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# **The National Invasive Species Strategy For The Bahamas**

**March 2003**

## **Message from the Minister of Health and Environment**

As the world becomes a global village, countries find it more and more difficult to isolate themselves from problems in other countries. The issue of biological invasion has become globally significant because no country is immune to the negative impacts it can cause.

Invasive species are typically defined as those organisms that negatively impact the environment, economy, human welfare and human health of a country. Invasives are thought to be one of the main causes of biodiversity loss worldwide. This problem is of sufficient significance to be addressed in the Convention on Biological Diversity, the international agreement on conservation, protection and sustainable use of biodiversity.

The National Invasive Species Strategy Project has afforded The Bahamas the opportunity to examine what invasive species occur in our country, which species need to be given priority and what mechanisms can be developed to address their introduction and spread. The project has involved a series of stakeholder workshops, public awareness campaigns and training. One of its objectives has been realized in the publication of this document, the National Invasive Species Strategy. It is hoped that various aspects of this Strategy will be implemented immediately and others in the near future.

Consultation has been an important aspect of this project as the Government recognizes that we cannot deal with issues of national significance without national discussions. Stakeholder workshops were carried out in several Bahamian islands, including Abaco, Andros, Grand Bahama and Eleuthera. All other islands were consulted through Local Government representatives. The result is a plan that encompasses as succinctly as possible the concerns expressed by all.

I encourage you to not only read this Strategy, but to also contribute to its implementation. If every citizen of The Bahamas can apply what is recommended, if only within their own homes, we will have achieved much in our efforts to address the invasive species problem.

On behalf of the Government, I wish to again express our gratitude to the British Government for their assistance in combating this global biological problem. This project represents the first joint effort between our two countries in addressing an environmental issue. It is our sincere hope that this is only the beginning of a fruitful cooperative relationship.

On behalf of the Ministry of Health and Environment and the BEST Commission, I wish to thank all who have participated in this worthy effort and have made this project a success.

Dr. Marcus C. Bethel  
Minister of Health and Environment  
The Commonwealth of The Bahamas

## **Message from the British High Commissioner**

The National Invasive Species Strategy Project represents an important milestone in the cooperative relationship between the United Kingdom and the Commonwealth of The Bahamas. It is the first opportunity that my Government has been able to work jointly with the Government of the Commonwealth of The Bahamas on an issue of environmental concern.

Invasive species pose not only a threat to The Bahamas, but to the world. Everyday, native species and habitats are put at risk of displacement and extinction from invasion by non-native plants and animals. These invasions have increased globally due to expansion in the trade of goods and services, the increased mobility of people, the liberalization of markets and the use of exotic species in a wide range of activities.

This project has enabled The Bahamas to begin to assess the impact of invasive species nationally and develop a strategy to combat invasion and protect its native species and habitats. The British Government is proud to be able to contribute to such a worthwhile activity and to aid in the conservation and protection of the biological diversity of these islands.

Funding for this project has been made possible through the Environment Project Fund of the Foreign and Commonwealth Office (FCO) of the British Government. The FCO works to protect and improve the quality of the global environment as a foundation for sustainable development. It is committed to addressing critical environmental issues, such as biodiversity, biotechnology, energy, resource supply and climate change.

The FCO accomplishes its tasks through a global network of missions, and the Environment Fund aims to utilise this network in association with governments, NGOs and institutions to support a range of focused, high quality environment projects, such as the Bahamian invasive species project.

It is our hope that this is only the beginning of joint efforts between the United Kingdom and The Bahamas to address environmental issues and concerns to the betterment of all humankind.

His Excellency Peter Heigl  
British High Commissioner  
Nassau, The Bahamas  
15<sup>th</sup> February 2003

## **Message from the Ambassador for the Environment**

The National Invasive Species Strategy Project represents the second phase in a national effort to address the issue of biological invasion. This project builds on the work completed under the Inter-American Biodiversity Information Network Invasives Information (I3N) Project, which enabled the development of databases of invasive species found in The Bahamas. While we realize these databases are not complete, they provided a starting point for work to begin on dealing with this problem.

Both projects have provided The Bahamas the opportunity to work cooperatively with foreign Governments and organizations. The information project was made possible through assistance from the United States Geological Survey and the current strategy project, through the Environment Project Fund of the British Government's Foreign and Commonwealth Office. The willingness of these agencies to work cooperatively with The Bahamas, a small islands developing State, speaks to the global concern on this issue.

Invasive species are not just an ecological problem. They are also an economic one. Worldwide, millions of dollars are spent every year to control invasive species and to repair the damage they cause. As we experience trying economic times globally, we must strive to ensure that issues that may further impact us negatively are adequately addressed. Biological invasion is one such issue.

Island states, like The Bahamas, are generally considered highly susceptible to invasions because of their particularly vulnerable native biodiversity and predominantly import driven economies.

The recommendations contained within this Strategy represent The Bahamas' initial effort to deal with invasive species nationally. It is our intent to continue to build on this initial work towards achieving implementation and instituting effective management mechanisms.

On behalf of the BEST Commission, I thank the British High Commission and all persons involved for their invaluable assistance in this project, and making the publication of this document possible through their contributions of knowledge, expertise, insights and opinions.

His Excellency Keod M. Smith  
Ambassador for the Environment  
The Commonwealth of The Bahamas

## **Preface**

The National Invasive Species Strategy (NISS) project was developed in 2002 and jointly funded by The Bahamas Government and the Environment Project Fund of the Foreign and Commonwealth Office of the British Government.

The project facilitates the assessment of the current mechanisms existing in The Bahamas to address the invasive species issue while enabling increased public awareness and involvement in the process. There have been numerous stakeholder and public exercises during the project over the past few months. The project has resulted in the development of awareness materials that will hopefully be of benefit, not only to The Bahamas, but also to other Small Island Developing States (SIDS).

The NISS project has also afforded The Bahamas the opportunity to begin to build partnerships with international organizations, such as the Global Invasive Species Programme (GISP), Invasive Species Specialist Group (ISSG), Islands Initiative and The Nature Conservancy (TNC).

This project builds on initial work completed under the Inter-American Biodiversity Information Network (IABIN) Invasives Information Network Project in which databases on invasives species, expertise and programmes were developed and made accessible on the Worldwide Web. This phased approach has been very successful and it is intended that the work on this issue will continue, resulting in the development of a comprehensive infrastructure that will prevent the entry and establishment of unwanted invasive species and other biological threats to the biodiversity of the Bahamian islands.

