordia curassavica*) and prickly pear (*Opuntia* species) and the partially successful control of vieille fille, undertaken between 1914 and 1947, represent some of the first positive interventions for conservation in Mauritius (Fowler *et al.* 2000).

The most serious introduced disease during the British period was malaria, which became increasingly prevalent from the mid-nineteenth century. A concerted eradication campaign was conducted after the Second World War. A combination of ecosystem management and widespread use of DDT brought malaria under control by the early 1950s and the disease was declared eradicated in 1973 (Box 1).

A combination of its insular nature and sound management practices has resulted in a large number of other public health successes in the Republic of Mauritius. The last case of plague was reported in 1899, the last case of cholera in 1863, the last case of dengue fever in 1976 and yellow fever and rabies have never been reported from the country.

Species introductions have accelerated in the post-colonial era. Recent naturalisations with potentially destructive ecological effects include the Madagascan day gecko (*Phelsuma madagascariensis grandis*) and the golden apple mystery snail (*Pomacea bridgesi*). Reliable information has yet to be compiled on plant introduction levels but they too are likely to be increasing. A study on insect pest introductions to Mauritius shows that these have accelerated considerably in the late 20th century (Williams and Ganeshan 2001). Of the 22 significant insect pests that entered Mauritius over the century 14 had arrived since 1975.

The situation regarding introduced species in the Mauritian marine environment is poorly understood. Port surveys are currently being undertaken. These are part of the process of establishing the baseline regarding marine IAS in Mauritian waters. Some of the IAS challenges facing Mauritius' marine and aquatic sectors are summarised in Box 2.

BOX 1 - ON-GOING EFFORTS TO KEEP THE REPUBLIC OF MAURITIUS MALARIA-FREE

Malaria was eradicated from Mauritius in 1973; however *Anopheles gambiae*, a malaria vector is still present on the island.

In 1975 extensive new breeding places for the vector were created as the result of a massive cyclone. Malaria was re-introduced by workers who came to re-establish essential services. The situation worsened in the following years with a peak of 668 cases in 1982, of which 99% were indigenous.

With technical expertise from the World Health Organisation a plan of action was developed and the situation improved over the years. In the period 1990-2001, the Republic of Mauritius has been free from indigenous malaria except for two small localised outbreaks of *Plasmodium vivax* malaria in 1992 and 1996 when 13 and 17 cases were reported respectively. As a result of the aggressive control measures taken no indigenous cases were reported in these localities in the year following these outbreaks.

In 2006 only 26 imported cases were recorded. However the risk of re-introduction of the diseases from imported malaria cases is high if proper preventive measures, as outlined below, are not taken.



Keeping awareness levels about mosquito-borne diseases high in the Republic of Mauritius.
Ministry of Health and Quality of life

The population is encouraged

- To eliminate mosquito breeding grounds in the immediate surroundings;
- To seek medical attention in cases of fever;
- To take prophylaxis if travelling to a country where malaria is present and;
- Nurses and doctors in both the public and private sectors are encouraged to take blood smears from suspected malaria cases.

Most of the preventive measures are carried out by Government Services:

- Surveillance at the Port and Airport – All air travellers coming from or transiting through countries where malaria is present are controlled by Health Inspectors on their arrival;
- All passengers originating or having transited through countries where malaria is present are registered by staff of the Port and Airport Units and their names and addresses are referred to the respective regional offices for visits by Health Surveillance Officers.
- Spraying operations are carried out only when indigenous or introduced cases are detected;
- Potential mosquito breeding grounds are treated with insecticide at regular intervals;
- Drugs for malaria prophylaxis are dispensed free of charge to travellers leaving for countries where malaria is present;
- All malaria cases are treated free of charge;
- All malaria cases are followed up to a period ranging from 3 months to one year depending on the species of malaria parasites and
- Health Education is routinely carried out in primary schools and to the population in general.

All these measures are backed up by research:

- There is a special government laboratory for malaria diagnosis;
- All cases of *Plasmodium falciparum* malaria and cases of *P. vivax* are monitored for resistance to drugs and
- Entomological surveillance consisting of surveys to assess mosquito behaviour and density is carried out by Vector Biology and Control Division of the Ministry of Health and Quality of Life.

BOX 2 – MARINE AND FRESHWATER ECOSYSTEMS IN THE REPUBLIC OF MAURITIUS – SOME OF THE IAS CHALLENGES

The intake and outflow of ballast water by ships at ports of departure and entry across the world has been responsible for the introduction of numerous marine IAS. Ballast water is essential for ship stability and is pumped either in or out depending on the weight of cargo being loaded or unloaded onto a ship. Although essential, it poses serious threats to the ecology, economy and health of countries where ballast is discharged. The fundamental reason why long-distance dispersal of marine organisms in ballast water constitutes an environmental problem is that whilst the oceans are continuous, coastal marine life and to some extent oceanic marine life, is geographically discontinuous. The broad expanse of oceans, ocean circulation patterns and geographical differences in sea surface temperatures act as barriers to natural dispersal. Anything that is small enough to pass through the ballast water intake-pumps, such as bacteria, small invertebrates and eggs, cysts and larvae of various species can be transported between ports. Whilst many species do not survive the journey in ballast water, some do and can proliferate and spread in and from ports outside their natural range. These species are then more likely to re-enter ballast water and be transported to other new locations. In Mauritius, the discharge of ballast water is mainly by ships that transport sugar and molasses. About 30 such ships call to Mauritius each year. Currently there are no monitoring procedures to determine the origin of vessels or the number of potential invasive and harmful organisms they might harbour.



Ballast water exchange.
National Ballast Water Information Clearinghouse (USA)

Examples of introductions of IAS in ballast water elsewhere include:

- European freshwater zebra mussels (and of other species) into the Great Lakes of North America with the resultant major environmental and economic problems.
- Severe damage to commercial fisheries in the Black and Azov Seas as a result of the introduction of an American comb jellyfish.
- More than 10,000 people were reported to have died in South America in the early 1990s from a ballast-mediated cholera epidemic.
- The discharge of cholera with ballast from South America into ports of the USA.
- In addition to bacteria and viruses, ballast water can also transfer a range of species of micro-algae, including toxic species that may form harmful algae blooms or 'red tides'. The public health impacts of such outbreaks are well documented and include paralytic shellfish poisoning, which can cause severe illness and death in humans.

Aquatic ecosystems, particularly freshwater systems, are also at risk from other modes of IAS introduction, notably the accidental or deliberate release of aquatic organisms held or cultivated in captive conditions. For example, over the past decade there has been a growing trend for the sale of exotic reptiles and amphibians as pets in Mauritius. Such animals can be brought from a number of outlets, such as markets, garden centres, aquariums and supermarkets. One of the commonly sold aquatic reptiles in Mauritius is a small freshwater turtle known as the red-eared slider, *Trachemys scripta elegans*. Native to North America, the slider has been exported in large numbers worldwide; it has been estimated that between 1988 and 1994 up to 26 million sliders were exported from North America for the international pet trade. The sliders are sold as juveniles when they are about the size of a coin, but can rapidly grow to the size of a dinner plate, where they frequently become aggressive and difficult to manage. Whilst desirable as juveniles they are less so as adults and unwanted sliders are generally released into local freshwater systems. Accidental and deliberate introductions of sliders into the wild have occurred in numerous locations around the world. Once established these reptiles have had substantial impacts upon native freshwater ecosystems through the consumption of native aquatic species, such as fish, invertebrates and vegetation. They can also cause the destruction of bird nests, eggs and chicks, and compete with native species for aquatic resources. In view of the damage caused, the red-eared slider has been listed as one of the World's Worst IAS by the IUCN's Invasive Species Specialist Group. Currently, the status of the slider and its potential impact in the freshwater ecosystems of Mauritius is unknown.

Rodrigues, the islets around Mauritius and Rodrigues, and the Outer Islands are of considerable biodiversity importance in their own right. Of its native flowering plants 39 % are unique to Rodrigues and 54 % unique to the Mascarenes (Mauritius, La Réunion and Rodrigues). Other species groups show similar levels of endemism. The pattern of habitat destruction and species introductions to Rodrigues has paralleled the situation in Mauritius. However, certain damaging invasives that are present in Mauritius; monkeys and red whiskered bulbuls (*Pycnonotus jocosus*) for example have not been introduced to Rodrigues. Rodrigues has also never been affected by malaria. The physical isolation of Rodrigues presents opportunities for invasive species prevention and management. However, the fact that it is politically part of the Republic of Mauritius makes the imposition of the necessary biosecurity measures a challenge. Similar biosecurity challenges and opportunities exist for the islets around Mauritius and Rodrigues and the Outer Islands that are part of the Republic of Mauritius.

Large scale management of IAS in the Republic of Mauritius in the pre-independence period was driven by human health and agricultural concerns; although as mentioned weed biological control initiatives did have positive biodiversity outcomes. Attempts to manage invasive plants for biodiversity conservation started with the sporadic weed management that had been undertaken in a 0.1 ha. plot in the Macchabé forest in the Black River Gorges from the late 1930s. In 1969 a 1.44 ha. weeded plot was established. This plot was also fenced to keep out deer and pigs. International collaboration in Mauritian terrestrial conservation work started in 1973 with the visit of Sir Peter Scott. Invasive species management within a framework of species recovery work and ecosystem restoration has been a central element in these efforts from the beginning (Box 3).

BOX 3 - MANAGEMENT OF IAS FOR TERRESTRIAL BIODIVERSITY CONSERVATION IN THE REPUBLIC OF MAURITIUS

Invasive alien species are the biggest threat to the native biodiversity of the Republic of Mauritius. As a consequence, efforts to manage IAS have been at the forefront of the country's terrestrial biodiversity conservation programmes.

Biological control

Although the motivation behind the biological control programmes for black sage (*Cordia curassavica*), prickly pear (*Opuntia* species) and the vielle fille (*Lantana camara*) was agricultural, these programmes undertaken between 1914 and 1947, represent some very positive interventions for conservation in Mauritius. The black sage and prickly pear control measures were highly successful and the vielle fille measures partially successful.

Active weed management

All Mauritian forest has been invaded by alien plant species and can only be saved by active weed management. The first such management of invasive species specifically for terrestrial biodiversity conservation was initiated in the 1930s with the weeding of a 0.1 ha. plot of invaded upland forest in the Black River Gorges. The necessary maintenance weeding of this small plot was only sporadically undertaken until the early 1980s. The area under active weed management has expanded consistently since then. There are currently 94.44 and 30 ha. under active weed management on the Mauritian mainland and its islets respectively and about 46.4 ha. in Rodrigues and Cocos and Sables Islands

Species recovery programmes

The Republic of Mauritius can boast some of the most spectacular species recovery successes undertaken anywhere in the world. The Mauritius kestrel for example has recovered from only four known wild birds to a population of some 800 birds today. Intensive captive breeding efforts in the early 1980s provided the birds for a successful reintroduction programme. One of the principal reasons for the success of this reintroduction was the intensive predator control work undertaken around release sites. Predator control continues to be an integral part of the species recovery programmes for the other endangered birds of Mauritius. It is also very likely that the control of omnivores such as rats has also aided the recovery of Mauritian native vegetation.

