**MAINSTREAMING PREVENTION AND CONTROL MEASURES FOR INVASIVE ALIEN SPECIES INTO TRADE, TRANSPORT AND TRAVEL ACROSS THE PRODUCTION LANDSCAPE**

**REVIEW AND EVALUATION OF INVASIVE ALIEN SPECIES (IAS) CONTROL AND ERADICATION ACTIVITIES IN SEYCHELLES AND DEVELOPMENT OF A FIELD GUIDE ON IAS MANAGEMENT**

# REVIEW OF IAS CONTROL AND ERADICATION PROGRAMMES IN SEYCHELLES

## ooooooo ANNEXES ONLY ooooooo

**Prepared by the Plant Conservation Action group**

**Editors: Katy Beaver and James Mougal**

**December 2009**

# ANNEX 1 I.A.S. QUESTIONNAIRE RESPONSES AND ANALYSIS

## The Questionnaire

A questionnaire was devised by PCA and circulated to around 45 stakeholder organisations (often several individuals within the organisation to be more likely of getting a response - some 70 people in all). Organisations included different sections of the Department of Environment DoE; parastatal organisations (Seychelles Agricultural Agency SAA, Seychelles National Parks Authority SNPA); environmental NGOs; island managers; eco-tourism hotels and resorts (some on small islands, others on the main islands); other protected area managers; and individuals who might have experience of dealing with IAS in their work or as landowners.

Question 1 was designed to find out:

a) which Invasive Alien Species (IAS) are the most problematic for these stakeholders,
b) which of these IAS they are currently controlling,
c) which IAS have been a problem in the past and have been eradicated, or controlled but rebounded.

A Table of possible IAS was presented so that it was easy for respondents to check and to add extra species if necessary (see Results Table on p 7)

Questions 2 to 6 were designed to find out:

a) whether there might be unpublished reports available that PCA had not seen,
b) whether the stakeholder would be willing to share information and experience, and if so, how freely,
c) for which invasive species stakeholders require more management information,
d) whether it would be useful to have a system for prioritising IAS control.

## Responses

Around 25 responses were obtained, with 21 being in the form of returned Questionnaires by organisations (an almost 50% return). There was a general tendency for stakeholders to focus on IAS that are more problematic to their respective organisations, therefore some of the questionnaires were only partially completed.

<u>The IAS which are important for stakeholders</u>

The Table of results for Question 1 is given on pages 7-10). A summary table ranking all named IAS, from most often reported to least often reported, is given on page 3. Similar group summaries (e.g. Birds, Trees) are given on pages 4-6. An overall verbal summary is given below:

- The biggest current problem species appears to be Spiralling whitefly (14 respondents).
- Next most reported are Black rat and Mealy bugs (Lipou blan) (9 and 8 respondents respectively).
- Several species were reported by 7 respondents - Indian myna, Giant African snail, Scale insects, Albizia, Lantana (Vyeyfiy), Leucena (Kassi) and Takamaka Wilt disease.
- Also important (5-6 respondents) are Feral cat and Yellow crazy ant (as animals), with the remainder being plant species - Cocoplum (Prindfrans), *Stachytarpheta* (Zepible), *Alstonia* (Bwa zonn), Coconut, *Clidemia* (Fo watouk), Water lettuce and Philodendron creepers.
- Some species were only a problem on specific outer islands, e.g. Feral goat on Aldabra, several ornamental plants (Oleander, Oyster plant, Lys-bordmer) on Alphonse).
- Interestingly the *Merremia* creeper which is so prevalent on Mahé does not yet appear to be a problem on other islands.
- In certain cases invasive species have been controlled but have returned in greater numbers or remain a problem, e.g. Black rat, Indian myna, Mealy bugs, Takamaka Wilt disease.
- Overall, respondents are managing or controlling about 58% of the species they recorded as being a problem.
- There was a disagreement on the invasive status of a few species, e.g. Papaya, among stakeholders.

Responses to Questions 2 to 6

2. Might you have additional unpublished reports about IAS control that we may not have found during our research? Yes: **5** **No: 14**

3. If any species (IAS) is currently being managed by your organisation, would you be willing to share your experience with other stakeholders, for the benefit of all?
   **Yes (unconditional): 10** **Yes, with certain limitations: 9** No: **0**

4. Do you have other important lessons/experience with IAS that you are willing to share with others? (We would be particularly grateful for information on IAS control/maintenance costs and effectiveness)
   **Yes: 9** **No: 8**

6. Would it be useful to you to have a system for prioritising control of problem species (e.g. a chart with specific criteria) in order to decide which species to tackle first?
   **Yes: 14** No: **3**

Note that Question 5 required specific IAS to be named in order to acquire further information. These species will be followed up in the Field Guide to best IAS management practices.

Comments

- Question 2: It seems that a few unpublished reports from five sources may still be extant but as some respondents are reluctant to share unconditionally, these may remain unavailable.
- Question 3: Some information relating to control of invasive alien species may still require documenting or validating, although again, certain respondents are reluctant to share their information unconditionally so it may remain unavailable.
- Question 4: Likewise for sharing of important lessons learned - some information can be followed up but there remains a reluctance to share without specific conditions attached.
- Question 6: The majority of respondents would find it useful to have a mechanism for prioritising problem species that require control.

The general reticence of certain managers, NGOs and staff in sharing useful information is a well known phenomenon in Seychelles. While it is understood that there are certain reasons for this, it is regrettable to see that people are reluctant to share their experience and knowledge with each other for fear that someone else will take the information and use it in some way that benefits himself or herself, their island or their organisation alone. But that is life, and a way around this problem would be useful to find! However, we would like to sincerely thank all the respondents who have agreed to share their information unconditionally or with limited conditions for the benefit of others.

## Conclusions

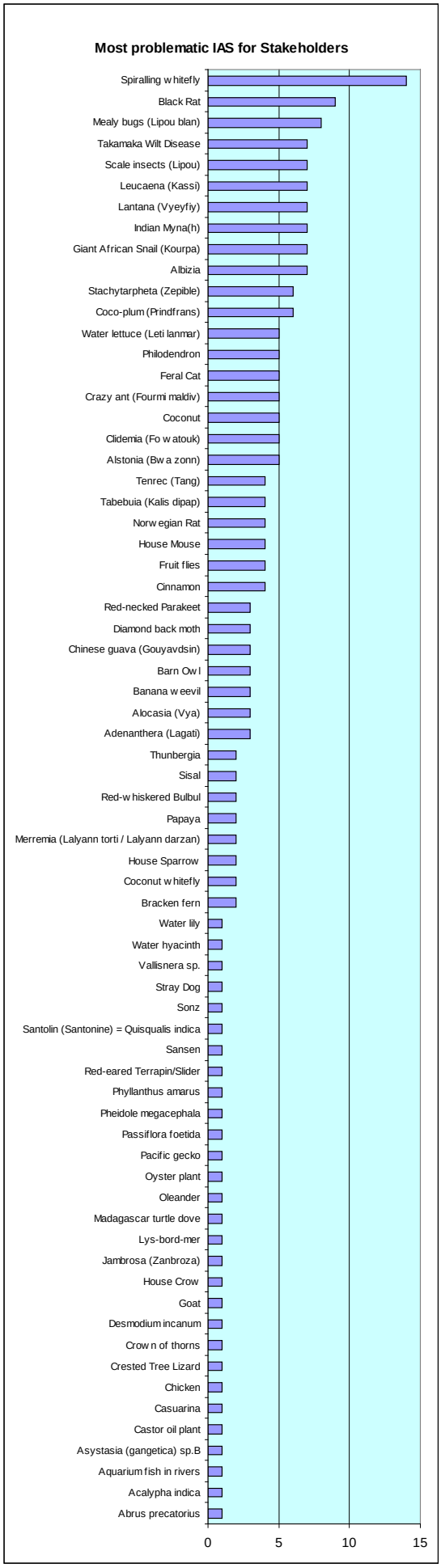
Overall the responses to the Questionnaire have helped to identify that:

- Spiralling whitefly is the most serious pest, and Black rats and Mealy bugs remain a problem in spite of control programmes;
- that there are many IAS which are a problem for stakeholders and for which no reports are available regarding their management, even though the species are undergoing some sort of control;
- several common problem species remain difficult for stakeholders to control.

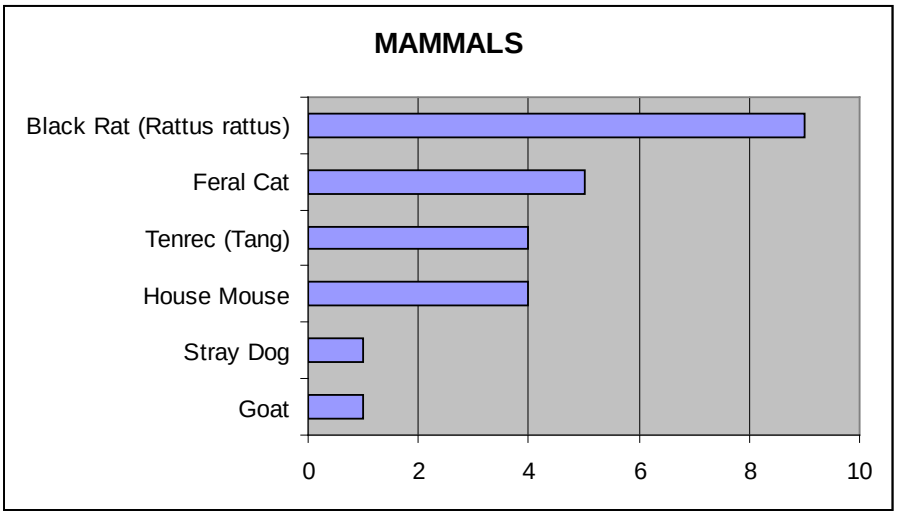
## Recommendations

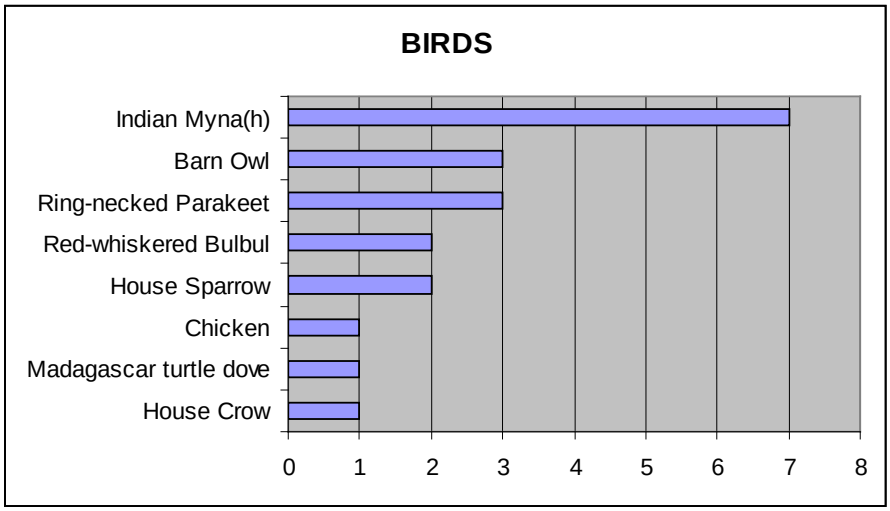
1. A suitable mechanism for prioritising the control of IAS requires development. This should be a future project or activity as it does not fall within the remit of this project. Some countries or areas have already developed such systems (e.g. Galapagos) which could be adapted for use in Seychelles.