## **Acknowledgements**

This project was successfully completed through the hard work of the following individuals of the BEST Commission: Dr. Donald Cooper, Nakira Wilchcombe, Stefan Moss, Sharrah Moss, Lorca Bowe, Maria Hield and Diane Adderley; and the British High Commission, Nassau: Dave Wells and Sheila Lendgren.

The following persons have made invaluable contributions through the lending of their time, knowledge and expertise: Dr. John Hammerton, Paul Dean, Dr. Maurice Isaacs, Pastor James Redmon, Chris Bergh, Ruark Cleary, and Dr. Maj de Poorter.

Consultants for the project were: Dr. Moses Kairo, Cynthra Persad and Dr. Bibi Ali, CAB International and Lihong Zhu, Natural Resources Institute.

All stakeholders and members of the public who provided input and insight in discussions on invasive species and how the country can move forward have made the project worthwhile and fulfilling for all who have participated.

*Stacey Wells-Moultrie  
Project Coordinator  
BEST Commission  
Ministry of Health and Environment*

*Nassau, March 2003*

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## 1.0 Abbreviations and Acronyms

|                   |  |
|-------------------|--|
| BEST              | Bahamas Environment, Science and Technology  |
| CAB International | Successor of a number agencies including the Commonwealth Agricultural Bureau initially existing in the United Kingdom and other parts of the Commonwealth |
| CBD               | Convention on Biological Diversity   |
| FAO               | United Nations Food and Agriculture Organization   |
| FCO               | Foreign and Commonwealth Office  |
| GISP              | Global Invasive Species Programme  |
| I3N               | IABIN Invasives Information Network  |
| IABIN             | Inter-American Biodiversity Information Network  |
| ICAO              | International Civil Aviation Organization  |
| IMO               | International Maritime Organization  |
| IPPC              | International Plant Protection Convention  |
| ISSG              | Invasive Species Specialist Group  |
| IUCN              | World Conservation Union   |
| NBSAP             | National Biodiversity Strategy and Action Plan   |
| NGO               | Non-Governmental Organization  |
| NISS              | National Invasive Species Strategy   |
| OIE               | Office International des Epizooties  |
| Ramsar            | Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971)  |
| SIDS              | Small Island Developing States   |
| SPS               | Agreement on the Application of Sanitary and Phytosanitary Measures  |
| TNC               | The Nature Conservancy   |
| UNCLOS            | United Nations Convention on Law of the Sea (Montego Bay, 1982)  |
| UNCED             | United Nations Conference on Environment and Development (Rio de Janeiro, 1992)  |
| WHO               | World Health Organization  |
| WTO               | World Trade Organization   |

## 2.0 Glossary of Terms

Aggressive species – Those species (plants, animals, micro-organisms) that overwhelm the landscape whether they are native or introduced.

Alien species – non-native, non-indigenous, foreign, exotic species occurring outside of their natural range and dispersal potential, and includes any part, such as seeds and larvae, that might survive and subsequently reproduce.

Biodiversity – The variability among living organisms from all sources including, *inter alia*, 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. Short for biological diversity.

Conservation of biodiversity - The management of human interactions with genes, species, and ecosystems so as to provide the maximum benefit to the present generation while maintaining their potential to meet the needs and aspirations of future generations; encompasses elements of saving, studying, and using biodiversity.

Domesticated or cultivated species - Species in which the evolutionary process has been influenced by humans to meet their needs.

Ecology - A branch of science concerned with the interrelationship of organisms and their environment.

Ecosystem - A dynamic complex of plant, animal, fungal, and microorganism communities and their associated non- living environment interacting as an ecological unit.

Endemic species – A species restricted to a specified region or locality.

Harmful or dangerous – Plants and animals that sting, prickle, cause allergies, are poisonous to humans or other organisms or exclude other organisms from an ecosystem or habitat.

Feral animals – Animals that are untamed or wild.

Historic – Those plants and animals that were introduced long ago but now are accepted by most persons as “native”.

Intentional introduction – An introduction made deliberately by humans, involving the purposeful movement of a species outside of its natural range and dispersal potential. Such introductions may be done legally or illegally.

Introduction – The movement by human agency of a species, subspecies or lower taxon outside its natural range. This movement can be either within a country or between countries.

Invasive alien species - Alien species that become established in a new environment, then proliferate and spread in ways that are destructive to native ecosystems, human health, and ultimately human welfare.

Native species – A species occurring within its natural range and dispersal potential, i.e. within the range it occupies naturally or could occupy without direct or indirect introduction or by care of humans. Those plants and animals that occurred when Columbus arrived.

Naturalized – Plants and animals that have been introduced and now propagate on their own.

Unintentional introduction – An unintended introduction made as a result of a species utilizing humans or human delivery systems as vectors for dispersal outside its natural range.

### 3.0 Introduction: An Overview of Invasive Alien Species

Invasive alien species may be defined as:

*Alien species that become established in a new environment, then proliferate and spread in ways that are destructive to native ecosystems, human health, and ultimately human welfare.*

Invasive species spread because the natural controls that keep them in check in their native homelands, such as disease and predators, do not exist when they introduced into a new habitat.

Invasive species occur globally and are represented in every taxonomic group. They can be:

- micro-organisms, such as bacteria and plankton;
- plants, such as trees, shrubs and vines; or
- animals, such as insects, reptiles, amphibians and mammals

Invasive species have negative economic and environmental impacts. Some of these negative impacts include:

- loss of genetic diversity, i.e. they dilute the gene pool through hybridization;
- competition with native species, resulting in their loss or displacement;
- introduction of diseases; and
- change in the physical properties of the environment, e.g. decrease amount of dissolved oxygen in water, decrease the amount of sunlight reaching an area.

The direct economic costs of invasive alien species run into many billions of dollars annually. A recent effort by United States ecologists to calculate the annual costs of all alien invasives in the United States concluded that invasive weeds cost US agriculture about \$27 billion per year. The total costs to the United States of all non-indigenous species (plants, animals, and microorganisms) were estimated at over \$138 billion per year.

Increasing globalization of markets and rises in global trade, transport, travel and tourism mean that more and more species from all parts of the world are moving to new habitats, enhancing the possibility of invasion in all ecosystems all over the world.

The degradation of natural habitats globally has made it easier for alien species to establish and become invasive. Global climate change is also a factor assisting the spread and establishment of invasive alien species. For example, increased temperatures may enable alien, disease-carrying mosquitoes to extend their range.