Islet restoration

The Republic of Mauritius is fortunate in having a number of islets that have not been invaded to the same extent as the mainland. Rats, cats and other introduced predatory mammals have never colonised Round Island, a fact that saved many of Mauritius' endemic reptiles from extinction. Invasive species have nonetheless had an impact on the Republic of Mauritius' islets including Round Island. Fortunately, the potential for mammal eradication from such islets is high. Goats and rabbits, which were destroying Round Island's fragile ecosystem, were eradicated in 1979 and 1986 respectively. Rats, cats and mongooses have been eradicated from Ile aux Aigrettes. These eradications have made rare bird reintroductions possible. The eradication of rats has also aided the recovery of the vegetation of Ile aux Aigrettes. Other islets around Mauritius and Rodrigues have huge conservation potential.

In recognition of this rats were eradicated from the islets off the north of Mauritius on which they were found in 1995 and 1998

(Bell and Lomax 1999). Mice were also eradicated from Flat Island and rabbits from Gunner's Quoin in 1998. Mice were eradicated from Ile aux Cocos and Ile aux Sables, Rodrigues in 1995. These operations were undertaken to remove the threat of introduced rodents to the extant biota of these islands, to reduce the possibility of transfer of rodents between islands and as a precursor to major restoration programmes on all these islets.

It is essential that future introductions to islets from the mainland are minimised. As a consequence quarantine and early detection and rapid response plans have been drawn up for several of the Republic of Mauritius' islets.



Ile aux Aigrettes - invasive species management is a central component of its restoration.
Pierre Argo

Other examples of successful invasive species management efforts undertaken in Mauritius in recent years include the collaborative Mauritius-La Réunion programme to prevent the white grub (*Hoplochelus marginalis*) establishing in Mauritius (Box 4) and the early detection and eradication of the Oriental fruit fly (*Bactrocera dorsalis*) from Mauritius between 1996 and 1999 (Box 5).

The actions undertaken to manage IAS impacts in the Republic of Mauritius to date, though sometimes successful, have been largely reactive and piecemeal, responding to new problems and pathways. They have been driven by the perceived needs of individual sectors. However, the problems posed by IAS are not simply the responsibility of a single ministry or department. Rather, the problem is spread through many economic sectors, compromising of both public and private stakeholders. As with other aspects of biodiversity conservation, successfully addressing the problems of IAS will require effective collaboration among these various institutions. The National Invasive Alien Species Strategy (NIASS) seeks to provide the framework within which all Mauritians can work together to minimise the negative impacts of IAS. A National Invasive Alien Species Strategy is a prerequisite if the country is to move from a situation where the norm for IAS management is a single species focus, *ad hoc* actions and a sectoral approach to a situation where IAS management norms are outcome-oriented, strategic and multi-sectoral.

BOX 4 - MEASURES TAKEN TO PREVENT WHITE GRUBS ENTERING AND SPREADING IN MAURITIUS

The white grub or ver blanc, *Hoplochelus marginalis* is a polyphagous beetle whose root-boring larvae can cause huge losses to sugar cane crops. It is indigenous to Madagascar and does not occur naturally in the Mascarenes.

In 1981, the first *H. marginalis* damage was noted close to the port area (La Possession) of La Réunion, approximately 200 km to the west of Mauritius and it has since spread to all suitable areas of la Réunion. Prompt action was taken to prevent the importation of *H. marginalis* into Mauritius. A 'White Grub' Sub-committee was set under the 'Plant Introduction and Quarantine Standing Committee'. This comprised of members of the Mauritius Sugar Industry Research Institute (MSIRI), Mauritian Ministry of Agriculture and the University of Mauritius. All measures formulated were carried out in consultation with CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement), Services de la Protection des Végétaux and the Direction Départementale de l'Agriculture et des Forêts (DAF) of La Réunion. Quarantine measures formulated included:



The White Grub.
photographies d'insectes © insecte.org

- Changes in flight and boat departure times. During the summer of each year (from 1st November to 31st January) the beetle actively flies around dusk and is attracted to light. No planes are allowed to take off from La Réunion to Mauritius between 18.30 and dawn. Similar restrictions apply to shipping and if ships have to stay overnight in La Réunion they must keep their lights off. All boats and planes are sprayed as necessary (Special measures are proposed in case of emergency)
- Airline companies are obliged to spray the plane (both hold and cabin) if stationed in La Réunion during the night and to close all the doors when parked.
- All the cargo is kept inside the cargo shed until it is being loaded on the plane.
- All cargo is checked and certified free from larva/adult of the white grub.
- Regular inspections using light traps around high-risk areas in Mauritius (around the airport and port areas).
- Regular spraying around the Mauritius airport region.

Regular meetings are held between specialists in Mauritius and La Réunion to assess the situation and a 'Protocole d'accord' has been signed by Mauritius and La Réunion to ensure that the above measures are applied.

A vital part of the management approach has been the reduction in the population densities of *H. marginalis* especially around the port of La Réunion. This has been achieved by the use of the fungal pathogen *Beauveria brongnartii*. Adult beetles are dipped in a fungal suspension and released to spread the infection. This has resulted in relatively low populations of *H. marginalis*, which has considerably lessened the chances of its accidental introduction into Mauritius.

Public awareness campaigns have also been intense and sustained. Posters can be seen at the airports in Mauritius and La Réunion. There are very few people in the Republic of Mauritius today who are not aware of the menace posed by the 'Ver Blanc'.

BOX 5 - EARLY DETECTION AND ERADICATION OF ORIENTAL FRUIT FLY

The Oriental fruit fly, *Bactrocera dorsalis* is recognised as one of the most destructive fruit fly pests in the world. The Oriental fruit fly was detected for the first time in Mauritius on 5 June 1996 at Camp Carol, a village situated at about 1.5 Km from Mauritius' only airport. A single female was caught in a McPhail trap (a baited trap used to attract female fruit flies).

This early detection was due to the fact that traps had been placed throughout the island as part of a national programme for the control of fruit flies, funded jointly by the European Union and the Government of the Republic of Mauritius.

A series of actions were applied in the village of Camp Carol, the main ones being the Bait Application Technique (BAT) which is directed at killing both male and female flies by means of spot spray of a protein hydrolysate/insecticide mixture at 7 to 10 days intervals and the Male Annihilation Technique (MAT) which attracts and kills the male flies through the use of parapheromones on plywood blocks at the rate of 10-14 blocks per hectare, renewed every three months.

Eradication measures were applied over an area of about 300 Km² in the South until June 1998. 367 traps with the protein mixture and 95 Mc Phail traps were operated in the eradicated area. An ULM ultralight aircraft was also used for BAT and MAT in inaccessible areas. Monitoring for detection consisted of intensive trapping with dry and wet traps and fruit sampling.

A total of 144 *Bactrocera dorsalis* were trapped from 22 villages and the last adult was trapped on 6 May 1997.

Bactrocera dorsalis was contained to the south of the country and was never detected in any other part of the island. It was officially declared to have been eradicated from Mauritius as from 1 July 1999. Measures for prevention and detection of future introductions of the Oriental fruit fly or other exotic fruit flies are on going.



The Oriental fruit fly.
Agricultural Research Service, United States Department of
Agriculture

International Obligations relating to IAS

The growing awareness of IAS as a cross-sectoral issue and the need for the development of a strategic framework to address IAS in a comprehensive way is reflected in the increasing incorporation of IAS-related provisions into international conventions and associated standard setting bodies and other organisations whose remits have IAS implications.

Article 8(h) of the Convention on Biological Diversity (CBD) calls on Parties to “prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats and species.” The decisions of the COPs (Conference of Parties) to the CBD have elaborated on the need for, and approaches to, the full implementation of Article 8(h) and called on Parties to establish national bodies to coordinate IAS issues and to develop national strategies to respond to the actual and potential threats from IAS.

The Republic of Mauritius is a signatory to the CBD, the International Plant Protection Convention (IPPC), the WTO (World Trade Organisation) Sanitary and Phytosanitary (SPS) Agreement, the Inter-African Phytosanitary Council (IAPSC), the World Organisation for Animal Health (OIE) and the International Maritime Organization (IMO). These and other

relevant international conventions, organisations and agreements to which the Republic of Mauritius is a signatory are listed in Annex 3.

These international agreements have been among the motivating factors in the development of national IAS strategies and action plans; examples of which include the United States National Invasive Species Council Management Plan (2001) and New Zealand's Biosecurity Strategy (2003). These plans adopt a transparent and comprehensive approach to IAS issues that is coordinated across respective national organisations and jurisdictions. Similar initiatives are being adopted in other countries. In the long-term, failure of the Republic of Mauritius to adopt such an approach could adversely affect her trade and travel relationships with her international partners.

The Development of the National Invasive Alien Species Strategy for the Republic of Mauritius

The Republic of Mauritius established the National Invasive Alien Species Committee (NIASC) in August 2003 under the aegis of the National Parks and Conservation Service (NPCS) of the then Ministry of Agriculture, Food Technology and Natural Resources. The NIASC comprises of representatives from the agriculture, biodiversity conservation, environment, health and education sectors and the private sector. The development of the NIASS has been initiated by the NIASC as one of the projects for implementation under Terrestrial Biodiversity Sector of the Second Environment Investment Programme (EIP II) funded by the Ministry of Environment and National Development Unit.

In order to draft the NIASS, the NIASC established four sub-committees with a Chairman and a Secretary on each of the themes below for the Republic of Mauritius:

- (i) Agriculture
- (ii) Biodiversity (Marine and Terrestrial)
- (iii) Education and Awareness
- (iv) Health

The NIASC invited the Rodrigues Regional Assembly (RRA) to establish a Sub-committee to look over the management and control of IAS in Rodrigues. However, action has yet to be initiated by the RRA.

Thirteen members from the sub-committees on Biodiversity Sectors (Marine and Terrestrial and Agriculture) and Health were grouped in three working groups to provide their inputs into a draft strategy, based on the Global Invasive Species Programme (GISP) "Global Strategy for addressing the problem of IAS (McNeely *et al.* 2001)".

An International Consultancy Team, assisted by a National Consultant and in consultation with the NIASC, produced a first draft strategy incorporating the inputs of the three working groups. This draft was circulated among stakeholders for comments and inputs, which were incorporated into a second draft. This second draft was reviewed and endorsed during a National Workshop, with participants from the NIASC and other key stakeholder organisations and lead by the International and National Consultants, on 28 and 29 November 2007.

The National Invasive Alien Species Strategy was finalised on December 11, 2007. The Strategy was approved by the Acting Director of the National Parks and Conservation Service of the Ministry of Agro Industry and Fisheries on December 12 2007.

