Anguilla Invasive Species

WORKSHOP REPORT

29th May 2007
Paradise Cove Hotel, Anguilla

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WORKSHOP BACKGROUND

Invasive species are a huge threat to biodiversity worldwide, and possibly the biggest threat currently facing the continued survival of wildlife on small islands. Many species are moved around the planet by humans, some deliberately like crop plants and domestic animals, and some accidentally like insects in the soil of imported plants, or the larvae of marine animals in ships’ ballast water. Most of these new introductions do not go on to cause environmental problems but a small proportion do, and can wreak havoc on unprepared native wildlife. They also can have detrimental human and economic impacts.

Anguilla is not exempt from non-native species introductions. Species such as the black rat are having devastating impacts on globally important seabird populations and carry diseases which affect human health.

The Joint Nature Conservation Committee (JNCC) in the UK has developed a non-native species database which collected all known records of non-native species in the UK Overseas Territories. There are currently 212 species recorded in the database for Anguilla, 1 invertebrate, 196 plants (61 if cultivated plants are not included) and 15 vertebrates (3 amphibians, 5 reptiles, 1 bird, 6 mammals). There are many gaps in the database and for most species there is little or no supporting information.

WORKSHOP PURPOSE

The purpose of the workshop was to gather information about the scale of the threat invasive species pose to Anguilla’s native plants and animals, to start to prioritise the species which need to be tackled first and discuss some of the actions that need to be undertaken.

The purpose was achieved by:
- General introduction to invasive species globally and in the Caribbean
- Presentation of a case study from Anguilla (Giant African Snail)
- An overview of the JNCC non-native species database
- Updating and filling in the gaps in the JNCC database list of non-native species for Anguilla
- Identifying and using potential criteria for invasive species prioritisation
- Discussion of the actions that need to be undertaken for 3 invasive species
- Development of objectives which could form the basis for an invasive species strategy

PARTICIPANTS

More than 20 participants attended the workshop from a wide range of government departments and organisations (See Appendix 1). The main stakeholder groups not represented were the garden centres and customs.

Participants were asked to write their expectations at the start of the workshop (See Appendix 3). The main reasons given for attending the workshop were to increase knowledge of invasive species issues and to find out more about the practical actions that can be taken to control or eradicate various species.
METHODS

The workshop endeavoured to facilitate the equitable and effective participation of all key stakeholders. There were several informational presentations made during the workshop by the consultant and Department of Environment (See Appendix 4). Group work was employed to maximise discussion and to bring out the key species and issues. The workshop agenda appears as Appendix 2.

WORKSHOP OUTPUTS

The main outputs of the workshop were:

- Increased understanding of the detrimental impact of invasive species on Anguilla
- Updated list for the JNCC database (Appendix 6)
- The beginnings of invasive species action plans for 3 priority species, the Giant African Snail, Black Rat and Cuban Tree Frog (Appendix 7)
- Objectives which could form the basis for an invasive species strategy (Appendix 8)

NEXT STEPS

- Establish an Invasive Species Working Group led by the Department of Environment with representatives from the stakeholders listed in Appendix 9. The main stakeholders would include Environment Health, Animal Welfare, Anguilla National Trust, Department of Agriculture and Department of Education (Lead is Rhon Connor, Dept. of Environment)
- Develop and implement plans for 3 priority species identified during the workshop (Giant African Snail, Black Rat, Cuban Tree Frog). Note although the Cuban Tree Frog has negative impacts for humans it is not known to have any impacts on native species
- Use the information from the workshop to inform the development of an invasive species strategy and the biodiversity strategy and action plan
- Verify and send the updated non-native species list to JNCC (Karen Varnham)
- Set up a database on Anguilla that links to the JNCC database in the UK (follow up with Tara Pelembe – tara.pelembe@jncc.gov.uk)

ACKNOWLEDGEMENTS

Thanks to the Anguilla National Trust and the Anguilla Department of Environment for all their support in organising the workshop and the UK Governments Overseas Territories and Environment Programme for providing the funding.
APPENDIX 1: Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Contact Details</th>
</tr>
</thead>
<tbody>
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<tr>
<td>13. Oliver Hodge</td>
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<td>15. Marino Hodge</td>
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## APPENDIX 2: Workshop Programme

<table>
<thead>
<tr>
<th>Session 1</th>
<th>Session 2</th>
<th>Break</th>
<th>Session 2</th>
<th>Lunch</th>
<th>Session 3</th>
<th>Break</th>
<th>Session 4</th>
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<tbody>
<tr>
<td>9:00 – 9:30</td>
<td>9:30 – 10:30</td>
<td>10:30 – 11:00</td>
<td>11:00 – 12:30</td>
<td>12:30 – 13:30</td>
<td>13:30 – 15:00</td>
<td>15:00 – 15:15</td>
<td>15:15 – 16:00</td>
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<tr>
<td>Ice-breaker: introductions, expectations</td>
<td>Introduction to invasives - Global/Caribbean/Anguilla Why they are an issue that can't be ignored</td>
<td>The current situation with invasive species on Anguilla. Brainstorm species. Review of the background document. Identifying criteria for prioritisation.</td>
<td>Focus on 3 key species. What needs to be done?</td>
<td>Identifying actions to inform a strategy. What needs to be done? By Who?</td>
<td>Conclusion/Next Steps</td>
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<tr>
<td>SS</td>
<td>KV &amp; RC</td>
<td>SS &amp; KV</td>
<td>SS &amp; KV</td>
<td>SS</td>
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<tr>
<td>Background presentations</td>
<td>Group work - Is list complete? - Identify criteria for invasive species prioritisation - Using criteria choose 3 top species.</td>
<td>Groupwork - Problem/threat - Distribution - Actions to be taken - Who should be involved?</td>
<td>Plenary discussion</td>
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APPENDIX 3: Workshop participants expectations