There are three categories of activities that can result in alien species becoming invasive:

1. Intentional introduction of species for use in biological production systems, i.e. agriculture, forestry, fisheries and landscaping, as well as recreational and ornamental purposes and for biological control of pests;

2. Intentional introduction of species as a commodity for uses where there is a known risk of escape or release to the wild, i.e. zoos, aquaculture, mariculture, aquariums, horticulture, pet trade, etc.; and
3. Unintentional introduction of species through pathways involving transport, trade, travel or tourism.

With unintentional introductions, alien species can be present in bilge and ballast water of ships, airplane wheel wells, tourists' shoes, as well as gut and hooves of imported livestock. Absent bioterrorism, the spread of disease by international travelers or freight, is also an unintentional introduction, e.g., West Nile virus.

Studies have shown that islands, like those of The Bahamas, are especially vulnerable to invasions. Island species often have small populations and are unique when compared to continental species due to the isolation of islands throughout prehistoric times. This isolation has been provided by the natural barriers of oceans, mountains, rivers and deserts that have enabled these unique species and ecosystems to evolve. Most island species are ill-equipped to defend against aggressive invading species and fare poorly in the face of competitors, predators, pathogens and parasites from other areas.

While the isolation of islands has proved to be a weakness in the ability of island species and ecosystems to be resilient against biological invasion, it can be used as an advantage by improvement of the capacity of governments of Island States to prevent the arrival of invasive alien species with better knowledge, improved legislation and greater management capacity, supported by quarantine and customs systems that are capable of identifying and intercepting invasive alien species.

#### 4.0 Mechanisms to Manage and Control Invasive Species

Measures that can be taken to address invasion by alien species include:

- Prevention
- Early detection and response
- Eradication
- Control

Prevention of the entry and establishment of unwanted invasive species will require a comprehensive infrastructure that includes a national inspection system, training of human resources, and funding. Public education and awareness is also an important part of prevention (see also Appendix I).

Prevention also involves reduction or elimination of those activities that make invasion possible, i.e. clear-cutting, pollution and other forms of habitat degradation.

An early detection system was previously used in The Bahamas for the Pink Hibiscus mealy bug (*Maconellicoccus hirsutus*). Early detection and response involves inventory and mapping of species, a rapid-response plan, public notification, and the resources to act quickly when a new invader is discovered. This system is the same as would be employed by a public health agency in the event of a new disease outbreak. A system for addressing invasive species would include components for:

1. Raising public awareness;
2. Generating support and funds for quality programs;
3. Developing effective integrated management plans with specific control actions; and
4. Assessing the economic and social impact of invasives.

An important component of an early detection system is monitoring. Monitoring of species must occur on a regular basis.

Early detection is facilitated by collaboration within the country to maximize human and financial resources with monitoring being carried out by those who are regularly in the field, i.e. birdwatchers, landscape crews and researchers.

Out of all possible management strategies of invasive species, eradication (removal of the entire population) is the most suited as a means for restoration of native biological diversity, although it is also the most difficult and expensive strategy to employ. Whether or not eradication can be accomplished is affected by whether it is feasible and if it can be carried out early enough in an invasion to be successful. Eradication of established populations of invasive species requires significant resources and years of committed action to accomplish. It is important to note that the most successful examples of eradication are from small islands.

Control of invasive species requires initial treatment followed by maintenance control. Maintenance control involves use of techniques in a coordinated manner on a continuous basis in order to maintain invasive populations at the lowest acceptable level. Options for control include prohibition and restriction with conditions. Control also involves ensuring the use of proper disposal methods and areas, especially with respect to invasive plant material. Control methods should be socially, culturally and ethically acceptable as well as efficient and non-polluting. Methods employed should minimize adverse affects on native flora and fauna, human health and well-being or agricultural stocks.

In exploring all the options available for addressing the invasive species problem, we must recognize the role that human habits and behaviours play in the introduction and spread of invasives and work to modify or change these. For example, in management of dogs, we must also focus on fostering responsible care of owned dogs, implementation of current and new legislation to achieve this and enforcement of legislation.

Human decisions and human activities not only affect the introduction and spread of invasive species, but also affect the resilience of ecosystems and the possibility of timely policy responses to deal with invasions. Degraded habitat, such as land that has been clear-cut, is prime habitat for invasion. If policy responses are slow, the risk of invasive species becoming established is increased and the success of preventive or control measures is negatively affected.

Any meaningful prevention and control strategy has a cost. Given budget constraints, any decision-making on what measures to apply will inevitably involve setting priorities and accepting trade-offs. In consequence, the determination of costs and benefits of invasive alien species control and the related options for prevention, control and management becomes vital.

There are a number of reasons why it may be economically worthwhile to protect native biological diversity. These include protecting:

- human health and safety - invasive species that introduce disease can impact directly on human well-being through sickness, debilitation and death.
- production standards - invasive species may disrupt production processes by reducing the productivity of pasture, plants and livestock. Such incursions of invasive species may impact on production through increased costs, reduced output volumes or lower prices from products perceived as of inferior quality.
- access to overseas markets - other countries may use the presence of potentially damaging invasive species in The Bahamas as a reason to erect trade barriers against Bahamian seafood and produce exports. These barriers can impact the prices for exports, and in the long term, may also lead to changes in the volume of products sent to export.
- a sense of security and cultural identity - such impacts are difficult to quantify, but there can be a real reduction in well-being for the population at large from introduction of invasive species which damage parts of the environment significant for national or cultural identity, such as traditional use beaches and fisheries.

## 5.0 Recommendations

It must be clarified that actions recommended under this strategy are specific to invasive plants and animals. It is hoped that at a later stage micro-organisms and diseases will be addressed.

Stakeholders consulted during the project have recommended the following:

1. There should be building of awareness through the development of a database on invasive species to include:
  - Information on risks associated with each species;
  - All characteristics of each species (e.g. breeding habits, migration patterns, physical description);
  - Management mechanisms and
  - Visual representation.
2. Training should occur in the following areas:
  - Customs officers in the identification, safe handling, holding and transfer of invasive species; and
  - Agricultural and fisheries officers in the identification, safe handling, holding, transfer and disposal of invasive species as well as methods of risk assessment and management.
  - Enforcement officers in the identification, safe handling, holding and transfer of invasive species.
3. All officers should be trained in a national mechanism that would coordinate action in the field with respect to invasive species. This mechanism would set up clear powers and responsibilities between the agencies concerned.
4. As monitoring cannot be achieved for the entire archipelago, it is recommended that specific sites be identified for regular monitoring, such as:
  - All public areas
  - National parks
  - Protected areas
  - Freshwater sources (groundwater and well fields)
  - Field stations
5. Existing legislation related to management and control of alien species should be enforced and where deficient, be amended. There will also be the need to draft and amend new legislation specific to management and control of invasive alien species.
6. There should be a sequenced approach to invasive species control:
  - i. Preventing entry of potential invasives from other countries and other Bahamian islands;
  - ii. If entry has already occurred, preventing the establishment and spread of invasives, i.e. rapid response;



- iii. Eradication of invasives at the earliest possible stage is preferred. Methods of eradication should be as ethical and humane as possible;
- iv. If eradication is not feasible or cost-effective, containment and long-term control measures should be considered.