THE STRATEGY

Vision

A nation in which the negative impacts of invasive alien species on the economy, environment and society are avoided, eliminated or minimised

Mission

To guide the nation so that all Mauritians are together responsible for avoiding, minimising or removing the negative impacts of invasive alien species.

Guiding Principles

1. Work within the frameworks of international agreements to develop the Invasive Alien Species Strategy for the Republic of Mauritius².
2. Develop a strategy that is science-based and utilises the best available knowledge and practices.
3. Emphasise as far as possible, the ecosystem approach - managing ecosystems to provide for all associated organisms, as opposed to a focus on individual species. In the context of IAS management this means a concentration on invasive species management as a means towards an "ecosystem" level end (greater biodiversity value, clean water, sustainable agriculture, human health benefits, etc.). i.e. invasive species management is not an end in itself.
4. Adopt an adaptive management approach that incorporates and continually improves on policies and practices by learning from the outcomes of operational programs as they progress.
5. Co-operate at all levels of government, private sector and non-governmental and civil society organisations within the Republic of Mauritius and internationally.
6. Synergise IAS-related actions with existing initiatives - National Biodiversity Strategy and Action Plan (NBSAP), ecosystem management plans, EIA procedures, etc³.
7. Mainstreaming – incorporation of IAS-issues into mainstream concerns e.g. into the plans and actions of major ministries whose activities have consequences for IAS³ and into the consciousness of the general public.
8. Involve the public in actions to address the threat of invasive alien species.
9. Ensure adequate resources (financial and non-financial) and commitment for any proposed actions.

² International organisations and agreements of relevance to IAS to which Mauritius is a signatory are listed in Annex 3.

³ Relevant national plans and legislation are listed in Annex 4

Target audience

The diverse range of stakeholders' whose activities are affected by and affect IAS impacts in the Republic of Mauritius. These include government organisations, non-governmental and civil society organisations, the private sector and affected communities.

Scope

The National Invasive Alien Species Strategy for the Republic of Mauritius provides a framework for the protection of the aquatic and terrestrial ecosystems of the Republic of Mauritius, and their native biological diversity and domestic plants and animals (including people), from the risks posed by invasive alien species.

This Strategy is applicable to all intentional introductions, both authorised and unauthorised (illegal), and all unintentional introductions. It includes those alien species that are imported and introduced from other countries, as well as those alien species that are native to some islands in the Republic of Mauritius, but not to others. It also applies to those species that are exported intentionally and unintentionally from the Republic of Mauritius to other countries and to other islands within the Republic of Mauritius. The Strategy is applicable to a wide range of sectors, including agriculture, fisheries and aquaculture, wildlife, forests, transportation, the private sector and the general public. It represents a first step towards a comprehensive and cooperative approach to the management of IAS impacts in the Republic of Mauritius. **This initiative recognises the roles and responsibilities of all levels of government in regulating and managing invasive alien species and the importance of the involvement of non-governmental and civil society organisations, the private sector and the general public. It also recognises the need for international cooperation to supplement actions at national and local levels.**

The NIASS will provide a high level overview of the actions needed to minimise the negative economic, environmental and human health impacts of invasive species in the Republic of Mauritius. A document of this nature is not an action plan and therefore it cannot go into precise detail. To ensure that the NIASS gives clear strategic direction it is essential that recommended actions are specified in a follow-up IAS Action Plan and that this Action Plan is accompanied by SMART (Specific, Measurable, Attainable, Realistic and Time bound) indicators. It is imperative that the IAS Action Plan is produced and implemented as soon as possible after the endorsement of the IAS Strategy in view of the increasing rates of species introduction from outside the country and between the islands that make up the Republic of Mauritius.

The IAS Action Plan will cover a five year period (2008-2012) with an independent review during year three. This will provide the basis for a consultative revision of the plan so as to facilitate an adaptive management approach and an optimal attainment of goals and objectives.

The Strategy applies to the invasive aspects of living modified organisms (LMOs), as the measures to manage the unintended impacts of LMOs are similar to those that are needed for other alien species

This Strategy does not address bioterrorism. Bioterrorism is in essence another means for the introduction of unwanted species. The intent, however, is quite different. Although not explicitly addressed in this Strategy, any efforts to mitigate bioterrorism should be undertaken with reference to the NIASS.

Approach

The Strategy comprises of eleven interlinked elements: five hierarchical “Management Elements” and six “Cross-Cutting Elements”. The management elements are those “on the ground actions” that directly address the Strategy’s vision of a nation in which the negative impacts of invasive alien species on the economy, environment and society are minimised. The cross-cutting elements are enabling actions that must be undertaken if the management elements are to successfully address the Strategy’s vision.

Management Elements

1. Prevention
2. Early Detection and Rapid Response
3. Eradication
4. Control and Management
5. Restoration

Cross-Cutting Elements

6. Legal, policy and Institutional Frameworks
7. Capacity Building and Education
8. Information Management and Research
9. Public Awareness and Engagement
10. International Cooperation
11. Provision of Adequate Resources

Prioritisation of Recommendations

Priority setting is critical for the development and implementation of a national invasive species Strategy. Three priority levels have been established:

- 1. Critical** refers to actions that are essential to the successful implementation of the IAS Strategy and should be initiated as soon as possible, within one year of the endorsement of the IAS Strategy.
- 2. High Priority** actions are essential to the successful implementation of the IAS Strategy and should also be initiated as soon as possible but in many cases their implementation is contingent upon prior actions being undertaken. These prior actions are classified as critical.
- 3. Medium Priority** actions are in some cases contingent upon the undertaking of high priority actions. In other cases, it is deemed that they would be of value but are not essential to the successful implementation of the IAS Strategy.

The following criteria have been used to guide decisions on priorities:

- Compelling public objectives (economic, environmental, social and health) are served in both the short and long-term.
- High probability of success in multiple sectors with a good return on investment.
- Risk analysis indicates that if the issue under consideration is not addressed there will be an unacceptable risk to the economy, environment, society, or human health.
- Funding is available for the foreseeable duration of the proposed action.
- The proposed action fulfils international obligations and other strategic goals.

THE MANAGEMENT ELEMENTS

“Prevention is better than cure”. This basic notion is articulated in CBD Guiding Principle 2.1-2 (three-stage hierarchical approach) which states that:

1. Prevention is generally far more cost-effective and environmentally desirable than measures taken following introduction and establishment of an invasive alien species.
2. Priority should be given to preventing the introduction of invasive alien species, between and within States. If an invasive alien species has been introduced, early detection and rapid action are crucial to prevent its establishment. The preferred response is often to eradicate the organisms as soon as possible (principle 13). In the event that eradication is not feasible or resources are not available for its eradication, containment (principle 14) and long-term control measures (principle 15) should be implemented. Any examination of benefits and costs (environmental, economic and social) should be done on a long-term basis.

The NIASS follows this hierarchical approach, starting with priorities for prevention, followed by early detection and rapid response, eradication, control and management, and restoration. However, in many cases the management elements are likely to be strongly interlinked and any “on the ground actions” will probably contain a mix of elements within an integrated pest management (IPM) framework. An IPM approach considers best available scientific information, the environmental impacts of management methods and their cost when selecting a range of complementary methods designed to achieve a specified objective.

1. PREVENTION

Goal: To minimise the number of unintended and intended IAS introductions to the Republic of Mauritius.

Prevention is the first line of defence against further introduction and establishment of IAS and is the most efficient and cost-effective strategy to minimise their long-term negative impacts. Prevention needs to be practiced at the national level and among isolated ecosystems within the Republic of Mauritius. These “ecosystem units” include the islets and islands that make up the Republic of Mauritius and isolated water catchments within the islands of Mauritius and Rodrigues. Prevention is especially important for aquatic introductions. Alien species can be extremely hard to detect in aquatic systems and they can disperse rapidly, making eradication or control exceedingly difficult.

Prevention has two principal aspects – prevention of those species that arrive unintentionally as “hitchhikers” on a commodity, conveyance, or person and prevention of those species that

are intentionally introduced for a specific purpose and are likely to have harmful consequences. Intentional introductions can be authorised (legal) and unauthorised (illegal). Some illegal introductions to the Republic of Mauritius are likely to be brought in through unofficial entry points in private vessels.

A risk-based approach is recommended. This would allow informed decision-making in relation to species introductions. This approach requires consideration of the likelihood of establishment and spread, and the severity of the resultant impacts. Such an approach should apply both to introductions to the Republic of Mauritius and introductions between the islands that form part of the Republic of Mauritius. A variety of risk-based tools are available.

The Republic of Mauritius also has a role to play in IAS prevention efforts of those countries with which it interacts by ensuring that it does not export IAS to other countries.

Lists

Species can be listed according to their perceived invasiveness. Listing can aid decision making on any actions to be undertaken on proposed legal introductions. A Black List contains a list of species whose introduction is strictly prohibited as they are known to be invasive and destructive. A White List contains species that are classified as low risk following a risk assessment or based on long-standing experience. Introduction of these species may be authorised without restriction or under conditions restricting their use to specific purposes (research, public education, etc.). A Grey List (or Holding List), which is not an actual list, contains all species not included in the Black or White List. Species on the Grey List should be subject to risk assessment prior to a decision on introduction.

An alternative and more conservative approach, which is now used in New Zealand, is to list all species currently in the country (and their status as captive species, pets, wild/feral, etc.) and ban all others unless permitted. The way to get a permit is to present a cost/risk versus benefit analysis and have that judged by a decision-making instrument of government (Box 6). It is recommended that the Republic of Mauritius adopts this approach as it minimises risk and its implementation is not dependent on an exhaustive knowledge of species that are currently absent from the country.

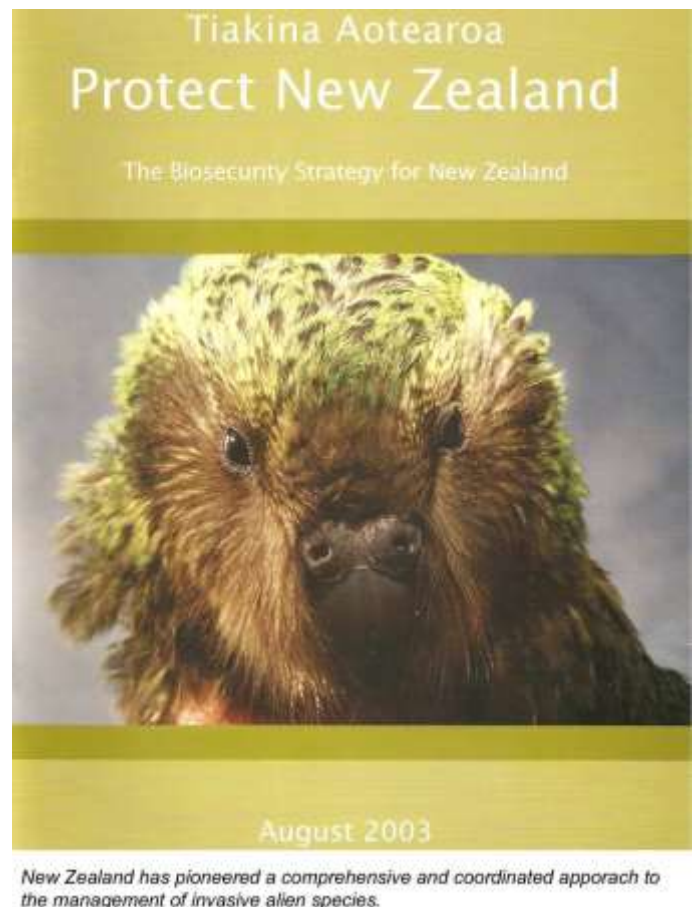
BOX 6 – THE NEW ZEALAND APPROACH TO NEW SPECIES IMPORTS

All new organisms (plants, animals, micro-organisms and LMOs) currently not in New Zealand are banned unless permitted. This approach has replaced the black listing approach that was formerly used.