- Identify main problems caused by invasives in Anguilla
- I am here to participate and learn. I expect to learn about the non-native species
- I am here as a participant to contribute and support all ideas that are workable. I hope that we can learn and apply the information
- How to take care about plants – (trimming and when to spray)
- To learn more about invasive species. To identify species other than the giant african snail which are destructive. To learn strategies and techniques to make this topic accessible to the students at the ALHCS
- Identification of invasive species. Procedures to eradicate invasive species. Damage/cost of these invasive species
- I would like to know how to eradicate those dangerous creatures
- I am hoping to have a more hands on treatment method to deal with African snails and other harmful pests in and around Anguilla’s neighbouring islands. Also to have a pest control board set up to rid the island of these pests
- Feral cats
- Strategies for controlling the snail population in Anguilla
- Prioritise actions to take in the near future
- I expect to hear much information on a few pests that we have on the island and how to go about eradicating them
- Methodology that works on stray cats and dogs. What about invasives that come by natural processes? Learning to deal with them
- To learn about the various invasives on the island. Effective methods of dealing with them (practical and cost effective)
- To learn more about vectors and the means of control. To learn about different species of rodents native to Anguilla
- Understanding which species are causing problems to native fauna and flora. What might be feasible to control/minimise future impact
- To find ways of effectively preventing and managing invasive species from Anguilla
- The UK has lots of problems with invasive species including plants, crayfish etc. I’m interested to learn about the situation on Anguilla to see what shared issues we have
APPENDIX 4: Workshop Presentations
Non-native species in the UK Overseas Territories: a review

Karen Varnham
The UK Overseas Territories

• Politically retain close links with the UK

• Two kinds of affiliation
  – Overseas Territories & Crown Dependencies

• Extremely diverse

Photo: www.pbs.org

Photo: www.away.com
Relative sizes of the UK and the OTs

- **British Antarctic Territory**: 1800 km²
- **Metropolitan UK**: 200 km²
- **All other OTs**: 0 km²
Invasive species in the OTs

• Many OTs and CDs are small islands
• Home to many rare and threatened species
• Biggest threat to biodiversity of small islands is invasive species (acc. IUCN)
• No baseline information available about invasive species in the UKOTs
JNCC invasive species review

• JNCC advise the UK government on nature conservation affecting the UK and internationally

• Their brief includes the UKOTs and CDs

• Commissioned a review of invasive species in UKOTs and CDs

• Aims: determine scale of problem and priorities for action
Invasive species in the OTs: Phase 1

- Desk study looking for records of invasive species in OTs
- Consulted wide range of written sources
- Quickly decided to broaden scope of study: all non-native species
Phase 1: Information gathered

- **Basic data**: Latin & common names, habitat types
- **Distribution & rate of spread**: Fields for date of introduction, present and potential distribution.
- **How species get around**: Fields for route of entry, modes of transmission.
- **Ecological problems**: Fields for known and suspected ecological problems caused
- **Actions**: Fields for actions so far, actions planned and desired conservation outcomes
Non-native species in the OTs: Phase 2

- Sent data out to experts for validation & review
- Doubled the number of non-native species records (from 1283 to 2950)
- Added extra data to many other species records
- Database & accompanying report now available online (www.jncc.gov.uk/page-3634)
Non-native species in the OTs

- Bermuda
- St Helena
- BIOT
- Falklands
- Anguilla
- Ascension
- Tristan
- Cayman
- Gibraltar
- S. Georgia
- Pitcairn
- Montserrat
- BVI
- Isle of Man
- Turks & Caicos
- Jersey
- Guernsey
- BAT
- Cyprus SBA
- S. Sandwich

No. of species records

- Vertebrates
- Inverts
- Plants
Invasive species in the OTs

• Some species were found in many OTs

• Mammals: Rats (14), cats (11), goats (5)

• Plants: *Leucaena* (10), *Casuarina* (8)
Invasive species in the OTs

- Others only found in one or two
- Reindeer in South Georgia & Falklands
- Starlings in Bermuda
- Logwood in Cayman
Invasive species in the OTs

Mesquite (*Prosopis juliflora*)

- Invasive in Ascension
- Accidental introduction in organic matter
- Outcompetes native plants, destroys turtle nesting habitat
- Controlled by weeding and biological control

Photos: [www.geol.umd.edu](http://www.geol.umd.edu), [www.landscape-resources.com](http://www.landscape-resources.com)
Invasive species in the OTs

Cat (*Felis catus*)

- TCI & elsewhere
- Deliberate introduction for pest control & ‘humanitarian’ reasons
- Contributed to local extinction of TCI iguanas
- Successfully eradicated from Long Cay in 1999

Photo: Charles Darwin Research Station, Galapagos
Future of the database

- Collect more data – encourage people to send more information
- Forum for sharing information and expertise within the OT community
- Source of information for prioritising which invasive species to control
- And for developing practical management plans to carry out this control
Acknowledgements

• Thanks to JNCC, UKOT Conservation Forum and the many other organisations & individuals involved

• Database and report available from www.jncc.gov.uk/page-3634


JNCC Report no. 372
Invasive Species and the Caribbean

Karen Varnham
The invasive species problem

• Invasive species are one of the biggest problems facing global biodiversity

• The World Conservation Union (IUCN) rates them as 2nd biggest threat after habitat loss

• But possibly the biggest single threat to small islands
What is an invasive species?

• Native species are those found naturally within a particular area

• e.g. bananaquits
What is an invasive species

- **Endemic species** are those found in only one location, e.g. Cayman blue iguanas
What is an invasive species?

- Introduced species (also called exotic, non-native or alien species) are those arriving due to human activity

- e.g. mango trees
What is an invasive species?

• **Invasive species** are introduced species that successfully establish in, and then overcome native ecosystems.

  e.g. rats & *Casuarina* trees
What makes a species invasive?

• Only a very few introduced species go on to become invasive (about 1%?)

• A species may become invasive in one particular place but not in others

• Best predictor of invasiveness is if a species is invasive in similar conditions elsewhere
What makes a species invasive?