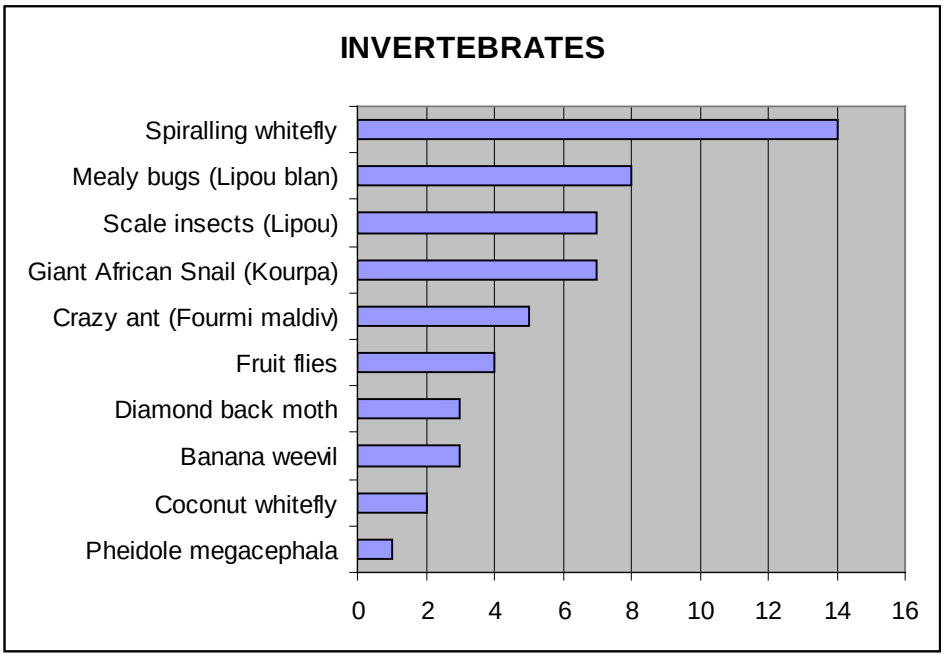
2. Certain of the IAS mentioned by stakeholders probably require a national response rather than a response from individual stakeholders, e.g. Spiralling whitefly.

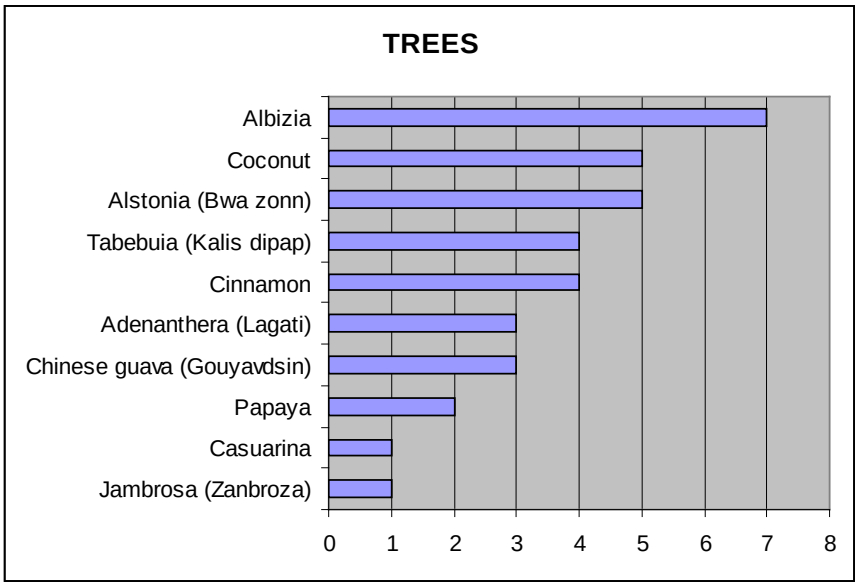

Most problematic IAS for Stakeholders
Spiralling whitefly
Black Rat
Mealy bugs (Lipou blan)
Takamaka Wilt Disease
Scale insects (Lipou)
Leucaena (Kassi)
Lantana (Vyeyfiy)
Indian Myna(h)
Giant African Snail (Kourpa)
Albizia
Stachytarpheta (Zepible)
Coco-plum (Prindfrans)
Water lettuce (Leti lanmar)
Philodendron
Feral Cat
Crazy ant (Fourmi maldiv)
Coconut
Clidemia (Fo watouk)
Alstonia (Bwa zonn)
Tenrec (Tang)
Tabebuia (Kalis dipap)
Norwegian Rat
House Mouse
Fruit flies
Cinnamon
Red-necked Parakeet
Diamond back moth
Chinese guava (Gouyavdsin)
Barn Owl
Banana weevil
Alocasia (Vya)
Adenanthera (Lagati)
Thunbergia
Sisal
Red-whiskered Bulbul
Papaya
Merremia (Lalyann torti / Lalyann darzan)
House Sparrow
Coconut whitefly
Bracken fern
Water lily
Water hyacinth
Vallisnera sp.
Stray Dog
Sonz
Santolin (Santonine) = Quisqualis indica
Sansen
Red-eared Terrapin/Slider
Phyllanthus amarus
Pheidole megacephala
Passiflora foetida
Pacific gecko
Oyster plant
Oleander
Madagascar turtle dove
Lys-bord-mer
Jambrosa (Zanbroza)
House Crow
Goat
Desmodium incanum
Crown of thorns
Crested Tree Lizard
Chicken
Casuarina
Castor oil plant
Asystasia (gangetica) sp.B
Aquarium fish in rivers
Acalypha indica
Abrus precatorius
0
5
10
15