This change was initiated following the exploitation of legal loopholes. For example chinchillas (*Chinchilla laniger*) were imported for fur farming after a risk assessment and approval, but then sold as pets. This risk of escape and establishment in the wild was thought much greater as pets than from farmed, enclosed animals.

The current system is that the importer must get a permit, at their cost, by applying to the Environmental Risk Management Authority (ERMA) demonstrating that the supposed benefits of the new species outweigh any costs and risks associated with the purpose for which the organism is introduced. These risks include the risk and costs should the organism escape into the wild. ERMA then assesses the application and its decision is final. ERMA has quasi-judicial status.

Failed applicants cannot appeal to ERMA in any court or through a politician other than by judicial review. i.e. if ERMA's process was flawed. More information is available on ERMA's website (<http://www.ermanz.govt.nz/>)



Risk Analysis

Risk analysis is composed of three processes: risk assessment - the process of evaluating biological or other scientific and economic evidence to determine whether an organism is likely to become invasive; risk communication - the exchange of information among relevant stakeholders throughout the risk analysis process; and risk management - deciding upon and implementing the appropriate course of action in order to minimise the identified risks. A number of approaches to IAS risk assessment and analysis have been pioneered (Andersen *et al.* 2004), such as those employed in the UK, or by the European Plant Protection Organisation (EPPO). These can be used as models upon which to base a system of risk analysis for the Republic of Mauritius.

Unintentional introductions can be addressed through the analysis of the risks posed by pre-border, border and post-border introduction pathways – ballast water, trade, sea travel, air travel, etc.

Border control and quarantine measures

Prevention goes beyond the production of lists and risk assessment. It can only be effective if border control and quarantine are prioritised, gaps, weaknesses and constraints are addressed, relevant capacity is built and sufficient resources are secured. International cooperation is essential. This includes pre-border activities aimed at intercepting IAS at their source and the sharing of information between relevant organisations regionally and internationally.

Recommended Actions

Critical

- Include provisions on IAS prevention in a comprehensive Mauritian IAS Action Plan.
- Analyse gaps, weaknesses and constraints in the current border control and quarantine system.
- Develop plans for a future border control and quarantine system that builds upon existing measures and engages all stakeholders to ensure that the system is cross-sectoral, science-based and practical, adopts an adaptive management approach, is adequately resourced and is compatible with international agreements to which the Republic of Mauritius is a signatory. Plans should make recommendations for changes in legislation if necessary.
- Produce a list of all alien species currently in the country (from existing knowledge and from new surveys) and their status as captive species, pets, wild/feral, etc. The potential invasiveness of species that are present but not currently invasive in the Republic of Mauritius should be indicated.
- Develop generic risk assessment procedures based on models pioneered elsewhere. Only minor changes are likely to be needed to the existing protocols.
- Conduct risk assessments on proposed introductions.
- Conduct pathways analysis to assess the risks posed by particular IAS pathways through which species may be unintentionally introduced.
- Classify the Republic of Mauritius into “ecosystem units” (based on islands/island groups, aquatic ecosystem units and protected ecosystems) and outline IAS prevention measures to be undertaken for these units.

High Priority

- Implement plans for a future border control and quarantine system that builds upon existing measures and engages all stakeholders to ensure that the system is comprehensive, science-based and practical, adopts an adaptive management approach, is adequately resourced and is compatible with international agreements to which the Republic of Mauritius is a signatory.
- Develop a coordinated national risk analysis process including the establishment of an inter-agency risk analysis group.
- Ensure that risk assessments are conducted of all pathways and potential pathways for unintentional introductions.
- Ensure that risk assessments are conducted for all proposed alien species introductions.
- Carry out risk assessments for species that have the potential to accidentally be

transported to the Republic of Mauritius that have already caused problems elsewhere, for example the cane toad and the brown tree snakes.

- Develop capacity for risk assessment, border inspections and enforcement as part of a national IAS capacity building programme.
- Access relevant information on IAS prevention from national and international sources and make this available as part of a national IAS online information system.
- Develop and implement a public awareness campaign including the production of codes of conduct for specific groups e.g. the pet trade, the horticulture trade and the travelling public.
- Cooperate internationally to prevent invasive alien species introductions at their source.

Medium Priority

- Conduct and support research on prevention tools to improve decision-making.
- Utilise Mauritian expertise in prevention tools in a regional capacity building programme.

2. EARLY DETECTION & RAPID RESPONSE

Goal: To minimise the number of IAS that go on to have harmful consequences once they are introduced to the Republic of Mauritius.

No system of prevention can ever be one hundred percent effective. It is therefore essential to implement an early detection and rapid response system (EDRR) to identify those species that have escaped prevention and are now present in low densities in regions of the country (or within defined ecosystem units - islets, conservation areas, etc.). Because an invasive species is more likely to become a permanent resident in an ecosystem once it becomes established, EDRR efforts if successful are likely to be far less costly than long-term invasive species management programs. The cost of managing several species at low densities, even if most of them do not establish, is often far outweighed by the cost of managing a single established species.

Key elements of a EDRR system include: A surveillance system for identifying alien species new to the country and new to ecosystem units within the country (rapid and accurate species identification is essential); access to reliable scientific and management information; access to appropriate technical expertise; robust standard procedures for rapid risk assessment; an effective stakeholder consultation and coordination process; rapid access to stable funding for emergency response efforts and public understanding and support.

The initial response phase to a new incursion consists of the following actions:

1. Identify the suspected organism.
2. Conduct an initial assessment of its extent and likely impacts.
3. Determine the initial response level.
4. Determine the initial means of introduction and ensure that this loophole is closed.
5. Consult key stakeholders (those potentially affected and those with advice and information).
6. Conduct a more thorough survey of the extent of the incursion.
7. Check legal issues related to any response.
8. Decide if eradication is feasible.
9. If yes, undertake an eradication campaign and decide upon who should do it and with what resources.
10. If no, undertake containment, sustained control (and decide upon who should do it and with what resources) or do nothing.

The Republic of Mauritius has experience in the implementation of EDRR systems. The Combat Chikungunya Campaign appears to have been ultimately successful. However, the plan could have been initiated earlier and at less cost if a pathways risk assessment process had been in place in the Republic of Mauritius (Box 7). The public, if sufficiently sensitised can be of great assistance to any early detection efforts. In contrast to the case of chikungunya, the risk posed by the white grub to the Mauritian sugar industry has been long identified and an EDRR system is already in place should existing prevention measures fail (Box 4). The challenge is to learn from, adapt and expand these approaches from single species to IAS as a whole.

BOX 7 - THE COMBAT CHIKUNGUNYA CAMPAIGN - MEASURES TAKEN

In April 2005 residents of Port Louis reported cases of fever accompanied by joint pains. On investigation by the Ministry of Health the causative agent of the fever was confirmed to be the chikungunya virus. During the summer of 2005, 3,586 cases of chikungunya were notified to the health authorities. With the onset of winter, no cases were notified after July 31, 2005. In December 2005 nine cases were notified; all were people who had travelled to La Réunion and returned with the infection. In 2006 10,072 cases were notified of which 552 were from in Rodrigues

A Strategy and Action Plan to Combat Chikungunya was released on February 1 2006. There are four main components to the Strategy: surveillance, vector control, health education and community mobilisation

1. Surveillance

- All Medical Officers are informed about chikungunya and instructed to report suspected cases to Health Offices.
- Since February 2006, the law has been amended to make it mandatory for all doctors, both in the private and the public sectors to notify all suspected cases of chikungunya to the health authorities.
- Passengers arriving from Indian Ocean Islands are put under surveillance by Health Surveillance Officers.
- Hotels and guest houses have been instructed to report suspected cases of chikungunya.
- Public health measures are taken in the region of all suspected cases: elimination of mosquito-breeding sites, larviciding and health education.
- Blood samples are sent for confirmation of diagnosis to the virology laboratory and
- Daily compilation of cases and mapping of the outbreak is undertaken in order to focus public health interventions in the affected areas.

2. Vector Control

- The services of a private company were engaged for fogging in order to eliminate adult mosquito pending the purchase of hot fog generators by the Ministry of Health.
- Fogging apparatus and insecticide Cyfluthrine have been purchased.
- Temephos has been purchased for larviciding activities.
- Human resources have been increased (a number of Health Inspectors, Sprayermen, Leading Hands and Community Health Care Officers have been trained to perform house to house visits)
- A special Chikungunya Unit has been set under the responsibility of a Regional Health Superintendent based at the Ministry of Health and Quality of Life.

3. Health Education and Community Mobilisation

- Television programmes have been presented in several languages (Creole English, French and Bhojpuri).
- Radio programmes on national channels and private radio channels in the above languages.
- TV spots and radio messages on national channels and interviews with local and international press have been given.
- Information sheets have been widely circulated and posters and billboards have been designed, produced and displayed throughout the island.
- Talks have been given in Community Centres, Women's Organisations, clubs for the elderly, religious organisations, schools and workplaces.

4. Collaboration

a. Intersectoral Collaboration:

- Increased collaboration with the Ministry of Local Government in cleaning up operations at Municipality and District Council levels.
- Increased involvement of the Ministry of Environment in the organisation of cleaning up events with community participation.
- Collaboration with the private sector strengthened.
- Civil society has been enlisted in the effort to combat and eliminate chikungunya.

b. Regional Collaboration:

- Mission to La Réunion by the Regional Public Health Superintendent in order to acquire information on measures employed there and lessons learned.

c. International Collaboration:

- The World Health Organisation (WHO), on request, provided experts in epidemiology and control of communicable diseases.
- Expert in communication for behaviour impact undertook a one-week mission.
- A team of experts in vector control from Singapore provided technical assistance.
- Three high level officers from the Ministry of Health attended a 10-day course on the Concepts for Communication for Behavioural Impact in La Réunion conducted by WHO Mediterranean Centre for Reduction of Vulnerability, Tunis.