- Adaptable – can live in several different habitats
- Short generation time – can build up numbers quickly
- Good powers of dispersal – can spread rapidly
- Lack natural predators or diseases in new range
- Arriving in habitats already disturbed by humans
Invasive species on islands

- Islands cover just 3% of the earth’s area
- Home to around 15-20% of all plant, reptile and bird species
- More than 80% of all recorded extinctions have occurred on islands
How do invasive species reach islands?

- **Accidental Introductions**
  - e.g. rats

- **Brought to the New World by European travellers**

- **Highly adaptable, now found on more than 80% of the world’s islands**
How do invasive species reach islands?

• **Accidental introductions** e.g. pink hibiscus mealybug

• Introduced to Grenada in 1994, now present in many parts of the Caribbean (inc. Anguilla)

• Attacks many valuable crop species including citrus and coconuts
How do invasive species reach islands?

- **Agricultural & Commercial imports** e.g. goats

- Still kept as livestock but others now live totally in the wild (feral)

- Eat native vegetation and trample bird and iguana nests
How do invasive species reach islands?

- Ornamental or landscaping plants e.g. *Scaevola taccada*
- Native to Indian & Pacific Ocean coasts
- Grows fast - has displaced native *Scaevola* from its natural range on many Caribbean islands
How do invasive species reach islands?

- To control other problem species
  - e.g. cats

- Introduced by early settlers to control rats and mice, now many feral cats living wild

- Very effective predators of native wildlife
What to do about invasive species?

• Prevention!

• Prevent imports of species known or suspected to be invasive

• Inspection, treatment and quarantine of high-risk imports
What to do about invasive species?

• Early detection

• Need to educate as many groups as possible to recognise potential invaders

• Rapid response - develop plan of action in case species is found
What to do about invasive species?

- **Eradication or control**
- **Biological control** - introduction of VERY host specific diseases or predators
- **Chemical methods** - e.g. herbicides, rodenticides
- **Trapping** - can be effective for large mammals
- **Exclusion** - fencing or other physical barriers
What to do about invasive species?

• Legislation & enforcement

• Need effective laws to deal rapidly with invasive species

• Restrict import of species that may cause ecological as well as purely economic damage
What to do about invasive species?

• Research & Communication

• Study effects of invasive species

• Share knowledge between islands and globally
What to do about invasive species?

- **Public involvement**
- Avoid feeding feral animals
- Encourage spaying & neutering of cats & dogs
- Discourage abandoning pets into the wild
- Plant native species as landscaping plants
Conclusions

• Caribbean islands have great biodiversity and are at great risk from invasive species

• Developing effective responses to invasive species problems will involve international organisations, national governments, NGOs and individual citizens

• First step is to understand the nature of the problem - different for every island
Invasive Species:
The Case of *Achatina fulica* and its impact in Anguilla

*By*

*Rhon A. Connor*
Introduction

Threats to Biodiversity

• Habitat loss
• Degradation
• Overexploitation
• Climate Change
• Invasive species (Biological Invasions)
What are Invasive species?

National Invasive Species Council (2001)

A species that is:
- Non-native or alien to ecosystem under consideration
- Whose introduction causes or is likely to cause harm (economic, environmental, human)
Current Invasive Species?

- Cuban Tree Frogs
- Dirt wasp
- Mealy bugs

and.............
Welcome to Anguilla

Bienvenue !!
Origin of the Giant African Snail

[Map showing the origin of the Giant African Snail in East Africa, with a red circle around Uganda, Kenya, and Tanzania.]
Introduction of Achatina in Caribbean

- Guadeloupe 1984
- Martinique 1988
- Barbados 2000
- St. Lucia 2000
- St. Maarten 2000?
- Anguilla 2000?
Achatina: When it got Here??

Year Learned About the GAS

- 1999
- 2001
- 2003
- 2005
- No answer

Respondents

%
How it Got here?

Possible Pathways

**Transported by several methods:**

- Plant trade
- Deliberate (Food)
- Exotic animal
- Container shipment

GAS method of arrival

- 44% imported plants
- 32% vehicles/containers
- 16% on blocks/cement
- 3% lumber
- 2% other
- 1% not applicable
- 1% don’t know
- 1% no answer
Distribution of GAS?

The Distribution of the Giant African Snails in Anguilla

Legend
- Study Sites
- Villages Infested
  - Before March 2006
  - After March 2006
  - Not Infested

Alan Mills, 2006
Achatina is Here! Is it a problem?
Achatina is Here! Is it a problem?

- Recognized in the top 100 most destructive invasive in the world
- Herbivore with voracious appetite
- Feeds on 500+ species of plants
- Extremely high reproductive rate
Achatina’s impact in Anguilla

- Agriculture/Horticulture
  - Feed on various plants species
  - Spread of fungal and bacterial disease of plants

![Image of damaged plant]

 Damage to Crops and/or Plants by GAS

- Yes: 44%
- No: 42%
- Don't know: 12%
- Not applicable: 1%
- No answer: 1%

![Pie chart showing damage percentages]
Economic Impact

• Government
  - control campaign launched by Agriculture Department
  - price of Methaldehyde bait subsidized
Workers from the Agricultural Department are setting bait for the Giant African snails that are roaming various areas of Anguilla destroying cultivated plant life and other forms of vegetation.

The snails, which are prevalent in the Stoney Ground area, are now spreading to other locations on the island. In some cases they leave unsightly trails on buildings and corrupt water sources around homes.

There have been many complaints from persons affected by the snail nuisance and some householders have resorted to procuring expensive poisoned bait to deal with the problem.
Economic Impact

- Residents continuously spend funds to control GAS
- Damage to subsistence farmers’ crops

Financial Losses Due to GAS
Ecological problems

- Achatina has potential to outcompete other species of snails
- Has been associated with destruction of native and endemic plants
Aesthetics

- Aggregate in large numbers (Unsightly)
- Attach to houses (leaving behind feces/slime)
- Overcrowd gardens
- Potential to create road block
Risk to Humans Health

- Potential carrier of a parasite
  \textit{Angiostrongylus cantonensis} (Rat lung worm)
- Potential cause of meningitis and brain damage
- Associated with Skin rashes (contact w/ slime)
- Shells’ potential for breeding Mosquitoes
Possibility of Eradication?