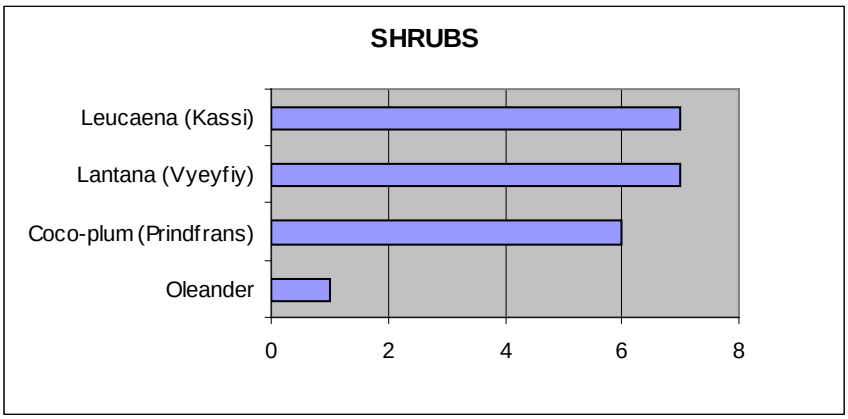
## Group summaries

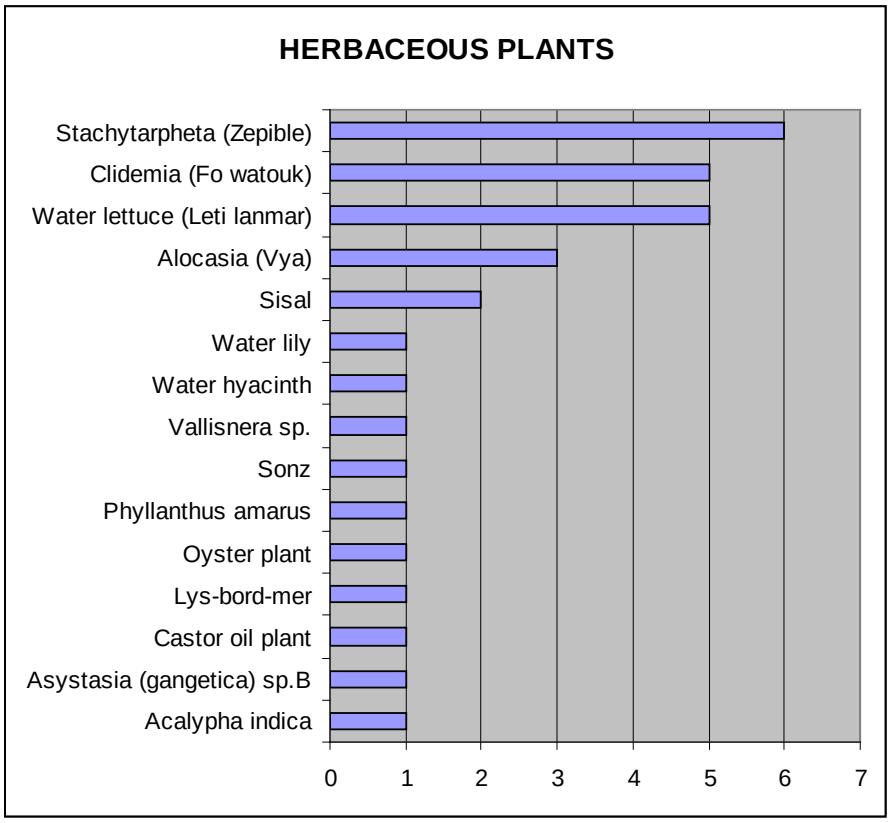


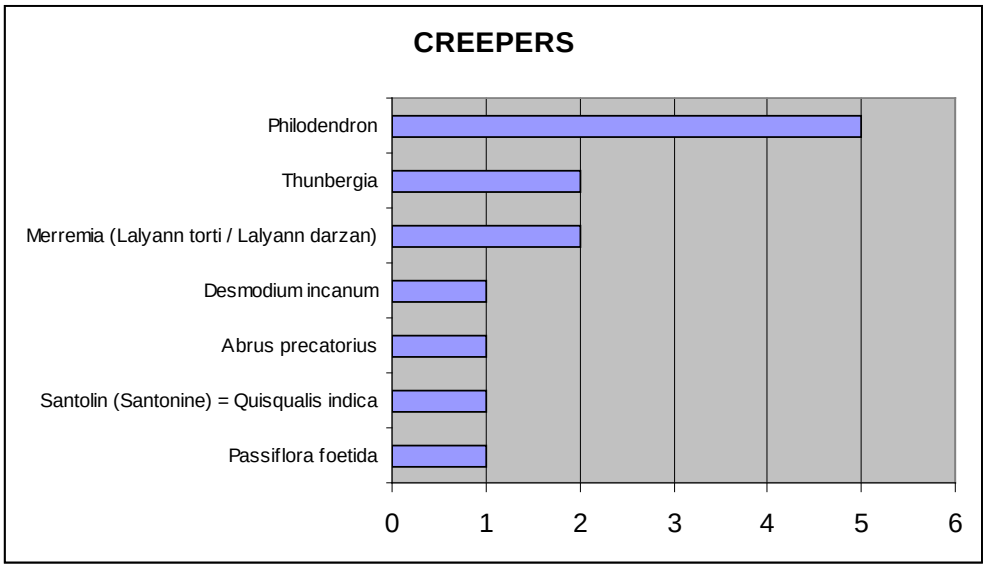



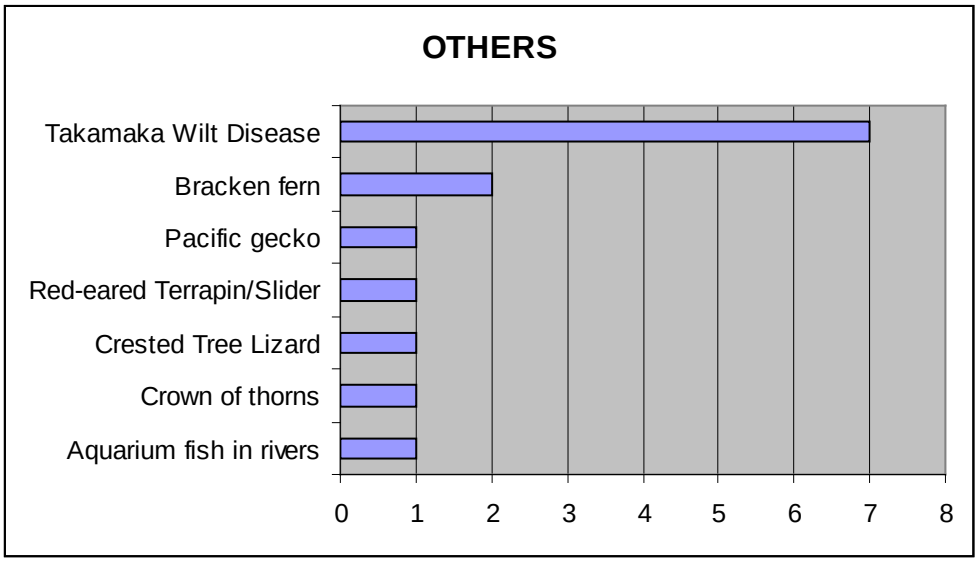




TREES
Albizia
Coconut
Alstonia (Bwa zonn)
Tabebuia (Kalis dipap)
Cinnamon
Adenanthera (Lagati)
Chinese guava (Gouyavdsin)
Papaya
Casuarina
Jambrosa (Zanbroza)
0
1
2
3
4
5
6
7
8


SHRUBS
Leucaena (Kassi)
Lantana (Vyeyfiy)
Coco-plum (Prindfrans)
Oleander
0
2
4
6
8


HERBACEOUS PLANTS
Stachytarpheta (Zepible)
Clidemia (Fo watouk)
Water lettuce (Leti lanmar)
Alocasia (Vya)
Sisal
Water lily
Water hyacinth
Vallisnera sp.
Sonz
Phyllanthus amarus
Oyster plant
Lys-bord-mer
Castor oil plant
Asystasia (gangetica) sp.B
Acalypha indica
0
1
2
3
4
5
6
7


CREEPERS
Philodendron
Thunbergia
Merremia (Lalyann torti / Lalyann darzan)
Desmodium incanum
Abrus precatorius
Santolin (Santonine) = Quisqualis indica
Passiflora foetida
0
1
2
3
4
5
6


OTHERS
Takamaka Wilt Disease
Bracken fern
Pacific gecko
Red-eared Terrapin/Slider
Crested Tree Lizard
Crown of thorns
Aquarium fish in rivers
0
1
2
3
4
5
6
7
8

**Results Table for Question 1**

| Invasive Alien Species | Is this species a major problem for your organisation? | Is this species currently being managed / controlled by your organisation? | Was this species once controlled but has increased in numbers again? | Was this species a problem in the past but is now eradicated? |
|---|---|---|---|---|
| **MAMMALS** | | | | |
| Feral Cat | **5** | **5** | **0** | **5** |
| Black Rat (*Rattus rattus)* | **9** | **6** | **2** | **3** |
| Norwegian Rat (*Rattus norvegicus*) | **4** | **1** | **1** | **2** |
| Feral Rabbit | **0** | **0** | **0** | **0** |
| House Mouse | **4** | **1** | **0** | **0** |
| Goat | **1** | **1** | **0** | **1** |
| Tenrec (Tang) | **4** | **1** | **0** | **0** |
| Stray Dog | **1** | **0** | **0** | **0** |
| | | | | |
| **BIRDS** | | | | |
| House Crow | **1** | **1** | **0** | **0** |
| Ring-necked Parakeet | **3** | **1** | **1** | **0** |
| House Sparrow | **2** | **1** | **0** | **0** |
| Barn Owl | **3** | **2** | **0** | **1** |
| Indian Myna(h) | **7** | **3** | **2** | **0** |
| Red-whiskered Bulbul | **2** | **0** | **1** | **0** |
| Chicken | **1** | **1** | **0** | **0** |
| Madagascar turtle dove | **1** | **0** | **0** | **0** |
| | | | | |
| **REPTILES** | | | | |
| Crested Tree Lizard | **1** | **1** | **0** | **0** |
| Red-eared Terrapin/Slider | **1** | **1** | **0** | **0** |
| Pacific gecko | **1** | **0** | **0** | **0** |
| | | | | |

| Invasive Alien Species | Is this species a major problem for your organisation? | Is this species currently being managed / controlled by your organisation? | Was this species once controlled but has increased in numbers again? | Was this species a problem in the past but is now eradicated? |
|---|---|---|---|---|
| **FISH** | | | | |
| Tilapia | **0** | **0** | **0** | **0** |
| Aquarium fish in rivers | **1** | **0** | **0** | **0** |
| Crown of thorns | **1** | **1** | **1** | **0** |
| | | | | |
| **INVERTEBRATES** | | | | |
| Crazy ant (Fourmi maldiv) | **5** | **0** | **1** | **0** |
| Giant African Snail (Kourpa) | **7** | **4** | **1** | **1** |
| Mealy bugs (Lipou blan) | **8** | **3** | **2** | **0** |
| Scale insects (Lipou) | **7** | **3** | **1** | **0** |
| Fruit flies | **4** | **1** | **1** | **0** |
| Spiralling whitefly | **14** | **2** | **1** | **0** |
| Banana weevil | **3** | **1** | **1** | **0** |
| Diamond back moth | **3** | **1** | **1** | **0** |
| *Pheidole megacephala* (Ant species) | **1** | **1** | **1** | **0** |
| Coconut whitefly | **2** | **0** | **0** | **0** |
| | | | | |
| **TREES** | | | | |
| Cinnamon | **4** | **3** | **0** | **0** |
| Chinese guava (Gouyavdsin) | **3** | **2** | **0** | **1** |
| Albizia | **7** | **5** | **0** | **1** |
| *Alstonia* (Bwa zonn) | **5** | **5** | **0** | **0** |
| *Tabebuia* (Kalis dipap) | **4** | **4** | **0** | **0** |
| *Adenanthera* (Lagati) | **3** | **2** | **0** | **0** |
| Coconut | **5** | **5** | **0** | **0** |
| Jambrosa (Zanbroza) | **1** | **0** | **0** | **0** |
| Papaya | **2** | **1** | **0** | **1** |

| Invasive Alien Species | Is this species a major problem for your organisation? | Is this species currently being managed / controlled by your organisation? | Was this species once controlled but has increased in numbers again? | Was this species a problem in the past but is now eradicated? |
|---|---|---|---|---|
| Casuarina | **1** | **1** | **0** | **0** |
| | | | | |
| **SHRUBS** | | | | |
| Coco-plum (Prindfrans) | **6** | **3** | **0** | **0** |
| *Lantana* (Vyeyfiy) | **7** | **6** | **0** | **1** |
| *Leucaena* (Kassi) | **7** | **4** | **0** | **1** |
| Oleander | **1** | **1** | **0** | **0** |
| | | | | |
| **HERBACEOUS** | | | | |
| *Clidemia* (Fo watouk) | **5** | **4** | **1** | **0** |
| Water lettuce (Leti lanmar) | **5** | **2** | **0** | **0** |
| *Stachytarpheta* (Zepible) | **6** | **5** | **0** | **0** |
| *Alocasia* (Vya) | **3** | **1** | **0** | **0** |
| *Asystasia* (*gangetica*) sp.B | **1** | **1** | **0** | **0** |
| *Acalypha indica* | **1** | **1** | **0** | **0** |
| *Phyllanthus amarus* | **1** | **1** | **0** | **0** |
| Sisal | **2** | **1** | **1** | **0** |
| Castor oil plant | **1** | **1** | **0** | **0** |
| Lys-bordmer | **1** | **1** | **0** | **0** |
| Oyster plant | **1** | **1** | **0** | **0** |
| Sonz | **1** | **0** | **0** | **0** |
| Water hyacinth | **1** | **1** | **0** | **0** |
| Water lily | **1** | **1** | **0** | **0** |
| *Vallisnera sp.* | **1** | **1** | **0** | **0** |
| | | | | |
| **CREEPERS** | | | | |
| *Merremia* (Lalyann torti / Lalyann darzan) | **2** | **1** | **0** | **0** |