7. Priority species should be listed for eradication and control. These lists therefore would not include all known invasives for The Bahamas. The latter list can be found at Appendix XVI and is the most current list to date. It should also be noted that species on the eradication and control lists would be reviewed on a regular basis with the result that current species may be deleted and new species added.

Species recommended for eradication are:

|                                 |  |
|---------------------------------|--|
| <i>Casuarina glauca</i>         | Suckering Australian Pine  |
| <i>Melaleuca quinquenervia</i>  | Melaleuca, (paper bark)  |
| <i>Mucuna pruriens</i>          | Monkey Tamarind  |
| <i>Scaevola taccada</i>         | Asian Scaevola, White Inkberry, (Hawaiian Seagrape)              |
| <i>Schinus terebinthifolius</i> | Brazilian Pepper, Bahamian Holly                                 |
| <i>Molothrus bonariensis</i>    | Shiny Cowbird  |
| <i>Procyon lotor</i>            | Raccoon (for all islands except New Providence and Grand Bahama) |

Species recommended for control are:

|                                     |   |
|-------------------------------------|---|
| <i>Albizia lebbbeck</i>             | Woman's Tongue                          |
| <i>Antigonon leptopus</i>           | Coral Vine                              |
| <i>Bauhinia variegata</i>           | Poor Man's Orchid                       |
| <i>Casuarina equisetifolia</i>      | Casuarina, Australian Pine, (beefwood)  |
| <i>Delonix spp.</i>                 | Poinciana                               |
| <i>Eichhornia crassipes</i>         | Water Hyacinth                          |
| <i>Haematoxylon campeachianum</i>   | Logwood                                 |
| <i>Impomoea purpurea</i>            | Morning Glory                           |
| <i>Leucaena glauca</i>              | Jumbey                                  |
| <i>Pimenta racemosa</i>             | Bay Rum                                 |
| <i>Prunus amygdalus</i>             | Almond                                  |
| <i>Ricinus communis</i>             | Castor Bean                             |
| <i>Spathodea campanulata</i>        | African Tulip Tree, Flame of the Forest |
| <i>Schefflera actinophylla</i>      | Schefflera, Queensland Umbrella Tree    |
| <i>Trachelosperumum jasminoides</i> | Star Jasmine                            |
| <i>Wedelia trilobata</i>            | Wedelia, (carpet daisy)                 |
| <i>Columba livia</i>                | Rock Dove                               |
| <i>Passer domesticus</i>            | House Sparrow                           |
| <i>Streptopelia decaocta</i>        | Eurasian Collared Dove                  |

|                      |   |
|----------------------|---|
| <i>Canine</i>        | Dogs  |
| <i>Felis catus</i>   | Cats  |
| <i>Procyon lotor</i> | Raccoon (for New Providence and Grand Bahama) |

8. The Government accept and implement an Invasive Species Policy as outlined in the draft at Appendix IV
9. Specific actions should be taken by the Government as given in the Code of Conduct in Appendix V.
10. Specific actions should be taken by sectors as identified in the Voluntary Codes of Conduct in Appendices VI through XIV.
11. The Government commit to give and seek funding for a sustained management program of invasive species and explore the option of maintaining a contingency fund specifically for emergency response purposes. Determining the size of such a fund would involve estimating the risk of an invasion emergency and the likely magnitude of such an event.
12. The Bahamas seeks to establish a comprehensive infrastructure for the management of invasive alien species in compliance with its international obligations under the following international agreements and organizations:
  - i. 1992 Convention on Biological Diversity, Article 8(h) and the Interim Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species
  - ii. 1971 Ramsar Convention, Resolution VII/14 on Invasive Species and Wetlands;
  - iii. 1995 FAO Code of Conduct for Responsible Fisheries and Code of Conduct for the Import and Release of Exotic Biological Control Agents
  - iv. 1994 World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)
  - v. International Plant Protection Convention (IPPC)
  - vi. World Health Organization (WHO)
  - vii. Codex Alimentarius Commission for Food Safety and Human Health
  - viii. Office International des Epizooties (OIE) for Animal Health
  - ix. 1982 United Nations Convention of the Law of the Sea (UNCLOS), Article 196
  - x. 1997 IMO Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens
  - xi. 1998 International Civil Aviation Organization (ICAO) Assembly Resolution A-32-9 on preventing the Introduction of Alien Invasive Species
  - xii. Agenda 21, United Nations Conference on Environment and Development (UNCED), 1992

- xiii. 1994 Barbados Programme of Action for the Sustainable Development of Small Islands Developing States (SIDS)

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## Appendices

### I. The Public and Implementation of the Strategy

Public education and awareness must occur at all levels and we define public to include the following:

|  |  |
|--|--|
| Cabinet Ministers                              | Contractors (i.e. landscapers, architects and construction industry) |
| Policy makers                                  | Schools and colleges   |
| Judiciary                                      | Importers and exporters  |
| Government Ministries and officials            | Airline companies  |
| Local Government                               | Shipping companies   |
| Technical Officers                             | Horticulturists  |
| Enforcement agencies                           | Plant nurseries  |
| Churches                                       | Botanical gardens  |
| Media  | Homeowners   |
| Youth  | Gardeners/gardening enthusiasts                                      |
| NGOs   | Gardening clubs  |
| Farmers  | Pet stores   |
| Fishermen                                      | Pet breeders and dealers   |
| Tourism sector (including hotels and tourists) | Pet owners   |

Public education should involve utilization of the media in the promotion of information on invasive species and their management.