- Extremely difficult task
- Requires lots of labour
- Extremely costly
- Most attempts failed
Possibility of Eradication?

Two success stories

• Miami, Florida
  - 1969-1979
    – over 1 million dollars
• Queensland, Australia
Recommendations

• Develop strategic program to prevent/control invasive species
  – Develop quarantine areas

• Continuously educate public about invasive species

• Collaborative effort among all stakeholders
  – using of bait
  – removing by hand
  – destroying eggs

• Encourage residents to keep surroundings clean
  – low grass / dried leaves/ old wood, etc
  – Proper drainage (sinks/bathrooms, etc)
Recommendations

• Avoid the introduction of predatory animals
  - Rosy wolf snail impact in Hawaii and other territories

- Planarian *Platedemus manokwari*
Thank You
APPENDIX 5: Brainstorm of invasive species found on Anguilla

- Giant African Snail
- Prickly Pear
- Rats
- Casuarina
- Mealy Bug
- Cuban Tree Frog
- Fire Ants
- Goats (Feral)
- Pit Scales
- Armoured Scales
- Potato White Flies
- Green Iguana
- Scavola
- Citrus Scales
- Army Worms
- House Sparrow (potential)
- German Roach
- Feral Cats
- Cane Toad
- Coral Snake
- Oleandar Caterpillar
- Chickens (Feral)
- Mud Wasps
- Dogs (Stray)
- Webworms

The army worm, giant african snail and rabbit were not listed in the JNCC database. The Cane Toad is not actually found on Anguilla.
APPENDIX 6: Updates for JNCC database

Non-native species recorded on Anguilla – summary from Varnham/JNCC (2006)

212 species recorded in database, but many of these are cultivated plants. While cultivated plants can become invasive, most of them have not been included in this document.

All data in red type are from the workshop, and referenced with a ‘w’.

- Invertebrates: 1 record
- Plants: 61 records (or 196 if cultivated species are also included)
- Vertebrates: 15 records (3 amphibians, 5 reptiles, 1 bird, 6 mammals)

GAPS –
No marine spp,
No fungi

* Classified as ‘invasive’ by CABI Invasives in the Caribbean database
** Classified as ‘exotic’ by CABI Invasives in the Caribbean database
† Classified as ‘naturalised’ by CABI Invasives in the Caribbean database
### INVERTEBRATES