| Invasive Alien Species | Is this species a major problem for your organisation? | Is this species currently being managed / controlled by your organisation? | Was this species once controlled but has increased in numbers again? | Was this species a problem in the past but is now eradicated? |
|---|---|---|---|---|
| Philodendron | **5** | **3** | **0** | **0** |
| *Thunbergia* | **2** | **2** | **0** | **1** |
| *Passiflora foetida* | **1** | **2** | **0** | **0** |
| *Passiflora suberosa* | **0** | **1** | **0** | **0** |
| Santolin (Santonine) = *Quisqualis indica* | **1** | **1** | **0** | **1** |
| **Sansen?** | **1** | **1** | **0** | **1** |
| Syngonum sp. | **0** | **1** | **0** | **0** |
| *Abrus precatorius* | **1** | **1** | **0** | **0** |
| *Desmodium incanum* | **1** | **1** | **0** | **0** |
| | | | | |
| **FERNS** | | | | |
| Bracken fern | **2** | **2** | **0** | **0** |
| | | | | |
| **FUNGI** | | | | |
| Takamaka Wilt Disease | **7** | **3** | **1** | **0** |
| Sandragon wilt | | | | |

## ANNEX 2 List of stakeholder questionnaire respondents

| Name of Organisation | Contact Person | Post Title | Contact Details |
|---|---|---|---|
| Cousine Island | Kevin Jolliffe | Conservation Officer | cousine2@seychelles.net<br>Tel. 322961/713421 |
| Fregate Island Private | Madel Wilkens<br>Brent Whittington | Conservation Manager<br>Ecology Manager | ecology@fregate.com<br>Tel. 727421/727436 |
| The Ecotourism Society of Seychelles (TESS) | Joseph Rath<br>Marc Marengo | Programs Development<br>Chairman | josephrath@hotmail.com<br>Tel. 225914/526794 |
| Nature Seychelles<br>Denis/Cousin Islands | Terence Vel | Education & Advocacy Coordinator | wcs@natureseychelles.org<br>Tel. 719047 |
| Seychelles Agricultural Agency (SAA)<br>Plant & Animal Health Service | Will Dogley | Manager | seypro@seychelles.net<br>Tel. 611479/722607 |
| Island Conservation Society (ICS)<br>Aride/Alphonse Islands | Riaz Aumeeruddy | Science & Project Manger | icsscience@seychelles.sc<br>Tel. 375354/71268 |
| Seychelles Islands Foundation (SIF)<br>Vallee de Mai/Aldabra Island | Nancy Bunbury<br>Naomi Doak | Projects Programme Coordinator Aldabra<br>Research Officer | nancy@sif.sc<br>Tel. 321735/565621 |
| Department of Environment (DoE)<br>Conservation Section | Elvina Henriette Payet | Senior Project Officer | Tel. 670500 |
| Island Conservation Society (ICS)<br>Alphonse Islands | Pierre-Andre Adam | Scientific Officer | pierreandreadam@yahoo.co.uk Tel. 229040 |
| Eden Island Development<br>Horticultural Department | Steve Vinda<br>Lucille Monty | | lucille@edenisland.sc<br>Tel. 346000 |
| Department of Environment (DoE)<br>Forestry Section | Basil Esther | Senior Project Officer | b.esther@env.gov.sc<br>Tel. 670500 |
| North Island | Linda Vanherck | Environment Officer | lindav@north-island.com<br>Tel. 293186/576111 |
| Seychelles National Park Authority (SNPA) Curieuse Island | Barbara Kilindo<br>Michelle Etienne | Research Officers | b.hoareau@scmrt-mpa.sc<br>Tel. 323494/522930 |
| Banyan Tree Resort Seychelles | Cedrick Thomas | Chief Gardner | Tel. 522281 |
| Barbarons Biodiversity Centre | Damien Doudee | Horticulturist | damien@cwci.blackberry.com Tel. 722170 |
| Fond Ferdinand Nature Reserve | Nigel Colin Valmont | Manager | collinvO@gmail.com<br>Tel. 722881 |
| Marine Conservation Society of Seychelles (MCSS) | Elke Talma<br>David Rowat | Project Officer<br>Chairman | elke@mcss.sc<br>Tel. 261511/713500 |
| Moyenne Island Nature Reserve | Brendon Grimshaw | Owner / manager | Tel. 552828 |
| Department of Environment (DoE) | Murugaiyan Pugazhendui | | Tel. 722415 |
| Nature Protection Trust of Seychelles (NPTS) Silhouette Island | Justin Gerlach | Scientific Coordinator | jstgerlach@aol.com |

## ANNEX 3 Report of the IAS workshop held on 29 September 2009

**REVIEW & EVALUATION OF INVASIVE ALIEN SPECIES CONTROL (IAS) AND ERADICATION ACTIVITIES IN SEYCHELLES and DEVELOPMENT OF A FIELD GUIDE ON IAS MANAGEMENT**

# REPORT OF THE WORKSHOP HELD ON

**TUESDAY 29 SEPTEMBER 2009 08.30 - 12.00**
**CARE House conference and training room**

### The workshop had the following objectives:

1. To briefly review the results of Objective 1 (see below - Review of IAS management field activities in the Seychelles), including the results of the Questionnaire previously sent out to most of the stakeholders.

2. To discuss what form of "field guide" (see Objective 2 below) would be most useful for stakeholders, and/or whether this is indeed the most valuable 'next step' in the consultancy as there are other options.

3. To make recommendations for this 'next step'.

### The overall objectives of this consultancy are:

1. To review IAS management field activities in the Seychelles, with particular reference to mitigation, control and eradication measures, including an evaluation of their effectiveness and efficiency.

2. To develop a "field guide on IAS control and eradication measures".

### Workshop participation

There were fewer participants at the workshop than the expected number of c.25 or more. Around 20 participants from government, environmental NGOs and parastatals were present, with no representatives from the private sector, which was disappointing as they could be one beneficiary of the expected output(s) from the following up activities. The participant list forms Annex 1 of this report.

### Workshop programme

The Workshop programme forms Annex 2 of this report. The programme went more or less according to plan. Several additional small activities were included as part of the main programme, e.g. participants were asked to name the six IAS they assessed as being the priority species for the country; there was a small demonstration activity to reveal the complexity of dealing with IAS management.

### Outcomes of Objective 1 (Review of IAS management report):

There were few comments on the review of the IAS field management activities in Seychelles, except for the possible need to standardise the definition of an Invasive Alien Species for the overall strategy for dealing with these species.

The main question regarding the review of the Questionnaire responses was how representative these were of the stakeholders who had been sent the questionnaire. It was explained that there was a broad range of responses, with around a 50% return from organisations, including NGOs, parastatals, protected areas, private islands, private enterprise, but no response from local community (districts).

## Outcomes of Objective 2 (Group work to discuss the possible next steps)

Participants were divided randomly into 3 groups of c.6 people and asked to discuss the possible next steps for the project, using the guidelines given in Annex 3. In summary:

1. Field guide - if so what kind and what format?
2. Field trials of management methods - What? When? Where? Who?
3. Action plan? - e.g. guidelines based on where we are at now.
4. System for prioritizing IAS problems / management? - At national level? At individual management level?

Group 1

- This group eliminated 'Field trails' as an immediate next step - as they can be done in the future (this was also agreed by other participants), and incorporated the Action plan guidelines into the other possibilities.
- The Field guide could be better conceived as a Toolkit for how to manage IAS, which could be a technical document but aimed at the general public to help with decision-making. One person in the group felt strongly that it should be technical, as general education and awareness about IAS were not the point of this project.
- The toolkit would deal with the main problem species (including photos and other identification information) but also include brief information to help with identifying other species.
- It could include a decision-making "tree" with good and bad practice case studies for the problem species, together with resources (references and contacts) for management.
- Prioritising - this could be done for species at a national level, e.g. through a stakeholder workshop.
- A prioritisation framework with criteria for IAS management could be at both a national level and a local level adapted for land owners and organisations. The framework would be roughly similar for both situations but with slightly different issues addressed.

Group 2

- This group concentrated on two possibilities for the next step.
- The Field guide could be in the form of an on-line database (perhaps with a CD-Rom), as this can be a more flexible tool than a printed book.
- Already-used management practices could be included and if there are none, this would be indicated. It might also be possible to use community-based information for management practices.
- The database would be updated as information becomes available.
- Prioritising system - this would not be easy as different sectors have different priorities e.g. agriculture and conservation, so the criteria would have to be chosen carefully (see also the Additional Suggestion on page 3 with respect to identifying the 'top ten').
- It could lay out international standards for IAS management practices where they already exist (e.g. for many agricultural IAS), so that managers would follow a protocol.
- It could help build awareness of IAS and also provide practical solutions for management.

Group 3

- This group looked at all four 'next step' suggestions.
- The Field guide could be:
    - A small simple guide for general use to maximise IAS awareness about the main problem species (c.100 species), with identification pictures and practical management actions (+ references + internet links for more information);
    - A more technical guide which has best detailed management practices/options for the most problematic species, together with actions to take against re-invasion, and a section on the potential risks of new introductions, with examples of the most dangerous.
- Field trials are useful to advance knowledge on species about which little is known (e.g. non-native ants), or where the specific reactions of an IAS are not well understood. Possible field trials: rat eradication in mangrove areas, whitefly, invasive ants, etc
- Information gained during trials carried out at the Agricultural training centre could be disseminated for household use.
- Funding for trials could be from owners/managers, overseas funding agencies or possibly government.
- The Action plan should be part of the Biosecurity Policy/Strategy.
- Action plans should be prepared for, say, the top ten most problematic species (see also the Additional Suggestion on page 3 with respect to identifying the 'top ten').