No cases of chikungunya have been notified from the Republic of Mauritius since mid-August 2006.

Recommended Actions

Critical

- Include provisions on EDRR in a comprehensive Mauritian IAS Action Plan. The EDRR plan should build upon existing national and international models and experiences, analyse gaps, weaknesses and constraints in current EDRR efforts in the Republic of Mauritius, and include provisions to engage all stakeholders to ensure that the system is cross-sectoral, science-based and practical, adopts an adaptive management approach, is adequately resourced and is compatible with international agreements to which the Republic of Mauritius is a signatory. The plan should include the following elements:
 - A national surveillance system.
 - Surveillance systems within ecosystem units.
 - Identification of “introduction hotspots” e.g. nurseries, pet shops, hotels, ports, marinas and people working with medicinal plants.
 - Standard risk assessment and data recording procedures.
 - An institutional framework for the implementation of the EDRR process.
 - Recommended legislative changes.
 - Actions to ensure access to sufficient taxonomic expertise.
 - Actions to ensure access to reliable scientific, management and geographical information.
 - Recommended actions to ensure public support and participation.
 - Recommended actions to ensure international cooperation for the exchange of information and other relevant resources.
 - Recommendations for mechanisms for resourcing core EDRR operations and stable and rapidly accessible resources for emergency response efforts.

High Priority

- Implement the action plan for a national early detection and rapid response system.
- Incorporate training in EDRR in a national capacity building programme.
- Cooperate regionally and internationally to develop a network of diagnostic and taxonomic expertise in key areas.

Medium Priority

- Conduct and support research on EDRR tools to improve decision-making.
- Utilise Mauritian expertise in EDRR in a regional capacity building programme.

3. ERADICATION

Goal: An agreed framework for eradication priorities is in place, eradications are undertaken as necessary and results are disseminated.

Eradication is often associated with EDRR. i.e. the eradication of a species from a small area close to the point of introduction. However, with improved techniques, it is now becoming possible to eradicate certain species from areas where previously long-term control was the only management option (Table 1). Islands are particularly suitable for species eradications as reinvasions are either unlikely or can be mitigated by adequate biosecurity measures. Rat eradications from islands, for example are becoming increasingly ambitious. The first documented rat eradication in the early 1960s was from the 1 ha Maria Island (New Zealand). Since then successful rat eradications have been undertaken on larger and larger islands and in 2003 the 11,300 ha Campbell Island (New Zealand), an island larger than Rodrigues, was declared rat free. Malaria has been successfully eradicated from many islands including Mauritius (Box 1) and smallpox has been eradicated from the entire planet! However, some species, notably plants and aquatic organisms are extremely difficult to eradicate unless their populations are very small and confined.

Table 1. The largest islands from which some common invasive mammals have been eradicated*.

Species	Island	Area (ha.)	Country
Feral goats (<i>Capra hircus</i>)	Isabela	500,000	Ecuador
Feral pigs (<i>Sus scrofa</i>)	Santiago	98,465	Ecuador
Feral cats (<i>Felis catus</i>)	Marion	24,000	S. Africa
Red fox (<i>Vulpes vulpes</i>)	Attu	93,000	USA (Alaska)
Mink (<i>Mustela vison</i>)	Kiimuu	100,000	Finland
Norway rat (<i>Rattus norvegicus</i>)	Campbell	11,300	New Zealand
Ship rat (<i>Rattus rattus</i>)	Hermite	1,022	Australia
Pacific rat (<i>Rattus exulans</i>)	Raoul	2,950	New Zealand
Mouse (<i>Mus musculus</i>)	Enderby	710	New Zealand
Rabbit (<i>Oryctolagus cuniculus</i>)	St. Paul	800	France (Kerguelen)

*The goat eradication from Isabela has yet to be confirmed

Eradication is not an end in itself and must be justified by ecosystem level goals so in some cases eradication might not be appropriate even if it were to be feasible. If eradication is deemed to be appropriate it is essential to consider a variety of factors when planning the eradication campaign. The eradication method or methods should be selected on the basis of their effectiveness against the target species, selectivity and cost. All individuals of a target species must be put at risk by the spatial scale over which operations are conducted, the density of resource allocation and by the technique(s) chosen. The chosen methods should be as humane as possible and impacts on non-target species and the target ecosystem should be minimised. The risk of reinvasion should be as close to zero as possible. Effort, costs and results should be monitored. Funding and personnel should be committed for the duration of the eradication campaign.

Recommended Actions

Critical

- Include provisions on eradication in a comprehensive Mauritian IAS Action Plan.
- Document the successes and failures of eradication attempts from the Republic of Mauritius undertaken to date.
- Analyse gaps, weaknesses and constraints in previous eradication efforts and recommend measures to address these.
- Produce a list of eradication priorities using a transparent prioritisation process (based on criteria such as feasibility, availability of funding and other resources, public acceptability, ecosystem outcomes, etc.). This list must cross-reference islet management plans, NBSAP and other relevant documents.

High Priority

- Produce feasibility plans for prioritised eradications aimed at funders.
- Undertake funded eradications based on an operational plan.
- Monitor eradications and disseminate findings.
- Incorporate training in eradication tools in a national capacity building programme.
- Incorporate information on eradication programmes in the Republic of Mauritius into a national IAS online information system which is linked to international eradication information sources.
- Develop and implement public awareness campaigns on eradication efforts as appropriate.
- Cooperate internationally to help to ensure that Mauritian eradication programmes meet international best practices.

Medium Priority

- Conduct and support research on eradication tools to improve decision-making.
- Develop and share Mauritian expertise on eradication techniques with other SIDS.
- Utilise Mauritian expertise in eradication tools in a regional capacity building programme.

4. CONTROL AND MANAGEMENT

Goal: To contain the distribution and abundance of IAS in the Republic of Mauritius to a long-term acceptable level.

Once IAS are established and eradication is no longer possible or cost effective under prevailing conditions, the most effective action is often the use of control measures to lessen the spread and negative impacts of the target species. Control methods used should be environmentally friendly, ecologically and financially sustainable and have minimum side effects. Control and management objectives include but are not restricted to: eradication from a specified area, population suppression to within biological or socio-economic thresholds, and limiting dispersal and reducing impacts. Control and management of IAS populations should be accomplished using an integrated pest management (IPM) approach. The range of complementary control methods to be implemented to achieve a desired objective may

include: 1) cultural practices (e.g., crop rotation, revegetation, grazing, water level manipulation and habitat management); 2) physical restraints (e.g., fences, equipment sanitation and electric dispersal barriers); 3) removal (e.g. culling, hand-removal, mechanical harvesting, cultivation, burning and mowing); 4) judicious use of chemical and biopesticides; 5) release of selective biological control agents (such as **host-specific** predator/herbivore organisms); and 6) interference with behaviour or reproduction (e.g. pheromone-baited traps and release of sterile males and conditioned taste aversion). Management methods that do not work directly on the target species include land use modifications, changes in lifestyle and the undertaking of mitigation work. Doing nothing is also a management option if the cost of proposed management efforts and/or the resulting harmful side-effects of this management are deemed to be unjustifiable.

Ex-situ storage of germplasm of species jeopardised by IAS is a management option that is being undertaken as part of the NBSAP for the Republic of Mauritius.

All of the Republic of Mauritius' remaining important native terrestrial ecosystems are invaded by a diverse array of IAS that is to all intents and purposes impossible to eradicate with the techniques, technology or methods available today. If it were not for the IAS control and management efforts that have been undertaken in recent years, these areas would degrade into ecosystems dominated by IAS. Control and management programmes are currently restricted to small areas which are not large enough to be ecologically viable in the long term. A major challenge is to scale up these efforts and secure sufficient resources for important ecosystems under both public and private management.

Recommended Actions

Critical

- Include provisions on IAS control in a comprehensive Mauritian IAS Action Plan.
- Review IAS control and management efforts undertaken in the Republic of Mauritius to date, documenting successes and lessons learned.
- Recommend control and management approaches that can be successfully and cost effectively executed on larger areas than those that are currently being managed for biodiversity conservation. These recommendations should take into account lessons learned from previous experience in the Republic of Mauritius and international best practice.
- Identify and prioritise a network of areas requiring IAS control measures.
- Assess Mauritian IAS management and control capacity and produce capacity building recommendations.
- Build upon existing efforts to showcase Mauritian IAS management projects in order to build public awareness nationally, in the Indian Ocean Region and globally.

High Priority

- Utilise recommended strategic control and management approaches in new and ongoing projects. Detailed monitoring needs to be conducted to provide a strong information base to be used when scaling up these projects.
- Scale up areas under integrated management utilising the experiences gained in completed and ongoing projects.
- Incorporate training in control and management in a national capacity building programme.
- Incorporate information on IAS control and management in the Republic of Mauritius into a national IAS online information system which is linked to relevant international information sources.
- Develop and implement public awareness campaigns on control and management programmes as appropriate.
- Cooperate internationally to help to ensure that Mauritian control and management programmes meet international best practices.
- Develop and share Mauritian expertise on eradication techniques with other tropical island states.

Medium Priority

- Conduct and support research on control and management tools to improve decision-making.
- Utilise Mauritian expertise in control and management tools in a regional capacity building programme.

5. RESTORATION

Goal: To undertake ecosystem restoration where necessary in the Republic of Mauritius to achieve long-term ecosystem goals.

Restoration approaches can be used for biodiversity conservation purposes and/or for the enhancement of ecosystem services such as soil conservation and adequate provision of water.

IAS can exert multiple, complex and interacting ecosystem impacts. In many cases control and even eradication are not sufficient alone to achieve the stated ecosystem level goals. Key species may have become locally or even globally extinct, nutrient and hydrological conditions may have been changed and multiple sources of invasion may still be present. It may then be necessary to actively restore the target ecosystem using techniques such as planting out of native plants, altering nutrient regimes and captive breeding and release of native animals and analogue species. Restoration techniques are improving all the time and larger and larger areas are now being restored. Many advances in restoration techniques have been pioneered in the Republic of Mauritius.

Restoration programmes have played a critical part in the conservation of the Republic of Mauritius' degraded terrestrial ecosystems for some time (Box 3). Ongoing mainland and islet restoration work undertaken by Government-NGO partnerships have been recently augmented by ecosystem restoration initiatives that have been initiated in biodiversity-rich

ecosystems under private management. As outlined in the Control and Management section, the major challenge is scaling up this restoration work and securing sufficient resources so that the restored ecosystems will be viable in the long-term and become more biogeographically secure.

Efforts to restore ecosystem services can lead to invasive species problems and other undesirable ecological consequences. Piquant loulou⁴ (*Acacia nilotica* *Acacia nilotica* subsp. *Adstringens*), for example, introduced to Rodrigues in the 1970s for erosion control, soil improvement and as a plantation tree, is now highly invasive. The revegetation of large areas with eucalyptus species, pine species and filao (*Casuarina equisetifolia*) appears to have resulted in low biodiversity and soil degradation.