<table>
<thead>
<tr>
<th>Scientific name(s)</th>
<th>Common name(s)</th>
<th>Broad habitat</th>
<th>Date/route of introduction</th>
<th>Effects (known/suspected)</th>
<th>Method of spread</th>
<th>Current distribution</th>
<th>Actions to date/planned</th>
<th>Native range</th>
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<tbody>
<tr>
<td><strong>Homoptera</strong></td>
<td></td>
<td></td>
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<tr>
<td><em>Macronellicoccus hirsutus</em></td>
<td>hibiscus mealybug; pink mealybug</td>
<td>Terrestrial</td>
<td>Transport of ornamental plants from infested countries (77).</td>
<td>Pest on several crop species (76). General agricultural and tree pest (98).</td>
<td></td>
<td></td>
<td>Effective biological control agents are available (76). Not sure if they have been used in Anguilla.</td>
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<tr>
<td><strong>Lepidoptera</strong></td>
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<tr>
<td>?<em>Pseudaelita unipuncta</em></td>
<td>armyworm</td>
<td>Terrestrial</td>
<td>Brought in on imported grass (w).</td>
<td>Eats grass and causes unsightly damage to lawns (w).</td>
<td>Moved around on plants, soil and grass (w).</td>
<td>Localised on lawns and golf courses (w).</td>
<td>Granular treatment (active ingredient not specified) (w).</td>
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<tr>
<td><strong>Mollusca</strong></td>
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<tr>
<td><em>Achatina fulica</em></td>
<td>giant African snail</td>
<td>Terrestrial</td>
<td>Introduced around 2000 (w)</td>
<td>Competes with and predate native snails. Affects agricultural and ornamental plants. Vector of disease. Leaves unsightly slime and droppings on buildings. (w)</td>
<td>Transport of soil and other materials. Also disperses under its own power. (w)</td>
<td>Widespread in centre and east of Anguilla. Centres around the Valley, Stoney Ground etc.(w)</td>
<td>Government-subsidised molluscicides on sale and widely used by private householders. (w) The following actions have been proposed: mechanical picking of snails, public awareness campaigns &amp; education, establish task force to co-ordinate eradication, lobby government to</td>
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<tr>
<td>Scientific name(s)</td>
<td>Common name(s)</td>
<td>Broad habitat</td>
<td>Date/route of introduction</td>
<td>Effects (known/suspected)</td>
<td>Method of spread</td>
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<td></td>
<td>establish legal rights for task force workers to enter property, improve quarantine of plants and other imports, develop detailed budgets &amp; seek funding, establish multi-agency approach, led by government (Dept of Agriculture). (w)</td>
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<tr>
<td><em>Achyanthes aspera</em></td>
<td>man-better man; hug-me-close</td>
<td>Terrestrial</td>
<td>Introduced (150)</td>
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<td>Introduced (150)</td>
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<td>Arecales</td>
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<tr>
<td><em>Cocos nucifera</em></td>
<td>coconut palm</td>
<td>Terrestrial</td>
<td>Introduced (150)</td>
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<tr>
<td><em>Calotropis prosera</em></td>
<td>headache bush; milky-milky bush; French cotton</td>
<td>Terrestrial</td>
<td>Introduced (150)</td>
<td>This species is valued locally (reasons unspecified) (w).</td>
<td>Transported by birds, animals and humans (w).</td>
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<tr>
<td>Asteraceae</td>
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<td><em>Emilia fosbergii</em></td>
<td>tassel flower; rabbit meat</td>
<td>Terrestrial</td>
<td>Introduced (150)</td>
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<td><em>Flaveria bidentis</em></td>
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<tr>
<td><em>Senecio confusus</em></td>
<td>Mexican flame vine</td>
<td>Terrestrial</td>
<td>Introduced (150)</td>
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<tr>
<td><em>Sonchus oleraceus</em></td>
<td>dandelion; sow thistle</td>
<td>Terrestrial</td>
<td>Introduced (150)</td>
<td>Can take over habitats if left unchecked (w).</td>
<td>Transported by birds, animals and humans (w).</td>
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<tr>
<td><em>Thymophylla tenuiloba</em></td>
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<td>Introduced (150)</td>
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<tr>
<td><em>Xanthium strumarium</em></td>
<td>burrweed</td>
<td>Terrestrial</td>
<td>Introduced (150)</td>
<td></td>
<td>Transported by animals and humans (w).</td>
<td>Throughout the island, especially on beaches (w).</td>
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<td>Bignoniaceae</td>
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<tr>
<td><em>Tabebuia heterophylla</em> †</td>
<td>white cedar; trumpet tree; pink Tecoma</td>
<td>Terrestrial</td>
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<td><strong>Boraginaceae</strong></td>
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<tr>
<td><em>Cordia obliqua</em></td>
<td>clamen cherry</td>
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<td>Introduced (150).</td>
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<tr>
<td><em>Heliotropium angiospermum</em></td>
<td>eyebright; scorpion tail</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Heliotropium curassavicum</em></td>
<td>small lavender; seaside heliotrope</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><strong>Brassicaceae</strong></td>
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<tr>
<td><em>Lepidium virginicum</em></td>
<td>pepper grass; vomiting bush</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><strong>Cactaceae</strong></td>
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<tr>
<td><em>Epiphyllum oxypetalum</em></td>
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<td><strong>Caesalpinaceae</strong></td>
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<td><em>Senna italica</em></td>
<td></td>
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<td><strong>Capparaceae</strong></td>
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<tr>
<td><em>Cleome gynandra</em></td>
<td>small spider flower; stinking miss</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Cleome viscosa</em></td>
<td>caia</td>
<td>Terrestrial</td>
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<td><strong>Casuarinaceae</strong></td>
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<tr>
<td><em>Casuarina equisetifolia</em></td>
<td>Casuarina; lumber tree; beefwood</td>
<td>Terrestrial</td>
<td>Introduced, cultivated (150).</td>
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<tr>
<td><strong>Chenopodiaceae</strong></td>
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<td><em>Atriplex pentandra</em></td>
<td></td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Chenopodium ambrosioides</em></td>
<td>wormweed</td>
<td>Terrestrial</td>
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<tr>
<td><strong>Combretaceae</strong></td>
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<tr>
<td>Terminalia catappa</td>
<td>almond; Indian almond</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><strong>Cucurbitaceae</strong></td>
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<tr>
<td>Cucumis anguria</td>
<td>wild cucumber</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td>Momordica charantia</td>
<td>maiden apple; wild balsam apple</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><strong>Euphorbiaceae</strong></td>
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<tr>
<td>Acalypha poiretii</td>
<td></td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td>Jatropha curcas</td>
<td>barricata bush</td>
<td>Terrestrial</td>
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<td><strong>Fabaceae</strong></td>
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<tr>
<td>Leucaena leucocephala**</td>
<td>Leucaena</td>
<td>Terrestrial</td>
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<tr>
<td>Macroptilium atropurpureum</td>
<td>kudzu</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td>Sophora tomentosa</td>
<td>bead tree</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><strong>Goodeniaceae</strong></td>
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<tr>
<td>Scaevola taccada</td>
<td></td>
<td>Terrestrial</td>
<td>Introduced, cultivated (150).</td>
<td></td>
<td></td>
<td></td>
<td>Mostly found in the grounds of large resorts (150).</td>
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<td><strong>Lamiaceae</strong></td>
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<tr>
<td>Leonotis nepetifolia</td>
<td>rabbit brush; ball of thread; hollow stalk; shandilay</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td>Ocimum basilicum</td>
<td>basil</td>
<td>Terrestrial</td>
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<tr>
<td>Abutilon indicum</td>
<td>monkey bush</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><strong>Mimosaceae</strong></td>
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<tr>
<td>Acacia farnesiana</td>
<td>queen casha; sweet acacia</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td>This species dominates areas in which it grows,</td>
<td>Moved around by animals</td>
<td></td>
<td>Island wide (w).</td>
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</tbody>
</table>