- Prioritisation needs to be in the form of a dynamic national system and updated (e.g. every 5 years), with the rationale driven by stakeholders (at least one person in the group felt that this should include government, private or NGO institutions, or any individuals who have an interest and can contribute).

### Outcome of the assessment of the most problematic IAS at a national level

Participants were asked to name the six most problematic species for the Seychelles by placing six coloured stickers on charts containing all the names of Invasive Alien problem species previously identified through the stakeholder questionnaire. Species in red are species which were added by workshop participants.

| ANIMAL species | No. of stickers | PLANT species | No. of stickers |
|---|---|---|---|
| Mammals | | Trees | |
| Black rat | 15 | Cinnamon | 6 |
| Feral cat | 2 | Chinese guava | 4 |
| Norwegian rat | 1 | Albizia | 3 |
| Feral goat | 1 | *Alstonia* (Bwa zonn) | 4 |
| Birds | | Jambrosa | 1 |
| Indian myna | 7 | *Chrysophyllum* (star apple) | 1 |
| Red-whiskered bulbul | 2 | Shrubs | |
| Madagascar turtle dove | 2 | Cocoplum | 4 |
| Invertebrates | | Lantana | 1 |
| Yellow crazy ant | 5 | *Ardisia spp.* | 2 |
| Spiralling whitefly | 6 | Creepers | |
| Fruit flies | 5 | "Philodendron" | 6 |
| Diamond-back moth | 1 | *Merremia* (lalyann darzan) | 1 |
| Other ant species | 1 | *Macfadyena unguis-cati* | 1 |
| Other animals | | *Lonicera spp.* | 1 |
| Pacific gecko | 1 | *Lygodium japonicum* (a fern) | 1 |
| Crested tree lizard | 1 | Herbaceous species | |
| Man | 1 | *Clidemia* (fo watouk) | 7 |
| | | Water lettuce | 1 |
| | | Water hyacinth | 1 |

The top six are: Black rat (15) / Clidemia (7) / Indian myna (7) / Cinnamon (6) / "Philodendron" (6) / Spiralling whitefly (6).

It was pointed out that the choices of the participants were most probably influenced by their field of work and experience. It was noticeable for example that one participant added 5 new plant species to the list, which are all incipient invasive species. If this exercise was to be carried out further to get a national assessment, it would require defined criteria, and a more scientific assessment. Nevertheless, it was an interesting exercise to have carried out and would have given further food for thought if there had been a greater number of participants.

**Additional suggestion**

There was a suggestion that it might be necessary to produce separate 'Top Ten' IAS priority lists for e.g. the Conservation, Agriculture, Health and Community sectors. These lists should be reviewed every 5-10 years.

**An interesting additional outcome arising from other activities in the workshop**

Although we are not professional psychologists or human behaviourists, it was interesting to note the reluctance of a very small minority to participate fully in the additional creative activities that were included in the workshop and/or the production of logical rather than creative outputs, which to our minds suggests the difficulty which some people have with the use of the 'right side of the brain' in their work. Current problems with IAS require creative thinking for their solution as well as more rigorous scientific work and there is much need for creative thought processes.

## CONCLUSIONS AND RECOMMENDATIONS

PCA's conclusions and suggestions based on the outcomes of the workshop:

- In general, the participants agreed that the PCA's review on IAS management activities in Seychelles was comprehensive and they did not have additional information to contribute.
- There is insufficient information available at the moment to produce a detailed field guide to best IAS management practices.
- Of the suggestions from stakeholders such as an 'identification' field guide with practical management actions for c.100 species, a field guide in the form of an online database, or a detailed technical manual, guide or toolkit, all would require considerable time (6-8 months) and effort to accomplish. At present, PCA does not have the time to produce such an output due to other prior commitments.
- However, based on the PCA review of IAS management programmes in Seychelles, it might be possible to produce a simple overall guide (e.g. 10 pages) to IAS management strategies. This would help stakeholders to understand what best practice involves (with a few local case studies of good and bad management) and an example of a decision-making tree that would assist stakeholders to decide whether or not management of a particular IAS is likely to be possible.

## ANNEX 1 of the IAS Workshop Report: Workshop participant list

**UNDP-GEF Biosecurity Project:**

**REVIEW & EVALUATION OF INVASIVE ALIEN SPECIES (IAS) CONTROL & ERADICATION ACTIVITIES IN SEYCHELLES and DEVELOPMENT OF A FIELD GUIDE ON IAS MANAGEMENT**

**29 September 2009 from 08.30am - 12.00 noon**
**at CARE House Meeting Room, Freedom Square**

| No. | Name | Organisation | Contact/ E-mail address |
|---|---|---|---|
| 1. | Sylvanna Antha | SNPA + PCA | s.antat@scmrt-mpa.sc |
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| 19. | Marc Jean-Baptiste | SIF | marc@sif.sc |
| 20. | Katy Beaver | PCA | kbeaver@seychelles.net |
| 21. | Joseph Rath | PCU + TESS | j.rath@pcusey.sc |

**ANNEX 2 of the IAS Workshop Report: Workshop programme**

# GOS- UNDP-GEF PROGRAMME COORDINATION UNIT

## MEETING TO REVIEW FINDINGS AND DISCUSS NEXT STEPS OF THE CONSULTANCY UNDER THE BIOSECURITY PROJECT:

## REVIEW & EVALUATION OF INVASIVE ALIEN SPECIES CONTROL (IAS) AND ERADICATION ACTIVITIES IN SEYCHELLES and DEVELOPMENT OF A FIELD GUIDE ON IAS MANAGEMENT

**TUESDAY 29 SEPTEMBER 2009 08.30 - 12.00**
**CARE House conference and training room**

**Introduction:**
This short-term consultancy is currently being undertaken by the local NGO, Plant Conservation Action group (PCA), with advice and input from an international consultant Dr Charlotte Causton. There are two main objectives (according to the ToR):

3. To review IAS management field activities in the Seychelles, with particular reference to mitigation, control and eradication measures, including an evaluation of their effectiveness and efficiency.
4. To develop a "field guide on IAS control and eradication measures".

**Workshop Objectives:**

4. To briefly review the results of Objective 1 (Review of IAS management field activities in the Seychelles), including the results of the Questionnaire previously sent out to most of the stakeholders.
5. To discuss what form of "field guide" (see Objective 2 above) would be most useful for stakeholders, and/or whether this is indeed the most valuable 'next step' in the consultancy as there are other options.
6. To make recommendations for this 'next step'.

**Workshop Facilitators**:

- Jan Rijpma (GOS-UNDP-GEF Biodiversity Programme Manager)
- Katy Beaver and James Mougal (on behalf of PCA)

**Proposed Programme:**

| TIME | TOPIC | FACILITATOR |
|---|---|---|
| 08.30 - 08.40 | Welcome + Background of the assignment | Jan Rijpma |
| 08.40 - 08.45 | IAS? (creative exercise) | Katy |
| 08.45 - 09.30 | Management of IAS: The review process / results / missing information + Questionnaire responses and analysis | James |
| 09:30 - 10:00 | Introduction to the 'Next Step': a. Field guide (if so what format?); b. Field testing; c. Action Plan; d. Prioritisation system | Katy |
| 10:00 - 10:20 | Tea / Coffee | |
| 10.20 - 11.20 | Small group discussions about the 'Next Step' | Katy |
| 11:20 - 12:00 | Plenary - Feedback from groups<br>- Discussion and recommendations | James / Katy / Jan |
| 12:00 | LUNCH | |

**Participants will include representatives from:**
Dept of Environment, Dept of Natural Resources, Seychelles National Parks Authority, Seychelles Agricultural Agency, Island Development Co., NGOs, Private Islands, Resorts, Environmental Education, Landscape personnel, Community leaders, etc.

**ANNEX 3 of the IAS Workshop Report: Small group discussion points**

## Field Guide?

- All 60 or so species identified? (with minimum info)
- Fewer species for which there is enough info?
- A few selected important problem species only?
- Awareness raising guide rather than only management?
- What content / format is required?

## Field trails?

- For which species?
- Where? Will stakeholders provide land areas?
- Who should do the trials? Are stakeholders willing?
- Who will fund?

## Action plan?

Less detailed than a field guide.

i. For each species, suggest whether eradication, control, containment or mitigation is best.

ii. Identify species that have been successfully controlled: Give brief overview of methods but no details, only relevant references and contacts.

iii. Identify species where efficacy of control methods not proven: Give basic appropriate methods based on what has been done here and elsewhere with refs and contacts. Recommend experiments/trials or other research.

iv. Species where no successful control methods known: ?

## System for prioritising IAS management?

This was considered a useful tool by 75% stakeholders.

It would require more time than is available to formulate but could be recommended as a next step.

- Devise criteria for use in decision making
- Give a weighting to each criterion

- Does this require a national priority list for IAS?
- Should it be prepared on a national basis?
- OR for individual management situations?