Restoration efforts on Mauritian aquatic ecosystems have been limited to date. This reflects the situation internationally. However, aquatic restoration techniques are improving and aquatic restoration in the Republic of Mauritius is likely to become increasingly important.

Recommended Actions

Critical

- Include provisions on ecological restoration in a comprehensive Mauritian IAS Action Plan.
- Review ecological restoration efforts undertaken in the Republic of Mauritius to date, documenting successes and synthesising the lessons learned.
- Recommend ecological restoration approaches that can be successfully executed on larger areas than those that are currently being managed for biodiversity conservation. These recommendations should take into account lessons learned from previous experience in the Republic of Mauritius and international best practice.
- Assess Mauritian ecological restoration capacity and produce capacity building recommendations.
- Build upon existing efforts to showcase ecological restoration projects in order to build public awareness.

High Priority

- Utilise recommended ecological restoration approaches in pilot projects. Detailed monitoring needs to be conducted to provide a strong information base to be used when scaling up these projects.
- Scale up areas under ecological restoration using the results of pilot projects.
- Incorporate training in ecological restoration in a national capacity building programme.
- Incorporate information on ecological restoration in the Republic of Mauritius into a national IAS online information system which is linked to relevant international information sources.
- Develop and implement public awareness campaigns on ecological restoration efforts as appropriate.
- Cooperate internationally to help to ensure that Mauritian ecological restoration

⁴ Piquant loulou is the local name for *Acacia nilotica* in Rodrigues and *Rubus alceifolius* in Mauritius

programmes meet international best practices.

Medium Priority

- Conduct and support research on ecological restoration tools to improve decision-making.
- Utilise Mauritian expertise in ecological restoration tools in a regional capacity building programme.

CROSS-CUTTING ELEMENTS

For IAS management to be executed optimally it is necessary that critical areas that cut across all the management elements are addressed. These “cross-cutting elements” are addressed below.

6. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORKS

Goal: A coordinated policy and management framework that minimises the risk of IAS to the economy, environment and society of the Republic of Mauritius.

Mauritian national legal measures have evolved in a reactive piecemeal manner, responding to new problems and pathways relating to IAS. Single sector approaches have been the norm. Coordination and cooperation between relevant institutions is necessary to address possible gaps, conflicts of interest, weaknesses and inconsistencies between the many legal, policy and institutional frameworks that address IAS in the Republic of Mauritius. Participation in activities that help minimise the negative impacts of IAS must be as inclusive as possible to make maximum use of available capacity and to heighten public interest.

Institutional mandates regarding IAS issues in the Republic of Mauritius are fragmented and spread across departments in different ministries. Private land owners also have obligations. The Republic of Mauritius has no formal apex body responsible for IAS issues. The NIASC, formed in 2003, is a cross-sectoral body responsible for providing advice on IAS issues to individual government departments but it has no formal authority and no full time staff. A formalised apex body for IAS issues would have more authority, capacity and resources to act. Recommended options for an IAS apex body for the Republic of Mauritius are outlined in Box 8.

BOX 8 - OPTIONS FOR AN IAS APEX BODY FOR THE REPUBLIC OF MAURITIUS

Representatives of stakeholder organisations met on 28 and 29 November 2007 to review the draft National Invasive Species Strategy for the Republic of Mauritius. There was unanimity on the need to establish an “Apex Body” to oversee IAS issues in the Republic of Mauritius.

Scope of the Apex body

There was consensus on the fact that the Apex Body should undertake a facilitating, but not an implementing role in the undertaking of actions to ensure that the negative impacts of invasive alien species on the economy, environment and society of the Republic of Mauritius are avoided, eliminated or minimised. i.e. facilitating the implementation of the forthcoming National IAS Action Plan. In carrying out this role the Apex Body would provide an overview of IAS issues in the Republic of Mauritius, facilitate the action of existing implementing agencies, identify gaps and overlaps and coordinate responses, and secure funds for recommended actions. The Apex Body would not remove powers from existing implementing agencies.



*Participants in a small group session at the National Invasive Species Strategy Workshop: 28-29 November 2007.
Photo - NPCS*

The Nature of the Apex Body

Three options were discussed:

1. A stand alone committee of representatives of major stakeholders.
2. A group embedded in a major government department
3. An independent government agency

Option 3 was the strongly recommended. It was emphasised that the agency would require high level full time technical and administrative staff though this did not need to be a large number of people. Although it would be an independent agency, it ought to be housed within an existing government department.

The Agency Hosting the Apex Body

Two principal options were discussed:

1. Housing the body within the Ministry of Agro Industry and Fisheries. Most of the government bodies responsible for IAS issues in the Republic of Mauritius fall under this Ministry so it was felt by many that it would be logical for the Apex Body to be housed here.
2. Housing the body within the Prime Minister's Office (PMO). Those in favour of this option felt that housing the Apex Body within the PMO would help it to maintain its independence and that it would enjoy a large amount of support at the highest level of government. Some participants, however, were concerned that being positioned at such a high political level could be disadvantageous as the Apex Body would not receive much attention from the institution within which it was housed.

Detailed recommendations on the establishment of an Apex Body for the Republic of Mauritius will be contained in the forthcoming National IAS Action Plan.

Economic policies, though not necessarily directly addressing IAS issues, can help to promote behaviour that can increase or decrease IAS impact. Species invasions are a consequence of economic decisions and have economic impacts. However the costs of invasions are seldom reflected in market prices. While prevention, eradication, control, mitigation and adaptation all yield economic benefits, they are public goods. If left only to the market, the control of IAS will be inadequately provided for. Because biological invasions often indicate market failure, an important part of any strategy to manage IAS is to make markets work to minimise IAS impacts wherever possible and to provide alternative solutions if markets do not exist or cannot be created. Therefore, countries must incorporate economic principles into their national strategies for addressing IAS, building on the following main principles: user pays, full social cost pricing and the precautionary principle.

Ensuring that IAS issues are addressed in institutional mandates and incorporating IAS considerations into economic instruments are examples of the mainstreaming process. This process is to be guided by the National Invasive Alien Species Strategy for the Republic of Mauritius which provides the framework for action to be taken to minimise the negative impacts of IAS in the Republic of Mauritius. It is to be supported by a detailed IAS Action Plan that will outline the specific steps to be taken to ensure the successful implementation of the National Invasive Alien Species Action Plan (NIASAP). This will be complemented by a series of supporting documents.

Recommended Actions

Critical

- Finalise the National Invasive Alien Species Strategy for the Republic of Mauritius and obtain Government endorsement.
- Produce the National Invasive Alien Species Action Plan for the Republic of Mauritius (which will include provisions on legal policy and institutional frameworks) and the other review and action plans recommended in the IAS Strategy.
- Identify gaps, weaknesses and inconsistencies in relevant policies, legislation and institutions of relevance to IAS issues, mapping current/potential needs against current accountabilities and abilities to deliver.
- Develop model policies and legislation, incorporating international agreements to which the Republic of Mauritius is a signatory where necessary. Legislation could take the form of a unitary piece of legislation (an Invasive Alien Species Bill) and/or amendments to existing legislation.
- Develop model institutional arrangements for the management of IAS in the Republic of Mauritius.
- Develop economic policies and tools incorporating user pays, full social cost pricing, the precautionary principle and the protection of the public interest.
- Examine issues that act as barriers to the effective enforcement of existing legislation (e.g. resource and capacity constraints, inadequate access to information and lack of public engagement).

High Priority

- Encourage authorities to adopt model policies and legislation, incorporating international agreements to which the Republic of Mauritius is a signatory.
- Incorporate IAS provisions in existing policies and tools as necessary.
- Form an Apex Body for IAS in the Republic of Mauritius, housed within an existing institution with representation from all relevant sectors.
- Improve institutional linkages and coordination in line with recommendations.
- Develop national level institutions and establish IAS specialist positions within these institutions.
- Develop strategic management teams or functional working groups to work on specific issues.
- Encourage authorities to adopt economic policies and tools incorporating user pays, full social cost pricing, precautionary principle and protection of the public interest.
- Implement actions to remove the barriers to the effective enforcement of existing legislation.

7. CAPACITY BUILDING AND EDUCATION

Goal: Appropriately skilled personnel from the Republic of Mauritius and elsewhere available to implement all aspects of IAS management in the country.

National will must be allied to the capacity to act if the Republic of Mauritius is to successfully address the problems posed by IAS. Building, obtaining and retaining capacity is always going to be a challenge to a SIDS. It is critical therefore, that existing capacity is used optimally. It is also imperative that capacity building initiatives at the national level are closely linked to regional and international efforts. International collaboration can result in resource sharing and pooling of expertise. Many Mauritians and professional non-Mauritians based in the Republic of Mauritius have been at the forefront of invasive species management efforts for some time and they have a great deal to offer to international capacity building initiatives and exchanges of expertise. Their expertise could be used in a regional capacity building programme which would provide opportunities to exchange relevant skills, knowledge and information.

Recommended Actions

Critical

- Include provisions on capacity building in a comprehensive Mauritian IAS Action Plan.
- Review current IAS management capacity levels in the Republic of Mauritius, assess gaps, make recommendations for the best use of available capacity and develop a capacity building programme that addresses these gaps.
- Produce a “registry of regional IAS expertise” along the lines of the Delivering Alien Invasive Species Inventories for Europe (DAISIE) system (<http://www.europe-alien.org/>) as part of a national invasive alien species online information system.
- Review coverage of IAS issues in national education curricula and produce recommendations for the incorporation of IAS issues into education curricula.

High Priority

- Launch national IAS capacity building programme for policy makers, managers, scientists, teachers, students, and others.
- Reinforce capacity in specific institutions.
- Implement recommendations for the best use of available capacity.
- Use existing projects as capacity building opportunities as part of longer term training schemes in the form of an “apprenticeship”. This could also promote the international exchange of “apprentices” thus broadening their training.
- Implement recommendations for the incorporation of IAS issues into education curricula.

Medium Priority

- Build capacity to implement capacity building and education programmes.
- Help to build a regional capacity building programme and utilise Mauritian expertise in this programme.

8. INFORMATION MANAGEMENT AND RESEARCH

Goal: (i) To have a clear understanding of the economic, environmental and social impacts of IAS that have become established in the Republic of Mauritius; (ii) to have ready access to critical information that will support IAS management programmes and (iii) to provide a strong scientific basis for decision-making and resource allocation;

IAS-related Information has expanded hugely in recent years. The high rates of internet availability in the Republic of Mauritius provide those working on IAS issues in the Republic of Mauritius with an unprecedented opportunity to access valuable information from within the region and elsewhere. The challenge is not a lack of information but the provision of accessible, accurate, referenced, up-to-date, comprehensive and comprehensible information on invasive species that will be useful to policy makers, managers, scientists, teachers, students and others. A national IAS online information system, linked to relevant and reliable national (e.g. MOI, NPCS, MWF, Ministry of Environment and National Development Unit, MSIRI) and international websites (e.g. GISP, PIER, IMO) could provide a one-stop shop for IAS information related to and of relevance to the Republic of Mauritius. This could be integrated into an existing information system such as that developed by the Ministry of Environment and National Development Unit.