## II. Plant and Animal Species Recommended for Eradication

|                                 |  |
|---------------------------------|--|
| <i>Casuarina glauca</i>         | Suckering Australian Pine  |
| <i>Melaleuca quinquenervia</i>  | Melaleuca, (paper bark)  |
| <i>Mucuna pruriens</i>          | Monkey Tamarind  |
| <i>Scaevola taccada</i>         | Asian Scaevola, White Inkberry, (Hawaiian Seagrape)              |
| <i>Schinus terebinthifolius</i> | Brazilian Pepper, Bahamian Holly                                 |
| <i>Molothrus bonariensis</i>    | Shiny Cowbird  |
| <i>Procyon lotor</i>            | Raccoon (for all islands except New Providence and Grand Bahama) |

## III. Plant and Animal Species Recommended for Control

|                                     |   |
|-------------------------------------|---|
| <i>Albizia lebbbeck</i>             | Woman's Tongue                                |
| <i>Antigonon leptopus</i>           | Coral Vine                                    |
| <i>Bauhinia variegata</i>           | Poor Man's Orchid                             |
| <i>Casuarina equisetifolia</i>      | Casuarina, Australian Pine, (beefwood)        |
| <i>Delonix spp.</i>                 | Poinciana                                     |
| <i>Eichhornia crassipes</i>         | Water Hyacinth                                |
| <i>Haematoxylon campeachianum</i>   | Logwood                                       |
| <i>Impomoea purpurea</i>            | Morning Glory                                 |
| <i>Leucaena glauca</i>              | Jumbey  |
| <i>Pimenta racemosa</i>             | Bay Rum                                       |
| <i>Prunus amygdalus</i>             | Almond  |
| <i>Ricinus communis</i>             | Castor Bean                                   |
| <i>Spathodea campanulata</i>        | African Tulip Tree, Flame of the Forest       |
| <i>Schefflera actinophylla</i>      | Schefflera, Queensland Umbrella Tree          |
| <i>Trachelosperumum jasminoides</i> | Star Jasmine                                  |
| <i>Wedelia trilobata</i>            | Wedelia, (carpet daisy)                       |
| <i>Columba livia</i>                | Rock Dove                                     |
| <i>Passer domesticus</i>            | House Sparrow                                 |
| <i>Streptopelia decaocta</i>        | Eurasian Collared Dove                        |
| <i>Canine</i>                       | Dogs  |
| <i>Felis catus</i>                  | Cats  |
| <i>Procyon lotor</i>                | Raccoon (for New Providence and Grand Bahama) |

## IV. Draft Policy on Invasive Species

### *The Commonwealth of The Bahamas*

## *Draft National Invasive Species Policy*

### *The Government of the Commonwealth of The Bahamas,*

*Recognizing* its obligation as a Party under Article 8(h) of the Convention on Biological Diversity to “prevent the introduction of, to control or to eradicate those alien species, which threaten ecosystems, habitats or species”,

*Acknowledging* that scientists and governments throughout the world recognize that biological invasions by alien species pose serious threats to native biological diversity,

*Noting* that invasive alien species are found in all taxonomic groups: plants, animals and microorganisms,

*Noting* that invasive alien species are as damaging to native species and biological diversity as the loss and degradation of habitat,

*Recognizing* that, globally, hundreds of species extinctions have already resulted from invasive alien species,

*Noting* that the natural barriers to the movement of species - oceans, rivers, mountains and deserts - that provided the isolation essential for the evolution of unique and endemic species, have become increasingly ineffective,

*Acknowledging* that globalization, and the emphasis on free trade, provide even greater opportunities than hitherto for species to be introduced, either deliberately or accidentally, to new habitats, with the opportunity to become invasive,

*Aware* that small islands developing states are particularly vulnerable to the impacts of seemingly innocuous invasions, and The Bahamas perhaps especially so, given its archipelagic nature and many ports of entry,

*Aware* that the impacts of alien invasive species are immense, insidious, and often irreversible and that the costs due to their damage on a global scale are enormous, both in ecological and economic terms, and in terms of human welfare,

*Recognizing* that The Bahamas relies heavily on its natural resources, and has an open economy heavily dependent on imports,

*Recognizing* that the cost of allowing the introduction of invasive alien species is the irretrievable loss of endemic species and of unique ecosystems,

*Recognizing* also that there are direct economic costs of control of alien animals and plants, disease and pests,

*Noting* that introduced alien diseases and parasites of humankind not only result in suffering, and perhaps death, but also have economic costs of medical treatments and the loss of productivity,

*Noting* that global climate change is also a significant factor in facilitating the establishment of many alien species, and

*Determined* to conserve and sustainably manage the biological diversity of The Bahamas for the benefit of present and future Bahamians,

***Has decided to adopt the following Policy:***

- To enact legislation to prevent the introduction of, to control and to eradicate those alien invasive species which threaten the ecosystems, habitats, endemic species and the human health and welfare of The Bahamas, in support of the Convention on Biological Diversity;
- To prepare a National Invasive Species Strategy for The Bahamas, which lists and prioritizes in order of significant impact those invasive species present in The Bahamas;
- To prepare Strategic Management Plans for individual species of high priority as identified under the National Invasive Species Strategy;
- To facilitate research on the occurrence, distribution and impacts of invasive alien species and invasive native species in The Bahamas;
- To prevent the introduction of invasive alien species into The Bahamas by regulatory and other relevant means;
- To monitor invasive species populations in The Bahamas by the conduct of surveys and risk assessments;
- To undertake control and management activities in an environmentally and cost-effective manner;
- To monitor potentially invasive alien species not yet established in The Bahamas;
- To promote, undertake and facilitate the reestablishment of native species, where appropriate, and the restoration of invaded and damaged habitats;

- To conduct and facilitate research into the best management and control practices for individual species, including plants, animals and microorganisms, using chemical, physical and biological methods that are environmentally sound;
- To promote public education and outreach on invasive alien species at all levels of society by appropriate methods;
- To promote international and regional cooperation which would aid in the fulfillment of this policy and implementation of the National Invasive Species Strategy;
- To mandate such cooperation between Government Ministries, Departments and other Agencies including Non-Governmental Organizations and the Private Sector, as necessary, to implement this policy and to carry out the Strategy.
- To promote and facilitate such infrastructural development as is necessary to enable Ministries, Departments, and other Agencies, to implement this Policy and the National Invasive Species Strategy.

## **V. Code of Conduct for Government**

Require risk assessment for Government-led or financed plant and animal introductions to ensure that no new harmful species are introduced, intentionally or unintentionally.

Do not distribute existing holdings of invasive plant and animal species to areas where they can potentially do harm.

Coordinate and facilitate collaboration in databases, early warning systems, monitoring and other means of preventing invasive plant species problems.