Anguilla Invasive Species workshop report  
Page 13
<table>
<thead>
<tr>
<th>Scientific name(s)</th>
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<th>Method of spread</th>
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<th>Actions to date/planned</th>
<th>Native range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia macracantha</td>
<td>kushar; long spine acacia</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td>This species dominates areas in which it grows, shading out native species (w).</td>
<td>Moved around by animals and birds (w).</td>
<td>Island wide (w).</td>
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<tr>
<td>Acacia nilotica*</td>
<td>casha; gum arabic tree</td>
<td>Terrestrial</td>
<td>Deliberately introduced as a shade tree (122).</td>
<td>This species dominates areas in which it grows, shading out native species (w).</td>
<td></td>
<td>Island wide (w).</td>
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<td>Oleaceae</td>
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<tr>
<td>Jasminum fluminense</td>
<td>wild jasmine; ink vine</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td>Oxalidaceae</td>
<td>Oxalis corniculata</td>
<td>sour grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td>Papaveraceae</td>
<td>Argemone mexicana</td>
<td>Mexican poppy; yellow thistle</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td>Poaceae</td>
<td>Bothriochloa pertusa</td>
<td>Antigua hay; Barbados sour grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td>Takes over areas in which it grows and prevents natural soil erosion (w).</td>
<td>Moved around by animals, birds and humans (w).</td>
<td>Island wide (w).</td>
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<td></td>
<td>Bothriochloa ischaemum</td>
<td>bluestem</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td></td>
<td>Chloris gayana</td>
<td>Rhodes grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><em>Cymbopogon citratus</em></td>
<td>lemon grass; fever grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td><em>Dactyloctenium aegyptium</em></td>
<td>crowfoot grass</td>
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<td>Introduced (150).</td>
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<tr>
<td><em>Digitaria decumbens</em></td>
<td>pangola grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Digitaria sanguinalis</em></td>
<td>crab grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td>Takes over habitats in which it grows (w).</td>
<td>Produces seeds and shoots (w).</td>
<td>Island wide (w).</td>
<td>Controlled on a small scale using chemicals such as 24D or MSMA (w).</td>
<td></td>
</tr>
<tr>
<td><em>Eleusine indica</em></td>
<td>chedda; Dutch grass; goose grass; fowlfoot grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td></td>
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</tr>
<tr>
<td><em>Eragrostis ciliaris</em></td>
<td>love grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Eragrostis tenella</em></td>
<td>Japanese lovegrass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td></td>
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<tr>
<td><em>Panicum maximum</em></td>
<td>Guineas grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Panicum molle</em></td>
<td></td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Pennisetum purpureum</em></td>
<td>elephant grass; napier grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<td></td>
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<tr>
<td><em>Rhynchelytrum repens</em></td>
<td>red-headed grass; natal grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><em>Tragus berteronianus</em></td>
<td>spike burgrass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td></td>
<td></td>
<td></td>
<td>Moved around by animals, birds and humans (w).</td>
<td>On beaches (w).</td>
</tr>
<tr>
<td><em>Vetiveria zizanioides</em></td>
<td>khus-khus; cockroach grass</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td>Scientific name(s)</td>
<td>Common name(s)</td>
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<td>Date/route of introduction</td>
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<td>Method of spread</td>
<td>Current distribution</td>
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<td>Native range</td>
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<tr>
<td><strong>Polygononaceae</strong></td>
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<tr>
<td>Antigonon leptopus</td>
<td>coral vine; coralita</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td>Takes over habitats in which it grows (w).</td>
<td>Deliberate planting (w).</td>
<td></td>
<td>Need to educate gardeners to avoid planting this species where it can spread unchecked (w).</td>
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<tr>
<td><strong>Polypodiaceae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Nephrolepis biserata</td>
<td>fern</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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<tr>
<td><strong>Portulacaceae</strong></td>
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<tr>
<td>Portulaca oleracea</td>
<td>pussley; purslane</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td>Takes over habitats in which it grows (w).</td>
<td>Seeds (w).</td>
<td>Widespread (w).</td>
<td></td>
<td></td>
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<tr>
<td><strong>Salicaceae</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Salix humboldtiana</td>
<td>willow</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
<td></td>
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<tr>
<td><strong>Solanaceae</strong></td>
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</tr>
<tr>
<td>Datura stramonium</td>
<td>wildfire; david bush; jimson weed</td>
<td>Terrestrial</td>
<td>Introduced (150).</td>
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## VERTEBRATES

<table>
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<tr>
<th>Scientific name(s)</th>
<th>Common name(s)</th>
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<th>Date/route of introduction</th>
<th>Effects (known/suspected)</th>
<th>Method of spread</th>
<th>Current distribution</th>
<th>Actions to date/planned</th>
<th>Native range</th>
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<tbody>
<tr>
<td><strong>Amphibians</strong></td>
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<tr>
<td><em>Bufo marinus</em></td>
<td>cane toad; marine toad</td>
<td>Freshwater</td>
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</tr>
<tr>
<td><em>Eleutherodactylus johnstonei</em></td>
<td>Johnstone's whistling frog</td>
<td>Terrestrial</td>
<td>Late 1980s (61). Accidentally introduced (61).</td>
<td>Possible effects on native lizards and arthropods, though this has yet to be evaluated (86). Believed to contaminate water (especially in cisterns) and considered a risk to human health (though means are unspecified). (w)</td>
<td>Active dispersal during wet weather, combined with passive dispersal by humans (on vehicles, plants etc) (86).</td>
<td>Population increased explosively in 1999 following an unusually wet year and this species is now found across most parts of the island. Usually in areas associated with human activity (86).</td>
<td>The following measures have been suggested: use of clorox &amp; salt solutions, liaise with planning department to ensure closed drainage and to prevent un-treated swimming pools, education and awareness raising programme. (w)</td>
<td></td>
</tr>
<tr>
<td><em>Osteopilus septentrionalis</em></td>
<td>Cuban tree frog</td>
<td>Terrestrial</td>
<td>Reported since the late 1980s (86). At least some individuals have been accidentally introduced on shipments of plants from Florida (86).</td>
<td></td>
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</tbody>
</table>

| **Birds**          |                |               |                            |                           |                   |                     |                         |              |
| *Gallus varius*    | chicken        | Terrestrial   | Reported to consume fairly large snakes elsewhere and so could easily kill juvenile Lesser Antillean iguanas (147) |                           |                   |                     |                         |              |