Research supports every aspect of invasive species management. Because of its size and concomitant capacity constraints it is unlikely that a SIDS such as the Republic of Mauritius can be at the forefront of much of the ongoing basic IAS-related research, although work that focuses on the Republic of Mauritius can be part of such research through exchange programmes. However, research on issues that are specific to the Mauritian situation is vital and findings from Mauritian research have been and will continue to be of value to the international community. A large amount of information can be derived from monitoring programmes which assess the impact of management actions on target organisms and ecosystems, or from the development of these management actions themselves. It is critical that all data is collated, analysed and written up in a way that makes it accessible to a number of different audiences. This dissemination process will improve understanding of IAS

issues and provide valuable information that can be used to improve future IAS management efforts.

In all cases there is “no need to reinvent the wheel” so it is crucial to be aware of what information is available so that any research undertaken in the Republic of Mauritius is filling gaps and is complimentary and synergistic to, rather than simply a repetition of work that has already been undertaken elsewhere. Failed actions must also be recorded, preventing others making the same mistakes.

Recommended Actions

Critical

- Include provisions on information management and research in a comprehensive Mauritian IAS Action Plan.
- Produce a review of IAS status in the Republic of Mauritius incorporating relevant research findings.
- Produce recommendations for IAS research in the Republic of Mauritius (see Box 9).
- Produce an online information system for the Republic of Mauritius which is linked to international sources of information.

High Priority

- Implement recommendations for IAS research in the Republic of Mauritius.

BOX 9 - PRIORITIES FOR IAS-RELATED RESEARCH IN THE REPUBLIC OF MAURITIUS

The National Invasive Alien Species Committee outlined some of the IAS-related research priorities for the Republic of Mauritius during the preparation of the NIASS. These ideas can feed into a national IAS research strategy.

Research priorities, listed below, can be divided into priorities for fundamental research and priorities for research applied to the Mauritian context. The Republic of Mauritius alone is unlikely to have the resources to prioritise the former but it will be useful for the country's scientists to keep abreast of fundamental research in order to improve the management of IAS in the Republic of Mauritius.

Fundamental Research

- Expanding research in systematics, thereby building the capacity to identify, record and monitor invasions.
- Improving the understanding of how and why species establish and become invasive.
- Developing a better understanding of geographical limits of species distributions with the aim of developing predictive indicators of invasive alien species impacts.
- Investigating the role of biological factors vs. freak events that mediate long-distance dispersal.
- Developing for wider application a modified version of the host- pathogen-environment framework used by the community of scientists working on plant pathology.
- Building a better understanding of the relationships among climate change, CO₂ levels, soil moisture availability, photosynthetic pathways and plant population dynamics.
- Improving the understanding of why one ecological community is more vulnerable to invasions than another.
- Developing criteria to measure and classify biological and economic impacts of alien species on natural ecosystems.
- Assessment and prediction of economic risks of IAS.
- Research into valuation of IAS, understanding the economic- ecological dynamics of invasions.
- Improving our understanding of risk and uncertainty and economic factors that encourage species invasions.
- Developing a risk analysis model for accidental introductions.
- Valuation of methods to mitigate the negative impacts of IAS, as an input into benefit-cost analysis.
- Improving the basis upon which biological control strategies are evaluated.
- Developing better methods for excluding or removing alien species from traded goods, packaging material, ballast water, personal luggage, aircraft and ships.



Well designed monitoring is an integral part of IAS-related research.
MWF.

Research Applied to the Mauritian Context

- Improved understanding of major entry points for new species.
- Mapping endangered areas and invasive species infestations.
- Understanding how Mauritian ecosystem diversity and function have been impacted by IAS.
- Determination of agronomic practices that might impact on IAS (e.g. fertilizer runoff, pesticide use, etc.).
- Determination of economic impacts of IAS.
- Characterising the differential effects of alien species on different human groups.
- Assessing the impacts of IAS management efforts.
- Assessing the cost: benefit balance of managing IAS as a tool for influencing decision makers.
- Developing effective, target-specific, humane and socially acceptable methods for IAS prevention, early detection and rapid response, eradication, management and control, and restoration.
- Developing effective, humane and socially acceptable methods for ecological restoration.
- Collaborate in the development of biological control for key species.
- Developing tools to factor invasive species into the National decision-making process.

9. PUBLIC AWARENESS AND ENGAGEMENT

Goal: The general public, decision-makers, scientists and other stakeholders in the Republic of Mauritius have a high level of awareness of IAS risks and the benefits of IAS prevention and management for the economy, environment and society; Stakeholders who are actively engaged in the development of best practices to minimise the negative impacts of IAS.

Views of invasive species issues are moulded by human values, decisions and behaviours. In the Republic of Mauritius there is currently a very high level of awareness of the significance of certain invasive species to certain sectors e.g. avian flu, malaria, white grubs and chikungunya. However, awareness of IAS as a generic and cross-sectoral issue is low. Most people in the Republic of Mauritius would probably not be familiar with the term “invasive alien species”. IAS prevention and management will require a change in behaviours, values and beliefs and in the way that decisions are made regarding our actions to address IAS. Such changes will be of benefit to all aspects of IAS management.

Public awareness work is essential if these changes are to be made. This work needs to be closely coordinated with IAS capacity building and education initiatives. It also needs to be linked to existing awareness raising programmes that relate to the biodiversity conservation, the wider environment, agriculture and health (Annex 5). This is one way in which IAS issues can be mainstreamed. Awareness-raising work will be principally targeted, at Mauritian residents but all those who engage in activities related to Mauritian trade, travel and transport need to be targeted as well

Public awareness programmes undertaken in the Republic of Mauritius can benefit from similar public awareness programmes undertaken in other countries which can be adapted to the local context. Information on Mauritian experiences can also be very useful for those working on IAS issues regionally and internationally.

Recommended Actions

Critical

- Include provisions on public awareness and engagement in a comprehensive Mauritian IAS Action Plan.
- Undertake a survey of IAS awareness levels in the Republic of Mauritius before and after public awareness campaigns, thus measuring the effectiveness of these campaigns.
- In conjunction with the above, conduct a stakeholder analysis to help ensure that an awareness campaign engages all stakeholders.
- Develop an IAS public awareness campaign targeted at different stakeholder groups; wherever possible making linkages between IAS-related actions and economic development programmes, environmental protection measures and other established societal priorities.

High Priority

- Implement a public awareness campaign targeting different stakeholder groups.
- Develop targeted awareness raising material including briefing documents for policy makers and make this material available on a national invasive alien species online information system.
- Use ongoing projects as awareness raising opportunities.
- Raise awareness of the Mauritian IAS situation regionally and internationally.

10. INTERNATIONAL COOPERATION

Goal: (i) The Republic of Mauritius should have access to the necessary information, technical support and other resources it needs to effectively meet its national and international obligations; (ii) Mauritian IAS experiences and lessons learned are effectively disseminated to help IAS initiatives regionally and internationally and (iii) the Republic of Mauritius is not a source of IAS for other countries

IAS are by definition an international issue with biological invasions driven by trade, travel and transport and the international legal regimes that govern them. National actions are necessary but by themselves not sufficient to manage the full range of activities and processes that generate invasions. The government has long realised that international cooperation is particularly important to a SIDS such as the Republic of Mauritius. This has been reflected in the many IAS-related initiatives that have been undertaken in partnership with international collaborators in the Republic of Mauritius.

The Republic of Mauritius has in turn always been supportive of international efforts to strengthen the process of invasive species prevention and management. As a SIDS, the Republic of Mauritius cannot easily initiate international programmes alone but it can lobby international agencies to undertake action that would improve IAS management worldwide. The establishment of IAS-related regional collaboration and consortia would strengthen this lobbying power. For example the Republic of Mauritius could play an important role in lobbying for the harmonisation of international regulations, the establishment of institutions such as an IAS equivalent of the Center for Disease Control that would provide data on the distribution, impact, movement and risks of invasive species and for the building of IAS into global change initiatives.

Recommended Actions

Critical

- Include provisions on international cooperation in a comprehensive Mauritian IAS Action Plan.
- Assess the Republic of Mauritius' needs for international technical cooperation.
- Assess the scope for regional collaboration in IAS issues.
- Continue to build links with international organisations that can support IAS-related in the Republic of Mauritius work through technical assistance, provision of funds and by other means.
- Continue to disseminate IAS-related information regionally and internationally.

High Priority

- Expand on existing regional collaboration in IAS issues.
- Expand on existing international collaboration in IAS issues.

Medium Priority

- Lobby (individually and in conjunction with other nations and interest and interest groups) governments and international agencies to consider IAS to be a strategic issue that needs to be addressed within the mainstream agenda.
- Lobby for harmonisation of regulation/legislation so that gaps and inconsistencies in major international and regional instruments relevant to IAS are resolved.
- Lobby for the establishment of an international invasive species information centre.
- Lobby for building IAS into global change programmes.
- Lobby for and support international initiatives to agree a common IAS vocabulary.
- Develop multi-national regional IAS-related projects.

11. PROVISION OF ADEQUATE RESOURCES

Goal: An IAS management system that has sufficient human, technical and financial resources for its sustainable implementation.

Recommended measures can only be undertaken if adequate resources are available. Technical resource requirements are addressed under capacity building. Financial resources are considered in this section.

A significant amount of funding for IAS management in the Republic of Mauritius currently comes from the central government's recurrent budget. The Republic of Mauritius has also been fortunate in having secured a number of international grants and national counterpart funding for IAS-related work. Such grants are very effective ways to establish initiatives but they do not represent a sustainable, predictable and long-term source of funding. Finding sustainable funding is a challenge for IAS-related work as in many instances it must be pursued indefinitely.

A very valuable source of financing for biodiversity conservation has been the National Parks and Conservation Fund, which is raised through a levy on the exploitation of invasive species in Mauritius' conservation areas. Funds from the Ministry of Environment and National Development Unit have also been used to finance IAS-related work. Growing contributions are being made by ecotourism projects. There exist a number of other potential sources of funding such as levies on imports of alien species and charges for phytosanitary services. IAS-related work; such as intensive weeding could be financed by job creation and social initiatives. A scheme to utilise ex-sugar industry workers in weed management programmes in the Black River Gorges National Park in Mauritius has recently been agreed and this represents a positive step in this direction. Similar approaches have been successfully pioneered by the Working for Water Programme in South Africa. In order to sustainably fund IAS-related work in the Republic of Mauritius it is essential to vigorously and creatively investigate all current and potential funding sources.