Lead and fund the development of environmentally sound methods to control harmful invasive plant species, seek control of such species on Crown and other public lands and promote their control on adjacent private lands.

Develop and promote the use of non-invasive plant species within all Government agencies and to the public.

Facilitate, lead, coordinate and evaluate public outreach and education on harmful invasive species.

Encourage public servants and managers to participate in ongoing training programmes on invasive species.

Foster international and regional cooperation to minimize the risk of import and export of potentially invasive species.



Develop partnerships and incentive programmes to lessen the impact of invasive species and provide non-invasive restoration materials.

Provide a forum for regular evaluation of the effectiveness of these voluntary codes of conduct towards preventing the invasive species problem.

Enforce existing invasive species legislation at all levels, and enact new legislation where deficiencies occur in existing legislation.

## **VI. Voluntary Code of Conduct for Botanical Gardens**

Conduct an internal review examining all activities that provide an opportunity to prevent the spread of invasive species and to inform visitors on this issue.

Avoid introducing invasive plants by establishing an invasive plant assessment procedure. This procedure should involve responsible and regular monitoring of the garden site.

Remove invasive species from plant collections. If for any reason the decision is made to retain an invasive species, ensure its control and provide strong interpretation to the public explaining the risk of the species and its function in the garden.

Seek to control harmful invasive species in natural areas managed by the garden and assist others in controlling them on their property, whenever possible.

Promote non-invasive alternative plants or help develop non-invasive alternatives through plant selection or breeding.

If your institution participates in seed or plant distribution, do not distribute known invasive plants except for bona fide research purposes and consider the consequences of distribution outside your biogeographic region. Consider attaching a statement of caution to species that appear to be potentially invasive but have not been fully evaluated.

Increase public awareness about invasive plants. Provide information on why they are a problem, their origin, mechanisms of harm and need for prevention and control. Work with local nurseries and seed industries to assist the public in environmentally safe gardening and sales.

Participate in developing, implementing or supporting regional, national or local early warning systems for immediate reporting and control.

Participate in the creation of regional lists of concern.

Become informed about the invasiveness of species within your institution in other biogeographic regions. Compile and share this information in a manner accessible to all.

Become partners with other organizations in the management of harmful invasive species.

Follow all laws on importation, exportation, quarantine and distribution of plant materials across political boundaries. Be sensitive to conventions and treaties that deal with this issue and encourage affiliated organizations (plant societies, garden clubs, etc.) to do the same.

### **VII. Voluntary Code of Conduct for Landscape Architects**

Work with local plant ecologists, horticulturists, nurseries, botanic gardens, conservation organizations and others to determine what species in your region either are currently highly invasive or show aggressive potential.

Increase interaction with other professionals and non-professionals to identify alternative plant material and other solutions to problems caused by harmful invasive plants.

Take advantage of continuing education opportunities to learn more about the invasive species issue.

Identify and specify non-invasive species that are aesthetically and horticulturally suitable alternatives to invasive species in your region.

Eliminate specification of species that are invasive in your region.

Be aware of potential environmental impacts beyond the designed and managed area of the landscape plan (for example, plants may spread to adjacent natural areas or cropland).

Encourage nurseries and other suppliers to provide landscape contractors and the public with non-invasive plants.

Collaborate with other local experts and agencies in the development and revision of local landscape ordinances. Promote inclusion of invasive species issues in these ordinances.

### **VIII. Voluntary Code of Conduct for the Gardening Public**

Ask for only non-invasive species when you purchase plants. Plant only environmentally safe species in your gardens. Work towards and promote new landscape design that is friendly to local ecosystems.

Seek the best information on which species are invasive in your area. Sources could include botanical gardens, nurseries, horticulturists, conservationists and Government agencies.

Remove invasive species from your property and replace them with non-invasive species suited to your site and needs.

Do not trade plants with other gardeners if you know they are species with invasive characteristics.

Request that botanical gardens and nurseries promote, display and sell only non-invasive species.

Help educate your community and other gardeners in your area through personal contact and in such settings as garden clubs and other civic groups.

Ask garden writers and other media to emphasize the problem of invasive species and provide information. Request that garden writers promote only non-invasive species.

Invite speakers knowledgeable on the invasive species issue to speak to garden clubs, schools and other community groups.

Seek the best information on control of invasive plant species and organize neighbourhood work groups to remove invasive plant species under the guidance of knowledgeable professionals.

Volunteer at botanical gardens and natural areas to assist ongoing efforts to diminish the threat of invasive plants.

Participate in early warning systems by reporting invasive species you observe in your area to the relevant authority, i.e. the BEST Commission, Department of Agriculture or the Botanical Gardens.

Assist garden clubs to create policies regarding the use of invasive species not only in horticulture, but in activities such as flower shows.

Urge florists and other to eliminate the use of invasive plant material.

### **IX. Voluntary Code of Conduct for Nursery Professionals**

Ensure that the invasive potential of plants is assessed prior to introducing and marketing a plant species new to The Bahamas. Invasive potential should be assessed by the introducer or qualified experts using risk assessment methods that consider plant characteristics and prior observations or experience with the plant elsewhere in the world.

Additional insights may be gained through extensive monitoring on the nursery site prior to distribution.

Work with local experts and stakeholders to determine which species are either currently invasive or will become invasive. Identify plants that could be suitable alternatives in your area.

Develop and promote alternative plant material through plant selection and breeding.

Where agreement has been reached among nursery associations, Government, academia and ecology and conservation organizations, phase out existing stocks of invasive species in areas where they are considered to be a threat.

Follow all laws on importation and quarantine of plant materials across political boundaries.

Encourage customers to use non-invasive plants.

### **X. Voluntary Code of Conduct for Zoos and Aquaria**

Conduct an internal review examining all activities that provide an opportunity to prevent the spread of invasive species and to inform visitors on the issue.

Avoid introducing invasive animals by establishing an invasive animal assessment procedure. This procedure should involve responsible and regular monitoring of the facility.

Take due care to prevent the release or escape of animals that are known to cause damage as invasives or may be potential invasives.

Remove invasive species from exhibits or displays. If the decision is made to retain an invasive species, ensure its control and containment and provide strong interpretation to the public explaining the risk associated with the species and its function in the facility.

If your institution participates in breed stock exchange, do not distribute known invasive animals except for bona fide research purposes and consider the consequence of distribution outside your biogeographic region. Consider attaching a statement of caution to species that appear to be potentially invasive but have not been fully evaluated.