<p>| <strong>Mammals</strong>        |                |               |                            |                           |                   |                     |                         |              |</p>
<table>
<thead>
<tr>
<th>Scientific name(s)</th>
<th>Common name(s)</th>
<th>Broad habitat</th>
<th>Date/route of introduction</th>
<th>Effects (known/ suspected)</th>
<th>Method of spread</th>
<th>Current distribution</th>
<th>Actions to date/planned</th>
<th>Native range</th>
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</thead>
<tbody>
<tr>
<td><em>Canis familiaris</em></td>
<td>dog</td>
<td>Terrestrial</td>
<td>Established from domestic stock (61).</td>
<td>Identified as a major threat to native iguanas (61). Likely to kill endangered Anguillian racer snakes (61). Kill goats (w).</td>
<td>Abandoned by humans (w).</td>
<td>Island wide (w).</td>
<td>1997 Report on Conservation of Lesser Antillean iguanas recommends residents should be encouraged to spay and neuter pet dogs and to keep them confined to their yards or houses (147). Education in schools also recommended (w).</td>
<td></td>
</tr>
<tr>
<td><em>Capra hircus</em></td>
<td>goat</td>
<td>Terrestrial</td>
<td>Feral populations appear to have derived from domestic stock (147).</td>
<td>Believed to compete with native Lesser Antillean iguanas for food, and to alter plant community structure by selective browsing. Can also damage sensitive iguana nesting sites by trampling (147).</td>
<td>Often encountered, even in remote areas of Anguilla. Also reported from Dog Island and Scrub Island (147).</td>
<td>1997 Report on Conservation of Lesser Antillean iguanas recommends allocating resources for goat removal (147).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Felis catus</em></td>
<td>cat</td>
<td>Terrestrial</td>
<td>Established from domestic stock (61).</td>
<td>Likely to kill endangered Anguillian racer snakes (61). Also likely to predate sea birds, land birds and native</td>
<td>Natural dispersal and also abandoned by humans (w).</td>
<td>Island wide (w).</td>
<td>Anguillian Racer Conservation Project report (1998) recommends initiating a cat control programme in association with</td>
<td></td>
</tr>
<tr>
<td>Scientific name(s)</td>
<td>Common name(s)</td>
<td>Broad habitat</td>
<td>Date/route of introduction</td>
<td>Effects (known/suspected)</td>
<td>Method of spread</td>
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</tr>
<tr>
<td>Mus musculus</td>
<td>house mouse</td>
<td>Terrestrial</td>
<td>Accidentally introduced (61).</td>
<td>Likely to be a potential risk to human health and also to eat cultivated fruits (w).</td>
<td></td>
<td></td>
<td>public education about the problems of feral cats (61). Some spaying of feral cats carried out by Anguilla Animal Rescue Foundation (w).</td>
<td></td>
</tr>
<tr>
<td>Oryctolagus cuniculus</td>
<td>rabbit</td>
<td>Terrestrial</td>
<td>c. 1997 (w). Introduced as pets and as a food source (w).</td>
<td>Believed to damage farmers crops (w).</td>
<td></td>
<td>Island Harbour (w).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rattus norvegicus</td>
<td>brown rat</td>
<td>Terrestrial</td>
<td>Accidentally introduced (61).</td>
<td>Likely to be a potential risk to human health and also to eat cultivated fruits (w).</td>
<td></td>
<td></td>
<td>The following measures have been suggested: education &amp; awareness raising, conduct feasibility studies of eradication &amp; control, review, amend &amp; enforce legislation (vector</td>
<td></td>
</tr>
<tr>
<td>Rattus rattus</td>
<td>black rat</td>
<td>Terrestrial</td>
<td>Accidentally introduced (61).</td>
<td>Known to eat snake eggs and to attack species similar to the endangered Anguillian racer snake (61). Economic problem - devalue</td>
<td></td>
<td>Everywhere - main island and cays (w).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific name(s)</td>
<td>Common name(s)</td>
<td>Broad habitat</td>
<td>Date/route of introduction</td>
<td>Effects (known/suspected)</td>
<td>Method of spread</td>
<td>Current distribution</td>
<td>Actions to date/planned</td>
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</tr>
<tr>
<td>Anolis carolinensis*</td>
<td>common iguana</td>
<td>Terrestrial</td>
<td>Reported for the first time in 1995 (61). May have floated to Anguilla on rafts of vegetation (100) shortly after Hurricane Luis (61). These animals would presumably have come from other non-native</td>
<td></td>
<td></td>
<td></td>
<td>Unsuccessful eradication project took place in 1999 (100). 1997 Report on Conservation of Lesser Antillean iguanas recommends removing from the wild all common iguanas caught in the future, and to take measures to prevent the import of</td>
<td></td>
</tr>
<tr>
<td>Elaphe guttata*</td>
<td>corn snake</td>
<td>Terrestrial</td>
<td>Accidentally introduced on ships from Africa (61).</td>
<td>Not seen as a threat. Considered beneficial to humans (through predation of insect pests?). (w)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Hemidactylus mabouia</td>
<td>common woodslave</td>
<td>Terrestrial</td>
<td>Accidentally introduced on ships from Africa (61).</td>
<td></td>
<td></td>
<td></td>
<td>Very widespread (61).</td>
<td></td>
</tr>
<tr>
<td>Iguana iguana*</td>
<td>common iguana</td>
<td>Terrestrial</td>
<td>Reported for the first time in 1995 (61). May have floated to Anguilla on rafts of vegetation (100) shortly after Hurricane Luis (61). These animals would presumably have come from other non-native</td>
<td></td>
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</tbody>
</table>

Reptiles

* Legislation), promote knowledge of existing laws & protocols, develop multi-agency approach, led by Environmental Health Unit. (w)
<table>
<thead>
<tr>
<th>Scientific name(s)</th>
<th>Common name(s)</th>
<th>Broad habitat</th>
<th>Date/route of introduction</th>
<th>Effects (known/suspected)</th>
<th>Method of spread</th>
<th>Current distribution</th>
<th>Actions to date/planned</th>
<th>Native range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rhamphotyphlops braminus</strong></td>
<td>worm snake</td>
<td>Terrestrial</td>
<td>Accidentally introduced (61).</td>
<td></td>
<td></td>
<td></td>
<td>common iguanas and the release of those present into the wild (147).</td>
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## REFERENCES