## ANNEX 4 Summary table of Invasive Alien Species (IAS) management activities carried out in the Seychelles

| Species | Location | Date | **Methodology** (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| **MAMMALS** | | | | | | |
| Feral Cat | Aride | 1930s | Dogs + boys | Eradication | ✓ | Physical method possible on small island with few cats. |
| | Fregate | 1960-1982 | Poison / traps | Control and Eradication | ✓ | Few details, first attempts (1960s/1970s) were control only.<br>Eradication in the early 1980s more systematic but again few details; eradication confirmed only by lack of cats seen. |
| | Cousine | 1983-1985 | Traps | Eradication | ✓ | Physical method (baited traps) possible on small island; eradication confirmed only by lack of cats seen. |
| | Curieuse | 2000 | Poison (0.1%1080) / traps | Eradication | ✓ | Feasibility study done; systematic programme of poisoning, followed by baited traps; but not followed up by systematic monitoring. |
| | Denis | 2000 | Poison (0.1%1080) / traps | Eradication | ✓ | Feasibility study done; systematic programme of poisoning, followed by baited traps; but not followed up by systematic monitoring. |
| | North | 2003 | Poison (0.1%1080) / traps | Eradication | ✓ | Population estimate prior to systematic pre-baiting, followed by poisoning and trapping; follow-up monitoring carried out. |
| | D'Arros | 2003 | No details | Eradication | ✓ | Suitable two years wait period before confirmation of eradication. |
| | Cosmoledo | 2007-2008 | Incidental poisoning during rat control programme + lack of food | Control | (✓) | After rat poisoning (Brodifacoum), cat numbers had decreased through incidental poisoning + subse-quent lack of food; proper eradication attempt with cat poison abandoned due to logistical problems. |
| | Aldabra | ongoing | Shooting | Control | (✓) | Trapping difficult because of non-target species; opportunistic shooting. |
| Black Rat (*Rattus rattus*) | Granitics / outer islands | Pre-1950s | Traps / poison (Zinc phosphide) + bounty | Control | (✓) | In the early 20th century, traditional 'lasonmwar' traps were often used, later replaced with metal traps of various types & rat glue. Bounty was increased over time. Campaigns helped to keep populations down in coconut plantations |
| | | 1950s-1980s | Traps / poison (anticoagulants) + bounty | Control | (✓) | |
| | | 1980s onwards | Traps / poison / public awareness campaigns | Control | (✓) | As before, with poison often in block bait form. Campaigns mostly carried out by Heath Ministry. |
| | Mahé | 1949-1952 | BC (Barn owl) | Control | X | No feasibility study done. Introduction proved a mistake as although Barn owls ate rats, they also ate indigenous fairy terms in considerable numbers and spread to other islands; a bounty was introduced for the owls in 1969. |
| | Mahé (La Misere | 2006-2009 | Poison bait / traps | Control | ✓ | Grid system developed with regular trapping and follow- |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| | & Haut Barbarons | | | | | up monitoring. |
| | Anonyme | 2003 | Poison (Brodifacoum 20ppm bait blocks) - land based application + traps | Eradication | X | Grid system and regular monitoring. Post-eradication monitoring interrupted by sale of island, so rats were able to recolonises part of the island. |
| | | 2006 | Poison (Brodifacoum 20ppm bait blocks) - land based application + traps | Eradication / Control | ✓ | Same system used as in 2003, with continuing follow-up monitoring. Occasional reinvading rats from Mahé are eliminated through the post-eradication protocol. |
| | Ile aux Rats (near Anonyme) | 2005 | Poison (Brodifacoum 20ppm bait pellets) - land based application x 1 + traps | Eradication / Containment | ✓ | Small islet only. Systematic method with follow-up monitoring. Partly carried out to prevent reinvasion of nearby Anonyme Island. |
| | Bird | 1996 | Poison (Brodifacoum 20ppm bait blocks and bait pellets) - land based application x2 + follow-up system | Eradication | ✓ | Feasibility study done. Grid system and regular monitoring. Post-eradication monitoring. Protocols in place for some non-target species, but some ground-feeding birds affected. Post-eradication protocols. |
| | Curieuse | 2000 | Poison (Brodifacoum 20ppm bait pellets) - aerial application x 2 + follow-up with some bait blocks | Eradication | X | Feasibility study done. Helicopter flew along transect system. Regular monitoring. Protocols in place for some non-target species, but some ground-feeding birds affected. Failure possibly due to rats remaining in mangrove or to lack of post-eradication protocols. |
| | Denis | 2000 | Poison (Brodifacoum 20ppm bait pellets) - aerial application x 2 + follow-up with some bait blocks | Eradication | X | Feasibility study done. Helicopter flew along transect system. Regular monitoring. Protocols in place for some non-target species, but some ground-feeding birds affected. Failure probably due to lack of post-eradication protocols. |
| | | 2002 | Poison - land-based application | Eradication | ✓ | No details made available. |
| | North | 2003 | Poison (Brodifacoum 20ppm bait pellets) - aerial application x 3 + follow-up system | Eradication | X | Feasibility study done + systematic methodology and regular monitoring. Helicopter flew along transects. Protocols in place for some non-target species, but some ground-feeding birds affected. Failure probably due to failure to follow post-eradication protocols well enough. |
| | | 2005 | Poison (Brodifacoum 20ppm bait pellets) - aerial application x 4 + follow-up system | Eradication | ✓ | Pre-programme preparation for follow-up protocols. Systematic methodology and regular monitoring. Helicopter mostly flew along transects. Protocols in place for some non-target species, but some ground-feeding birds affected. Post-eradication protocols strictly followed. |
| | Cosmoledo (Grande Ile, Grand Polyte, Petit Polyte) | 2007 | Poison (Brodifacoum 20ppm bait pellets) - aerial application x 2 + follow-up system | Eradication | ✓ | Systematic methodology and regular monitoring. Helicopter flew according to ground markers. Effects on non-target species monitored - no mortality. Systematic trapping 1 year later confirmed success. |
| Norwegian Rat (*Rattus* | Mahé | 1900s onwards | Traps / poison | Control | (✓) | The same methods used for Black rats are used for Norwegian rats, with limited success at reducing |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| *norvegicus*) | | | | | | populations. |
| | Fregate | 1995 | Poison (Flocoumafen) - ground-based + traps | Control | (✓) | Only semi-systematic following this first invasion but protocols in place for avoiding non-target species. |
| | | 1995-1996 | Poison (Difenacoum) - ground-based + traps | Eradication | X | Semi-systematic methods with partial grid system. Poisoning was not continuous. Traps sometimes caught non-target species. |
| | | 1996 | Poison (Brodifacoum bait blocks + bait pellets) - ground-based | Eradication | X | More systematic using grid system. Protocols in place for non-target species but programme stopped after 1 Magpie robin died probably from secondary poisoning. |
| | | 2000 | Poison (Brodifacoum 20ppm bait pellets) - aerial application x 3 + follow-up system | Eradication | ✓ | Feasibility study done. Helicopter flew along transect system. Regular monitoring. Protocols in place for all important non-target species, but some ground-feeding birds affected. Post-eradication monitoring and protocols in place. |
| | D'Arros | 2004 | Poison | Eradication | ✓ | No details made available. |
| | Conception | 2007 | Poison (Brodifacoum 20ppm bait pellets) - aerial application x 2 + follow-up system | Eradication | ✓ | Feasibility study done. Helicopter use visual transect system. Regular monitoring. Protocols + monitoring in place for important non-target species, no losses. Follow-up monitoring. |
| Feral Rabbit | Bird | 1995-1996 | Poison (20ppm Brodifacoum) : Land-based application | Eradication | ✓ | Visual population assessment only; carried out as part of rat eradication programme - rabbits killed by same poison; systematic land-based methodology but no follow-up monitoring of rabbits. |
| House Mouse | Bird | 1995-1996 | Poison (20ppm Brodifacoum) : Land-based application | Eradication | X | Visual population assessment only; carried out as part of rat eradication programme - mice killed by same poison; systematic land-based methodology but no follow-up monitoring; mice either survived or reinvaded. |
| | Fregate | 2000 | Poison (20ppm Brodifacoum) : Aerial application | Eradication | ✓assumed | Carried out as part of rat eradication programme - mice killed by same poison; systematic aerial poisoning; no details about follow up monitoring. |
| Feral goat | Aldabra | 1987-1988<br>1993-1997<br><br>2007-2009 onwards | Shooting.<br>Judas goats + shooting.<br>Neutered Judas goats + shooting | Control<br><br>Eradication<br><br>Eradication | ✓<br><br>X<br><br>? | 2 systematic shooting trips, followed by opportunistic shooting 1989-1992.<br>Eradication successful on 2 islands, but only control achieved on the largest. Opportunistic shooting 2000-2006 kept numbers fairly low.<br>Sterilized Judas goats more successful but difficult terrain means longer time necessary to achieve success (radio batteries to be replaced). |
| **BIRDS** | | | | | | |
| Indian House Crow | Mahé | 1977-1994 | Mainly shooting + trial with poison + bounty + awareness | Eradication | (✓) | Occasional invading birds can be shot, but if allowed to multiply, crows cannot be shot in large groups as they |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| | | | programme | | | become gun-shy. Chemical (alphachloralose) in bait attracted non-target species so could not be used. Eventually all individual birds were shot. |
| | | 1998 onwards | Shooting of individual birds + awareness programme | Containment / Eradication | ✓ | All the occasional re-invading crows have been individually shot and killed to prevent spread. |
| Ring-necked Parakeet | Mahé | 2000s | Shooting | Control | X | Shooting effort has been minimal and small or large flocks are now seen in some parts of Mahé. |
| House Sparrow | Mahé | 2002-2003 | Shooting + a variety of trapping methods | Containment / Eradication | (✓) | Occasional invading birds must be eliminated at once. If allowed to breed, systematic trapping at nest sites seemed most effective. |
| Barn Owl | Central Granitics | 1969 onwards | Bounty system | Control | X | Relatively ineffective at keeping numbers down. |
| | Aride | 1996 onwards | A variety of trapping methods + shooting | Eradication / Control | ✓ | Trapping is often more effective if a decoy bird and / or recorded calls are used. Shooting only possible if licensed gun + shooter available. New invasions require immediate action. |
| | North Island | 2003-2009 | Incidental poisoning during rat eradication + starvation | Eradication | ✓ | Rat eradication left little for barn owls to eat and the island currently has few seabirds; but reinvasions possible. |
| | Cousin / Cousine | 1999 onwards | Shooting | Eradication | ✓ | Occasional invading birds (attracted by seabird populations) apparently shot |
| Indian Myna(h) | Fregate | 1992 | Various trapping methods + poison (alphachloralose) | Experimental Control | X | Trapping not very effective; Mynas developed aversion to food containing the poison. Non-target endemic birds would be affected by poisons. |
| | | 1993-1997 | Shooting | Control | (✓) | Many birds shot, but not systematic enough to really impact the population. |
| | | 1998-2002 | Shooting + nest trapping | Control + Experimental | (✓) | Nest trapping had some success. More systematic shooting considerably reduced the Myna population but post-2002 this stopped and the population increased again. |
| | Aride | 1993-1994 | Shooting | Eradication | ✓ | 16 of 17 birds shot; the last apparently disappeared. |
| | | 2001 | Shooting | Eradication | ✓ | 2 newly invading birds shot. |
| | Cousin | 2000-2002 | Nest trapping + shooting | Eradication | ✓ | Small population eradicated. |
| | Cousine | <1996 | Trapping + shooting + bounty | Control | (✓) | Small population apparently controlled. |
| | | 2002 onwards | Shooting | Control / Eradication | ✓ | Apparently eliminated by shooting and occasional reinvading birds also shot. |
| | Denis | 2001 | Poison (DRC1339) + shooting | Experimental / Control | (✓) | Pre-baiting, followed by poisoning reduced Myna population in several areas; follow-up shooting was terminated due to reappearance of rats (precluding introduction of rat-sensitive threatened birds). |