Increase public awareness about invasive animals. Provide information on why they are a problem, their origin, mechanisms of harm and need for prevention and control.

Participate in developing, implementing or supporting regional, national or local early warning systems for immediate reporting and control.

Participate in the creation of regional lists of concern.

Become informed about the invasiveness of species within your facility in other biogeographic regions. Compile and share this information in a manner accessible to all.

Become partners with other organizations in the management of harmful invasive species.

Follow all laws on importation, exportation, quarantine and distribution of animals across political boundaries. Be sensitive to conventions and treaties that deal with this issue and encourage affiliated organizations to do the same.

### **XI. Voluntary Code of Conduct for Farms (Agricultural and Aquacultural)**

Ask for only non-invasive species when you purchase livestock or fish stock. If for any reason, the decision is taken to farm invasive species, ensure that they are controlled and contained through appropriate mechanisms, e.g. fencing to prevent escape or breeding with native species.

Take due care to prevent the release or escape of domestic animals that are known to cause damage as feral animals, e.g. pigs and goats.

Take due care to prevent the release or escape of livestock or fish stock that are known to cause damage due to their invasive characteristics or potential.

Seek information on which species are invasive in your area. Sources could include breeders, veterinarians, conservationists and Government agencies.

Do not trade stock with other farmers if you know that they are species with invasive characteristics.

Request that breeders and dealers promote and sell non-invasive species.

Help educate your community and other farmers in your area through personal contact and in such settings as farmers' association meetings.

Ask writers and other media to emphasize the problem of invasive species and be willing to provide information.

Invite speakers knowledgeable on the invasive species issue to speak to farmers' association meetings, schools and other community groups.

Seek the best information on control of invasive animal species.

Participate in early warning systems by reporting invasive species you observe in your area to the relevant authority, i.e. the BEST Commission, Department of Agriculture or Department of Fisheries.

Assist farmers' associations to create policies regarding the use of invasive species in agriculture and aquaculture.

### **XII. Voluntary Code of Conduct for Pet Stores, Breeders and Dealers**

Ensure that the invasive potential of animals is assessed prior to introducing and marketing an animal species new to The Bahamas. Invasive potential should be assessed by the introducer or qualified experts using risk assessment methods that consider animal characteristics and prior observations or experience with the animal elsewhere in the world.

Additional insights may be gained through extensive monitoring at your facility prior to distribution.

Work with local experts and stakeholders to determine which species are either currently invasive or will become invasive. Identify animals that could be suitable alternatives in your area.

Where agreement has been reached among associations, Government, academia and ecology and conservation organizations, phase out existing stocks of invasive species in areas where they are considered to be a threat.

Follow all laws on importation and quarantine of animals across political boundaries.

Encourage customers to purchase non-invasive pets or livestock.

### **XIII. Voluntary Code of Conduct for Pet Owners**

Ask for non-invasive species when you purchase pets. If the decision is taken to own an invasive species, ensure that it is contained and controlled through confinement to your property and reproductive control (e.g. spaying and neutering).

Seek information on which species are invasive in your country. Sources could include zoos, aquaria, pet stores, ecologists, conservationists and Government agencies.

Do not trade pets with other pet owners if you know they are species with invasive characteristics.

Request that pet stores and breeders promote, display and sell non-invasive species.

Help educate your community and other pet owners in your area through personal contact and in such settings as pet shows, training sessions, visits to the vet and other gatherings involving activities with pets.

Ask writers and other media to emphasize the problem of invasive species and provide information.

Invite speakers knowledgeable on the invasive species issue to speak to associations, clubs, schools and other community groups.

Seek the best information on control of invasive animal species and work with other like-minded individuals to remove these species from your area in an ethical and humane manner under the guidance of knowledgeable professionals.

Volunteer at zoos, aquaria, national parks and other natural areas to assist ongoing efforts to diminish the threat of invasive animals.

Participate in early warning systems by reporting invasive species you observe in your area to the relevant authority, i.e. the BEST Commission, Department of Agriculture or the Animal Control Unit.

#### **XIV. Voluntary Code of Conduct for Veterinarians**

Work with local ecologists, breeders, pet stores, conservation organizations and others to determine what species in your region either are currently highly invasive or show aggressive potential.

Increase interaction with other professionals and non-professionals to identify non-invasive animals and other solutions to problems caused by harmful invasive animals.

Take advantage of continuing education opportunities to learn more about the invasive species issue.

Identify and specify non-invasive species that are aesthetically and ecologically suitable alternatives to invasive species in your region.

Eliminate specification of species that are invasive in your region.

Encourage breeders and pet stores to provide farmers, private firms and the public with non-invasive animals.

#### **XV. Stakeholder Participant List**

##### **Abaco**

David Knowles  
Anita Rolle  
Beatrice Moxey  
Derrick Bailey  
Michael Albury  
A.J. Wells  
Mel Wells  
Don Cornish

Eric Collie  
Ed Newell  
Brickell Brennen  
John Hedden  
Moxey Williams  
A.L. Knowles  
John Bethell  
Doug Evans  
Lisa Evans  
Cleveland Banks

Molly Roberts  
Chris Roberts  
Mimi Rehor  
Dave Ralph  
Kathy Ralph  
Erin Pagliaro  
Ron Pagliaro  
Jack Hardy  
Bobby Jones  
Kendy Anderson  
Wayne Cornish  
H.B. Pinder  
Paul Pinder  
Chris Bergh

### **Andros**

Donald Cash  
Fred Pyfrom  
Mary Wilson  
Margo Blackwell  
Dewitt Edgecombe  
Deon Sweeting  
Peter Douglas  
Bill Adderley  
Donna McQueen  
Theresa Minnis  
Reverend N.W. Hamilton

### **Eleuthera**

Rufus E. Johnson  
Lionel Fernander  
Lloyd C. Johnson III  
Michael C. M. Culmer  
Robert Patterson  
Lawrence Griffin  
Bessie Culmer  
Branka Hanford  
Kevin Joseph Jr.  
Manon Tousignant  
Kingsley A. Bethel  
Drexel Boothe  
Kendal Sands  
Sally Chisholm

### **Grand Bahama**

Please call Nakira for these names

### **New Providence**

Eugene Torchon-Newry  
Lester Gittens  
Timothy Bethel  
Carol Albury  
Dr. E. McPhee  
Dr. Maurice Isaacs  
Nehemiah Francis  
Timothy Johnson  
Gwen Hammerton  
Dr. John Hammerton  
S.J. Miller  
Robert Myers  
Stephen Bethel  
Paul Dean  
Earl Seymour  
Pastor James Redmon  
Marian Rolle  
William Fielding  
Robin Wright  
Eric Rose  
Derek Smith  
Earlston McPhee  
Daniel Drost  
Eric Carey  
Eleanor Phillips  
Casuarina McKinney  
Stephen Bellot  
Stephan Moss  
Sharrah Moss  
Nakira Wilchcombe  
Deon Stewart  
Stacey Wells-Moultrie

### **Acklins & Crooked Island**

#### **Berry Islands**

#### **Bimini**

#### **Exuma & Ragged Island**

#### **Inagua**

#### **Long Island**

#### **Mayaguana**

#### **Run Cay & San Salvador**



Still awaiting response for above islands;  
will forward by Monday.