<table>
<thead>
<tr>
<th>Ref no.</th>
<th>Author/s</th>
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<th>Title</th>
<th>Location</th>
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<tr>
<td>98</td>
<td>Carty, A.</td>
<td>2003</td>
<td>pers comm.</td>
<td>(Ref 112 from the CABI database).</td>
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<tr>
<td>100</td>
<td>Hodge, K.</td>
<td>2003</td>
<td>pers comm.</td>
<td>(Ref 81 from the CABI database).</td>
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<tr>
<td>122</td>
<td>CABI</td>
<td>2003</td>
<td>Unreferenced comments from the CABI Invasives in the Caribbean database.</td>
<td><a href="http://www.issg.org/database/species/reference_files/Kair%e2%80%93et%e2%80%93al%e2%80%932003.pdf">www.issg.org/database/species/reference_files/Kair%e2%80%93et%e2%80%93al%e2%80%932003.pdf</a></td>
</tr>
<tr>
<td>150</td>
<td>Walker, M.</td>
<td>2004</td>
<td>pers comm.</td>
<td>Mary Walker has written a book on the flora of Anguilla</td>
</tr>
</tbody>
</table>
APPENDIX 7: Criteria identified for prioritising invasive species

**Group 1 (Amphibians, reptiles, invertebrates, birds):**

- Risk to human health
- Risk to property
- Risk to animals
- Risk to plants

**Economic Costs**

**Availability of safe control methods**

Ecological impact on food webs

**Group 2 (Plants):**

- Physical Impact
  - On people
  - Wildlife/vegetation
  - Economic

- **Cost/Ease of control**
  - Need for chemicals
  - Need for specialised labour

- **Role of media/public**

- **Available Government support**

- **Legislation**
  - Is it needed?
  - Is enforcement possible?

**Group 3 (Mammals):**

1. Economic Impact
2. Cost of Removal/Control
3. Effects on Humans
4. Severity of impact on Native Species
5. Feasibility of Removal/Control
6. Human Response/Reaction
7. Political Will
8. Sustainability (maintenance)

The groups then used these criteria to prioritise species within the taxonomic groups they had been given. All used a matrix/scoring approach.
APPENDIX 8: Priority list of invasive species

Participants were asked to select three priority species from the list of 9.

In no particular order:

- Queen Acacia 0
- Giant African Snail 17
- Crab Grass 0
- Cuban Tree Frog 9
- Spike Burgrass 4
- Army Worm 3
- Goats (Feral) 6
- Black Rat 13
- Brown Rat 2

The three priority species were Giant African Snail, Black Rat and Cuban Tree Frog. Note although the Cuban Tree Frog has negative human impacts, there are no known negative impacts on non-native species.
APPENDIX 9: Actions for priority invasive species

Group 1: Giant African Snail

Problem
- Potential to compete with native snails because of their cannibalistic nature
- Impact on agriculture (500 species of plants)
- Potential to cause disease (meningitis, rat lung etc.)
- Dominant in rainy season (false sense of security during dry season)
- Rapid reproduction rate (hermaphrodites, 400 eggs in one sitting, 2-4 week incubation period, eggs are viable for 4 years)
- Unsightly (droppings, trail/slimes etc.)
- Contamination of water sources

Distribution
Island wide but not on Cays. Mainly in SG, N&S Valley, GH, SouthHill and Little Harbour

Actions
- All attempts to eradicate but control in the short term
- Mechanical/handpicking
- Public Awareness Campaign
- Establish task force (co-ordinate eradication in key areas)
- Lobby government for legislation to empower workers
- Quarantine areas (control the spread)
- Sustainable long-term planning
- Budgeting
- Monitoring – continuous application and reapplication

By Whom
- Residents
- Department of Agriculture
- Department of Education
- Department of Environment
- Hotel Owners/Managers
- Public Health
- Volunteer Groups
- Legislators
- Anguilla National Trust
- Port Authorities
- Environment Health Unit
- Media (All)
- Donor Agencies
Group 2: Cuban Tree Frog

Aim: To eradicate

Problem
- Water contamination (skin toxicity, faecal matter)
- Noise pollution
- Bad PR – in hotel rooms!!
- May eat native invertebrates

Distribution
Island wide. First appeared at garden centre (non-specific)

Action
- Control availability of breeding habitat (still, fresh water)
- Screen cisterns
- Better drainage/waste water disposal
- Chlorox/salt solution to target individual adults

Responsibility
- Environment Health Unit (lead). To set guidance as stagnant water regulations already in place
- Planning Division when approving new development etc.

Also
- Media
- NGOs
- Tourist Board

Education is key.
Group 3: Black Rat

Problem
Economic
- Devaluation of Dog Island
- Destruction to property
- Destruction to food crops e.g. PawPaw

Ecological
- Bird Populations
- Flora and Fauna e.g. Anguilla Racer Snake, Iguana

Public health
- Food poisoning
- Carrier of other diseases (leptospirosis, rabies etc.)

Distribution
Mainland and Cays

Actions
- Education and awareness
- Stakeholder consultation
- Feasibility studies
- Control Measures/Eradication (Based on recommendations from feasibility studies)
- Review, amend and enforce legislation (biosecurity protocols)
- Source funding

Who
- Environmental Health (lead)
- Agriculture
- Department of Environment
- Customs
- Anguilla Health Authority
- Port Authority
- Anguilla Tourist Board & Anguilla Hotel and Tourist Association
- Fisheries & Marine resources
- Anguilla Beautification Club
- Farmers Association
- Chamber of Commerce
- Department of Education
- Anguilla National Trust
- Media
- Garden Centre Operators
- Disaster Preparedness Management Team
- Transportation (shipping, airlines (freight))
- Other Stakeholders e.g. landowners of Cays
ANNEX 10: Recommendations for an Invasive Species Strategy

These were drawn from actions that were common across the three focus species.

1. Strengthen Regional Early Warning System
2. Develop and implement invasive species action plans for priority species
3. Establish an invasive species working group
4. Set up a monitoring/surveillance system which includes a local database to record introduction, spread, distribution and actions taken on invasive species
5. Undertake more research and feasibility studies on priority species
6. Identify funding to take forward actions (local, regional and international)
7. Improve and enforce legislation (biosecurity arrangements)
8. Raise awareness and understanding