| | North | 2005 | Incidental poisoning during rat eradication (Brodifacoum) | Control | (✓) | Myna population considerably reduced (c50%) but subsequently increased again. |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| | | 2006-2008 | Poison (DRC1339) + nest trapping | (Eradication) / Control | X (✓) | Systematic programme of pre-baiting and poisoning reduced Myna population c70%. Planned follow-up shooting impossible due to delays with gun licensing. Subsequent nest trapping not effective; nor further poisoning (many non-target species attracted). |
| | | 2008-2009 | Shooting | Control | (✓) | Although Myna population increased during 2008, subsequent shooting again brought numbers down. |
| Red-whiskered Bulbul | Assumption | 2005 | Bounty system | Control / Containment | X | Not systematic. Partly carried out because of risk to Aldabra endemic bulbul and other endemic species. |
| Cattle egret (not alien) | Mahé, Praslin (rubbish dumps near airports) | 2000s | Poison + shooting | Control | (✓) | Poison not very effective due to too much food choice. Populations somewhat limited by shooting, especially at breeding sites. |
| **REPTILES** | | | | | | |
| Crested tree lizard | Ste Anne | 2004-2006 | Mainly pursuit and capture + bounty | Eradication / Control / Containment | X (✓) | Delayed action after 1st detection reduced the likelihood of eradication + lack of capacity hampered control measures + lack of long term follow up means lizards could spread to other islands. |
| **INVERTEBRATES (including agricultural pests)** | | | | | | |
| Crazy ant | Granitics (Mahé + later other islands) | 1969 | Insecticide (Dieldrin in fish bait) | Experimental trial / Control | X | Inconclusive and this pesticide now banned. |
| | | 1976-1994 | Poison (c.20 tested) + bait and poison sprays (Gamma-BHC, Chlorpyrifos, Bendiocarb) | Experimental trials / Control | ✓ | Very systematic testing methods. Both baits and poisons were tested. Aldrin (now banned) proved most effective in bait. Sprays were effective but could be applied only by professionals. In 1994 most of these chemicals were banned. |
| | | Current | Poison bait (Dursban = Chlorpyrifos) + IPM | Control | ✓ | Although Dursban is toxic to humans and the environment, it appears to still be used by some. IPM includes destroying the nest and good field sanitation. Other poisons (e.g. Fipronil, Pyriproxifen) may now be more effective with less effect on non-target species. |
| | Bird | 1998-2003 | Poison spray (unknown) + poison bait (Hydramethylnon) | Control | ✓ | Apparently effective in keeping numbers down. Current situation unknown due to lack of information. |
| Coccids (scale insects & mealy bugs) | Granitics | 1911 | BC (fungus) | Control | ✓ | Seems to have been a very specific biocontrol agent - effective against the Coffee green scale |
| | Mahé, Praslin, La Digue, North Silhouette, Platte | 1930-1938 | BC (ladybird predator spp.) | Control | ✓ ? | Since the 1960s no studies have been conducted to determine the effectiveness of the Coccinellid (ladybird) species. |
| | Granitics | 1980s | Insecticides (Ultracide & Rogor) | Control | ✓ | Effective but insecticides should be rotated - these pests can develop resistance. Products with systemic rather than contact action should be used. IPM = pruning, change planting regime, reduce fertilisation. |
| | | 2000 onwards | Other insecticides + IPM | Control | ✓ | |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| | Aldabra | 1989-1990 onwards | BC (ladybird predator sp.) | Control | ✓ | Ladybird *Rodolia chermesina* introduced to control Mealy bug *Icerya seychellarum,* using systematic procedures. Failure to follow up systematically but opportunistic monitoring shows apparent successful control, with limited localised flare-ups. |
| Diamond-back moth (poss. not alien) | Granitics | 1960-1980s | Insecticides (Agrocide & Lannate) | Control | ✓ | The mentioned insecticides are extremely toxic, therefore not recommended anymore. |
| | | 1980s onwards | BC (*Bacillus thuringi-ensis* = Thuricide) | Control | ✓ | Thuricide is a commercial biocontrol agent. Can be effective but depends greatly on the strain of *Bacillus thuringiensis* being used. |
| | | 1980s-2004 onwards | Insecticides (Decis, Ambush, Malathion) + IPM | Control | ✓ | Effective but insecticides should be rotated with the commercially available biological control agent *Bacillus thuringiensis* (Thuricide) - the pest can easily develop resistance. IPM = good field sanitation + netting, inter-cropping, mixed cropping or crop rotation. |
| | Agric Research Station, Anse Boileau, Mahé | 2007 | New insecticides (Teflubenzuron & Lufenuron) + BC *Bacillus thuringiensis* | Experimental trial | ✓ | Teflubenzuron was the most effective insecticide. It seems that *Bacillus thuringiensis* (Thuricide) when used alone is not too effective. |
| Banana (weevil) root borer | Granitics | 1952-1954 1960s on | BC (predatory Hister beetles) | Control | X | They are not specific predators of the Banana weevil, so their effectiveness against the pest is considered minimal. |
| | | 1960s | Insecticide (Dieldrin) | Control | ✓ | Extremely toxic pesticide - no longer recommended. |
| | | 1980s onwards | New insecticides (Primicid, Carbofuran, Nemacur) + IPM | Control | ✓ | The mentioned insecticides are extremely toxic therefore should be used with precautions. IPM = good field sanitation measures.<br>Sex pheromone traps and microbial bio-control are new control methods that could be used in Seychelles. |
| Citrus black-fly | Granitics | 1950s | Chemical | Control | (✓) | Simple use of kerosene/soap mixture or oil emulsions recommended. Although other chemicals can be used, once the biocontrol agent was introduced pesticides were not required. |
| | | 1955/1956 | BC (parasitic Eulophid wasp) | Control | ✓ | The introduction was considered a complete success, with occasional outbreaks being quickly controlled by the Eulophid wasp. However, no formal quantitative evaluation was carried out. Biocontrol is used elsewhere in the world with success. |
| | Poivre & Alphonse | 1958 | BC (parasitic Eulophid wasp) | Control | ✓ | No records of results but assumed to be successful. |
| African Rhinoceros beetle | Granitics | 1949-1969 | BC (parasitic Scoliid wasp) | Control | (✓) | Good field sanitation seemed to be important for the establishment of a Scoliid wasp colony. |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| (poss. not alien) | North Island | 1954-1956 | BC (parasitic Scoliid wasp) + good field sanitation measures | Experimental trial / Control | ✓ | Good field sanitation was presumed to be the reason behind the successful establishment of the Scoliid wasp. |
| | Mahé, Praslin, La Digue | 1954 | BC (predatory Elaterid beetle) | Control | X | It is presumed that both beetle species did not survive. |
| | Curieuse, La Digue, Praslin, Poivre | 1960/1961 | BC (predatory Carabid beetle) | Control | | |
| | Praslin | 1962 | Insecticide (Paradichlorobenzene) | Control | (✓) | Not too successful (50% of the treated palms were eventually attacked). |
| | Granitics | 1971-1972 | BC (*Rhabdovirus oryctes* virus) | Experimental trial / Control | Unknown | Infection rate was relatively high but the Rhinoceros beetle was able to maintain a breeding population. |
| | Ste Anne, Mahé, Praslin | 1981-1983 | BC (Baculovirus oryctes virus) | | (✓) | |
| Melittomma beetle (not alien) | Granitics | 1911-1914 onwards 1941 | Excision + tar + good sanitation measures Fumigation with insecticide (Paradichlorobenzene) | Control | (✓) | Though the physical treatment was reported to be effective, fumigation was assumed to be more effective. |
| | Praslin | 1953-1958 | Fumigation with insecticide (Paradichlorobenzene) | Experimental trial / Control | (✓) | Fumigation was confirmed to be partially effective (<53% of the treated palms remained infected). |
| | Mahé, Cerf | 1955 | BC (predatory Monotomid beetle) | Control | X | It is presumed that the predatory beetle did not survive. |
| | Granitics | 1959-1970s onwards | Excision + coal-tar/creosote + good sanitation measures | Control | ✓ | Creosote/coal-tar treatment must be applied 3 to 5 days after gouging. |
| | Mahé | 1970s | Numerous insecticides | Experimental trials / Control | (✓) | Effective only as a preventative measure - the insecticides used are persistent organic pollutants - not recommended by SAA. |
| | Victoria Botanic Garden | 2000s | Excision + new insecticide (Confidor) & fungicide (CAC Balsam) | Experimental trial / Control | ✓ | Seems to have been effective against newly infected palms. |
| Spiralling whitefly | Granitics | 2003 onwards | Numerous insecticides (Malathion, Decis, Vertimec, Confidor...) + improvement of plant hygiene | Control | (✓) | IPM may be the most successful method so far, using either pesticides or simpler soap/kerosene sprays linked with good field sanitation. Elsewhere in the world biocontrol using parasitic wasps has been very successful. |
| | | 2004 onwards | Light traps covered with Vaseline coating | Control | unknown | This was suggested but no records of follow-up. |
| Coconut whitefly | Mahé, Praslin, Silhouette, Ste Anne, La Digue | 2007 ? | BC (a new species of parasitoid - being described) | Control | ✓ | Effective: there seems to be a clear correlation between pest population levels & rate of parasitism, based on observations made on Mahé and La Digue. |
| Mediterranean fruit fly | Granitics | 1980s | Plastic 'sandwich container' trap containing attractant (Trimedlure) + insecticide-impregnated block | Control | (✓) | Mainly introduced to monitor the adult population size. Partially successful in reducing population expansion. |
| | | 1980s | Insecticides (Diazinon & Dipterex) | Control | (✓) | Later considered expensive and harmful to natural |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| | | onwards | | | X | enemies of the pest. |
| | | 2000s onwards | Pheromone-impregnated blocks with insecticide (Malathion) + IPM | Control | (✓) | IPM = good field sanitation measures + bagging of fruits + use of chemicals. |
| | | 2000s onwards | Cover spray or Bait spray (Malathion combined with protein hydrolysate liquid attractants) | Control | (✓) | Best used in combination with good field sanitation measures. |
| Melon fruit fly | Mahé | 2005-2007 | Pheromone (Cuelure)-impregnated blocks with insecticide (Malathion) + IPM | Control and Eradication | (✓)<br>X | IPM = good field sanitation measures + bagging of fruits. Programme partially successful but did not eradicate the fruit fly. |
| | | 2005-2007 | Insecticides (e.g. Malathion, Decis, Spinosad) | Control | ✓ | Cover sprays used by farmers; Spinosad proved successful but very expensive. |
| | | 2007 | Insecticides (Karate zone, Decis) | Control | ✓ | Study showed better control of pupae in cucumber by Karate zone. |
| Giant African Snail | Granitics | 1950s onwards | Collect adult snails + destroy their eggs & hideouts daily + establish physical barriers | Control | ✓ | Method works well on a very small scale but needs to be systematic and can be very labour intensive. |
| | Mahé, Praslin, Cerf, Ste Anne | 1957/1958 | BC (two carnivorous snail spp.) | Control | X | Small population size; restricted to lowland areas. *Euglandina sp*. is only found around Victoria. |
| | Granitics | 1961 onwards | Poison bait (Metaldehyde) + Epsom salt sprinkled on ground | Control | ✓ | Reasonably successful if used regularly. |
| **MARINE** | | | | | | |
| Crown of Thorns (not alien) | Mahé | 1998 | Poison (sodium bisulphite) | Control | (✓?) | Injection of poison. Results could not be evaluated due to coral bleaching event. |
| | | 2009 | Physical removal from sea | Control | ✓ | Easy and successful but labour intensive. |
| Black-spined Urchin (not alien) | Mahé | 2000 | Destroyed in situ with metal tools | Control | ✓ | Only to be used when populations are high (200 per 250m$^2$) and significant coral recruitment taking place. |
| **TREES** | | | | | | |
| Cinnamon | Congo Rouge, Mahé | 1995-1996 | Hand removal (uprooting) + Cutting / felling + Ring barking | Experimental trials / Control | (✓) | Physical control is possible on a very small scale but incredibly labour intensive. |
| | | | Herbicide trial using Roundup | | X | Can be effective at high dose (<15ml concentrate) but can have negative impact on non-targeted plant species. |
| | Silhouette | 1990s onwards | Ring barking of mature trees | Control | ✓ | Quite effective but should be done thoroughly + weekly removal of shoots. Very labour intensive. |
| Chinese guava | Congo Rouge, Mahé | 1995-1996 | Hand removal (uprooting) + Cutting / felling + Ring barking | Experimental trials / Control | (✓) | Physical control is possible on a very small scale but incredibly labour intensive. |
| | | | Herbicide trial using Roundup | | X | Can be effective at high dose (<15ml concentrate) but can have negative impact on non-targeted plant species. |
| Albizia | Mahé water catchment areas | 1990s | Cutting / felling + Ring barking | Control + Eradication | (✓) | Ring barking is more appropriate but should not be undertaken in public areas - as safety precaution. |