Recommended Actions

Critical

- Include provisions on securing of adequate resources in a comprehensive Mauritian IAS Action Plan.
- Produce detailed estimates of resource requirements in the IAS Action Plan.
- Produce report on mechanisms for sustainable funding of IAS programmes and recommendations for self-financing and cost recovery systems.

High Priority

- Establish a fund for rapid response.
- Establish a pilot sustainable financing and cost recovery programme for IAS activities.

Medium Priority

- Implement cost recovery programmes as appropriate in all IAS-related sectors.

CONCLUSION

Invasive alien species have established throughout the Republic of Mauritius, damaging her natural and cultivated ecosystems and causing severe health impacts. As a consequence IAS are now recognised as among the most serious threats to the Nation's economy, environment and society.

This plan represents a first step in the move from the prevailing sector-lead approach that focuses on particular species to a comprehensive coordinated approach that addresses IAS issues as a whole. This approach will be further developed in the National IAS Action Plan. This change of emphasis adopted by the Strategy and Action Plan is likely to help raise the profile of IAS in the country. This raised profile will help to secure the resources and public support that are needed if these plans are to be effectively implemented. This implementation phase will be a great challenge.

If this challenge is not met, then increasing mobility, greater volumes of trade and the growing complexity of transport networks are sure to result in increasingly severe IAS impacts in the Republic of Mauritius in the near future. Business as usual – an uncoordinated, reactive and *ad hoc* approach will prove to be much more costly to the Mauritian economy, environment and society than the coordinated and comprehensive approach outlined in this Strategy.

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ANNEXES

ANNEX 1. LIST OF ACRONYMS AND ABBREVIATIONS

BAT	Bait Application
CBD	Convention on Biological Diversity
COP	Conference of Parties
DAISIE	Delivering Alien Invasive Species Inventories for Europe
EDRR	early detection and rapid response system
EIP II	Second Environment Investment Programme
EPPO	European Plant Protection Organisation
ERMA	Environmental Risk Management Authority (New Zealand)
FAO	Food and Agricultural Organisation of the United Nations
GISP	Global Invasive Species Programme
IAPSC	Inter-African Phytosanitary Council
IAS	Invasive Alien Species
IMO	International Maritime Organisation
IPM	integrated pest management
IPPC	International Plant Protection Convention
LMO	Living Modified Organisms
MAT	Male Annihilation Technique
MOI	Mauritius Oceanography Institute
MSIRI	Mauritius Sugar Industry Research Institute
MWF	Mauritian Wildlife Foundation
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non Governmental Organisation
NIASC	National Invasive Alien Species Committee
NIASS	National Invasive Alien Species Strategy
NPCS	National Parks and Conservation Service
OIE	World Organisation for Animal Health
PIER	Pacific Island Ecosystems at Risk
PMO	Prime Minister's Office
RRA	Rodrigues Regional Assembly
SIDS	Small Island Developing State
SPS	Sanitary and Phytosanitary Agreement of the WTO
WHO	World Health Organisation
WTO	World Trade Organisation

ANNEX 2. GLOSSARY

Adaptive Management	Adaptive management allows for the implementation of corrective measures in systems on an ongoing basis, based on a process of continued monitoring (www.biotrade.org/Intro/Definitions/bti-definitions.htm).
Alien Species	A species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce (Convention on Biological Diversity Decision VI/23, 2002).
Ballast Water	Water with its suspended matter taken on board a ship to control trim, list, draught, stability or stresses of the ship (International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004).
Biodiversity	Variability among living organisms from all sources including, <i>inter alia</i> , terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity, 1992).
Biosecurity	Measures that are intended to prevent the introduction of invasive alien species (pests and diseases) which pose a risk to plant and animal health, ecosystems and human health.
Containment	Application of measures in and around an infested area to prevent spread of an invasive alien species beyond a defined area.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their abiotic environment interacting as a functional unit (ISPM No. 3, 1996; revised ICPM, 2005).

Ecosystem Approach	A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (Convention on Biological Diversity Decision V/6).
Endemic	A species native to an area and occurring nowhere else.
Eradication	Application of measures to eliminate an invasive alien species from a defined area (an Invasive Alien Species Strategy for Canada, 2004).
Establishment	The process of an alien species in a new habitat successfully producing viable offspring with the likelihood of continued survival (Convention on Biological Diversity Decision VI/23, 2002).
Full Social Cost Pricing	Pricing that takes account of the full cost of an item to include variables such as environmental impact and other externalities.
Introduction	The entry of a pest resulting in its establishment (FAO, 1990; revised FAO, 1995; IPPC, 1997).
Invasive Alien Species (IAS)	An alien species whose establishment and spread threaten ecosystems, habitats or species with economic or environmental harm. These are addressed under Article 8(h) of the Convention on Biological Diversity (CBD) (Working definitions used by the Global Invasive Species Programme (GISP) (UNEP/CBD/SBSTTA/6/INF/5 Annex II.)).
Living Modified Organism (LMO)	Any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology (Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000).
Mainstreaming	The integration of an issue into the mainstream. e.g. into the policies and plans of major ministries and into public awareness.

Naturalisation	A further step beyond establishment such that a species can reproduce and spread without human intervention, protection or support.
Pathway	The geographic route by which a species moves outside its natural range (past or present); the corridor of introduction (e.g. road, canal, tunnel); and/or the human activity that gives rise to an intentional or unintentional introduction (Convention on Biological Diversity Decision VI/23, 2002).
Phytosanitary Action	An official operation, such as inspection, testing, surveillance or treatment, undertaken to implement phytosanitary measures (ICPM, 2001; revised ICPM, 2005).
Precautionary Principle	Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (Rio Declaration, 1992).
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing and/or treatment (International Plant Protection Convention ISPM #05 Glossary of Phytosanitary Terms).
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing and/or treatment (FAO, 1990; revised FAO, 1995; CEPM, 1999).
Risk	The uncertainty that surrounds future events - a function of the likelihood of an adverse event and the severity of the consequences of that event.
Risk Analysis	The process that includes risk assessment, risk management and risk communication.

Risk Assessment	The evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences. Where economic consequences are interpreted to include environmental consequences (International Plant Protection Convention ISPM #05 Glossary of Phytosanitary Terms, 2002).
Risk Communication	The interactive exchange of information on risk among risk assessors, risk managers and other interested parties (World Organization for Animal Health (OIE) Terrestrial Animal Health Code, 11th Edition, 2003).
Risk Management	The evaluation and selection of options to reduce the risk of introduction and spread of a pest (International Plant Protection Convention ISPM #05 Glossary of Phytosanitary Terms).
Species	A group of interbreeding organisms that differs from and is reproductively isolated from other such groups.
Sterile Insect Technique	Method of pest control using area-wide inundative release of sterile insects to reduce reproduction in a field population of the same species (ISPM No. 3, 2005).
Taxonomy	The theory and practice of describing, naming and classifying plants and animals (http://www.nwfsc.noaa.gov/resources/lingo.cfm).
User Pays Principle	Variation of the polluter-pays principle that calls upon the user of a natural resource to bear the cost of running down natural capital (http://glossary.eea.europa.eu/EEAGlossary/U/user-pays_principle).
Vector	The physical means or agent (i.e. aeroplane, ship) in or on which a species moves outside its natural range (past or present). (Convention on Biological Diversity Decision VI/23, 2002).

ANNEX 3. INTERNATIONAL ORGANISATIONS AND AGREEMENTS OF RELEVANCE TO IAS TO WHICH THE REPUBLIC OF MAURITIUS IS A SIGNATORY

- African Convention for the Conservation of Nature and Natural Resources*
- African Eurasian Waterbird Agreement (AEWA)
- Cartagena Protocol on Biosafety, 11 September 2003;
- Convention on Biological Diversity (CBD)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on Migratory Species (CMS)
- Convention on the Prevention of Pollution from Ships of 1973, as modified by the Protocol of 1978 (MARPOL 73/78)
- FAO Code of Conduct for Responsible Fisheries;
- ICES (International Council for the Exploration of the Sea) Code of Practice
- Inter-African Phytosanitary Council (IAPSC)
- International Civil aviation Organisation (ICAO)
- International Health regulations (IHR)
- International Maritime Organisation (IMO)
- International Plant Protection Convention (IPPC)
- United Nations Convention on the Law of the Sea (UNCLOS)
- United Nations Convention to Combat Desertification (UNCCD)
- United Nations Framework Convention on Climate Change (UNFCCC)
- Wetlands (Ramsar) Convention
- World Organisation for Animal Health (OIE)
- WTO SPS Agreement

• *A revised African Convention on the Conservation of Nature and Natural Resources (Algiers Convention, 2003) has not yet been signed nor acceded by Mauritius;

ANNEX 4. MAURITIAN NATIONAL PLANS, LEGISLATION AND COMMITTEES OF RELEVANCE TO IAS

Amendments to EPA on Multilateral Environment Agreement
Animal Diseases Act (1925)
Aquatic Business Bill (in preparation)
Fisheries and Marine Resources Act (1998)
Food Act (2003)
Forests and Reserves Act (1983 amended in 2003)
GMO Act (1997)
Islets National Park Strategy Plan (2004)
Marine Protected Area Regulations (2001)
Maritime Zones Act (2005)
National Action Plan for Climate Change
National Biodiversity Strategy and Action Plan (2006-2015)
National Capacity Needs Self-assessment for Global Environment ()
National Development Strategy (2003)
National Environment Strategy (1999)
National Forestry Policy (2006)
National Invasive Alien Species Committee (2003)
National Threatened Plants Technical Committee
Non-Sugar Sector Strategic Plan (2003-2007)
Plant (Importation and Exportation) Regulations (1976)
Plant (Pest and Disease Control) Regulations (1984)
Plant Breeders' Rights Act (1994)
Plant Protection Act (2006)
Ports Master Plan (2002, currently under review)
Public Health Act (2005)
Strategic Options in Crop Diversification and Livestock Sector (2007-2015)
Sustainable Land Management Plan Strategy Plan
Task Force on Ballast Water Management (2003)
Technical Advisory Committee on Fresh Water Courses
Wetland Bill (in preparation)
Wildlife and National Parks Act (1993)

ANNEX 5. ORGANISATIONS WITH EXISTING AWARENESS RAISING PROGRAMMES WHICH COULD HAVE SYNERGIES WITH AN IAS AWARENESS RAISING INITIATIVE

- Agricultural Research and Extension Unit – Ministry of Agriculture, Agro Industries and Fisheries.
- Division of Veterinary Services – Ministry of Agriculture, Agro Industries and Fisheries.
- Entomology Division – Ministry of Agriculture, Agro Industries and Fisheries.
- Forestry Services – Ministry of Agriculture, Agro Industries and Fisheries.
- Mauritian Wildlife Foundation.
- Ministry of Health and Quality of Life.
- National Parks and Conservation Service – Ministry of Agriculture, Agro Industries and Fisheries.
- National Plant Protection Office – Ministry of Agriculture, Agro Industries and Fisheries.