## XVI. List of Known Invasive Alien Species in The Bahamas

### Plant Species

|                                     |  |
|-------------------------------------|--|
| <i>Abrus precatorius</i>            | Rosary pea   |
| <i>Alibiza lebbeck</i>              | Woman's tongue   |
| <i>Antigonon leptopus</i>           | Coral vine   |
| <i>Asparagus densiflorus</i>        | Asparagus fern   |
| <i>Bauhinia variegata</i>           | Poor man's Orchid, Orchid tree   |
| <i>Casuarina equisetifolia</i>      | Australian Pine, Beefwood  |
| <i>Casuarina glauca</i>             | suckering Australian pine  |
| <i>Cestrum diurnum</i>              | Day jessamine  |
| <i>Colubrina asiatica</i>           | Lather leaf  |
| <i>Dioscorea alata</i>              | Winged yam   |
| <i>Dioscorea bulbifera</i>          | Air potato   |
| <i>Eichhornia crassipes</i>         | Water hyacinth   |
| <i>Eugenia uniflora</i>             | Surinam cherry   |
| <i>Haematoxylon campeachianum</i>   | Logwood  |
| <i>Impomoea purpurea</i>            | Morning Glory  |
| <i>Jasminum fluminense</i>          | Azores jasmine, Brazilian jasmine  |
| <i>Lantana camara</i>               | Lantana, Shrub verbena, angel lips, big sage,<br>black sage, white sage, prickly lantana |
| <i>Leucaena glauca</i>              | Jumbey   |
| <i>Melaleuca quinquenervia</i>      | Melaleuca, paper bark  |
| <i>Nephrolepis multiflora</i>       | Asian sword fern   |
| <i>Panicum repens</i>               | Torpedo grass  |
| <i>Pennisetum purpureum</i>         | Napier grass   |
| <i>Pimenta racemosa</i>             | Bay Rum  |
| <i>Prunus amygdalus</i>             | Almond   |
| <i>Ricinus communis</i>             | Castor Bean  |
| <i>Ruellia brittoniana</i>          | Mexican petunia  |
| <i>Scaevola taccada</i>             | Asian Scaevola, Hawaiian seagrape, White inkberry  |
| <i>Schefflera actinophylla</i>      | Schefflera, Queensland umbrella tree   |
| <i>Schinus terebinthifolius</i>     | Brazilian pepper, Bahamian holly   |
| <i>Spathodea campanulata</i>        | African tulip tree, flame of the forest  |
| <i>Syngonium podophyllum</i>        | Arrow head vine  |
| <i>Thespesia populnea</i>           | Seaside mahoe, cork tree, Spanish cork   |
| <i>Trachelosperumum jasminoides</i> | Star Jasmine   |
| <i>Wedelia trilobata</i>            | Wedelia, carpet daisy  |

### Bird Species

|                      |           |
|----------------------|-----------|
| <i>Columba livia</i> | Rock Dove |
|----------------------|-----------|

*Molothrus bonariensis*  
*Passer domesticus*  
*Streptopelia decaocta*

Shiny Cowbird  
House Sparrow  
Eurasian Collared Dove

### Terrestrial Animals Species

|                                |                                   |
|--------------------------------|-----------------------------------|
| <i>Bos taurus</i>              | Holstein                          |
| <i>Canine</i>                  | Dogs (all breeds and types)       |
| <i>Capra hircus</i>            | Goat                              |
| <i>Elaphe guttata</i>          | Corn snake                        |
| <i>Eleutherodactylus coqui</i> | Caribbean tree frog, common coqui |
| <i>Equus asinus</i>            | Donkey                            |
| <i>Felis catus</i>             | Cats (all breeds and types)       |
| <i>Mus musculus</i>            | Mouse                             |
| <i>Ovis aries</i>              | Sheep                             |
| <i>Procyon lotor</i>           | Raccoon                           |
| <i>Rattus norvegicus</i>       | Norway rat                        |
| <i>Rattus rattus</i>           | Ship rat                          |
| <i>Solenopsis invicta</i>      | Red imported fire ant             |
| <i>Sus scrofa</i>              | Pig                               |
| <i>Trachemys scripta</i>       | Red-eared slider                  |
| <i>Loxosceles reclusa</i>      | Brown recluse spider              |
| <i>Wasmannia auropunctatus</i> | Little fire ant                   |

### Aquatic Species

|                                  |                        |
|----------------------------------|------------------------|
| <i>Amphiprion sp</i>             | Clown fish             |
| <i>Artemia cysts</i>             | Brine shrimp           |
| <i>Callinectes sapidus</i>       | Blue crab              |
| <i>Callionymus lyra</i>          | Dragonet               |
| <i>Cherax quadricarinatus</i>    | Red claw               |
| <i>Chiloscyllium punctatum</i>   | Banded shark           |
| <i>Chkosoyllium piunctatum</i>   | Brown Bamboo shark     |
| <i>Chrysoara quinquechirra</i>   | Sea nettle             |
| Family Cichlidae                 | Cichlid fish           |
| <i>Crassostrea virginica</i>     | American oyster        |
| <i>Dunaliella sp.</i>            | Green algae            |
| <i>Epinephelus lanceolatus</i>   | Queenland grouper      |
| <i>Euxiophipops navarchis</i>    | Blue-girded angelfish  |
| <i>Euxiophipops xanthometapm</i> | Yellow-faced angelfish |
| <i>Hemiscylliidae</i>            | Bamboo shark           |
| <i>Heterodontus zebras</i>       | Zebra Bullhead shark   |
| <i>Nannochloropsis oculata</i>   | Algae                  |
| <i>Oreochrommis ureblepis</i>    | Tilapia                |
| <i>Radianthus</i>                | Sea anemone            |