| Species | Location | Date | Methodology (BC = Biological Control; IPM = Integrated Pest Management) | Management strategy | Success confirmed | Additional comments |
|---|---|---|---|---|---|---|
| **OTHER PLANTS** | | | | | | |
| Bracken fern (not alien) | Granitics | 1958-1968 | Cutting (x2 or x3) | Eradication | (✓) | Method worked well, but needs to be systematic - followed by planting with desirable plant species. Very labour intensive. |
| Gazontrelle (grass) | Granitics (forestry areas) | 1951-1958 | Weeding, change planting regime, mulching | Control | (✓) | Method worked well, but needs to be systematic - followed by planting with desirable plant species. Very labour intensive. |
| | | 1955 | Herbicide trial using Tecane | Experimental trials / Control | X | More expensive than physical control over the long-term. |
| | | 1966 | Herbicide trial using Gramoxone | | ✓ | No info on whether it was ever tried on a large scale or its cost effectiveness. The herbicide is highly toxic to mammals. |
| Fo watouk (*Clidemia*) | Mahé | 1990s | Hand removal (uprooting) - dept. of environment staff | Control + Containment | (✓) X | Physical control is possible on a very small scale but very labour intensive and needs to be systematic, including post-control monitoring programme. It did not prevent the spread of this invasive. |
| | | 2003 | Uprooting - community mainly + awareness campaign | Control + Containment | (✓) X | |
| **INVASIVE CREEPERS** | | | | | | |
| Filodendron (*Epipremnum*) | Vallée de Mai | 1997-2002 | Cutting (as high as possible all round tree trunk) + hand removal (uprooting) | Experimental Eradication | ✓ | Method works well for small area but needs to be systematic including regular monitoring programme. Very labour intensive. |
| | Mahé | 2003 | Herbicide trial using salt water and Roundup | Experimental trial / Control | X | Not effective. |
| | | | Herbicide trial using Vigilant | | ✓ | Preliminary results were good but the long-term effects remain untested. |
| *Merremia* (Lalyann darzan) | Intendance, Mahé | 1999 | Hand removal (uprooting) | Experimental trail / Control | ✓ | Method works well, needs to be systematic including post-control monitoring programme. |
| | Mahé (c.26ha in areas of high biodiversity) | 1999-2001 | Hand removal (uprooting) | Eradication | (✓) | Method works well if systematic + followed by planting with desirable plant species. Very labour intensive and expensive. |
| *Quisqualis indica* (Rangoon creeper) | Cousin | 2000s | Herbicide (Vigilant) | Control | ✓ | Quite effective and apparently more cost-effective than physical control, but its impact on non-target species remains untested. |
| **WATER WEEDS** | | | | | | |
| Water lettuce (*Pistia*) | Mahé (NE Point & Anse Royale), Praslin, La Digue | 2000-2004 | Hand removal (uprooting) | Control | (✓) | Physical control is possible on a small scale but very labour intensive; needs to be systematic including post-control monitoring. Potential for bio-control. |
| Water hyacinth (*Eichhornia*) | Mahé (NE Point & Anse Royale), La Digue | 2000-2004 | Hand removal (uprooting) | Control | (✓) | Physical control is possible on a small scale but very labour intensive; needs to be systematic including post-control monitoring. Bio-control is reported to be more successful and self-sustaining. |

## ANNEX 5 Table of pesticides and herbicides

(*) Pesticide or herbicide not listed under SECHDULE 1 of the PESTICIDES CONTROL ACT, 1996, but has been used in Seychelles post-1996.

| Pesticides & Herbicides | Other Names | Active Ingredients | Pests & Weeds | Precautions |
|---|---|---|---|---|
| 1080 * | ACTA 1080 Concentrate, Sodium monofluoroacetate | **(mono)fluoroacetate** (with a sodium salt ) a naturally-occurring plant toxin | Feral cat and dog | Harmful if swallowed. Highly toxic to birds and mammals. Very low in toxicity to aquatic invertebrates. |
| Alpha Chloralose | Alpha-D-Glucochloralose, Chloralose | **alphachloralose** (a narcotic drug; acts by anaesthetising rather than killing) | Pest birds (Indian house crow, Indian myna, Turtle dove, House sparrow, Magpie…) | Harmful if swallowed or by inhalation. Highly toxic to birds and mammals. |
| Ambush | Talcord, Permethrin, Pounce | **permethrin** (a synthetic pyrethroid) | Scale insects, Mealy bugs, Diamond back moth, Caterpillars, Bean pod borer ... | Highly toxic to bees and fish and other aquatic organisms. Low in toxicity to mammals. |
| Brodifacoum rat bait | Ratak, Volak, WBA 8119 | **brodifacoum** (a highly toxic indirect anticoagulant) | Black rat, Norwegian rat, House mouse | Harmful if swallowed in large quantities. Highly toxic to birds and mammals. |
| Carbaryl | Sevin, Carbafor | **carbaryl** (1-naphthyl methylcarbamate) | Scale insects, Mealy bugs, Diamond back moth, Bean pod borer, Beetles, Mites, Aphids, Moths, Caterpillars, Leaf miners.. | Harmful if swallowed, absorbed through the skin, inhaled or if in the eyes. Highly toxic to bees, aquatic and estuarine invertebrates. |
| Carbofuran * | Faradan, Curater | **carbofuran** (an extremely toxic carbamate) | Banana root borer, Nematodes, Rootworms, Wireworms, Aphids, Thrips... | Poisonous if swallowed, harmful or fatal in prolonged or repeated contact with skin or by inhalation. Extremely toxic to humans, wildlife, fish and other aquatic organisms. |
| Confidor * | Admire, Gaucho, Imidacloprid | **imidacloprid** (a systemic neonicotinoid) | Scale insects, Mealy bugs, Spiralling whitefly, Mites, Aphids, Leaf miners, Thrips, Termites… | Harmful if swallowed or skin and eye contact. Highly toxic to bees. Low in toxicity to birds, mammals and fish. |
| Decis | K-orthrine, Deltamethrin | **deltamethrin** (a synthetic pyrethroid) | Scale insects, Mealy bugs, Diamond back moth, Melitoma beetle, Spiralling whitefly, Aphids, Leaf miners, Psyllids, Thrips… | Harmful if swallowed, absorbed through the skin, inhaled or if in the eyes. Highly toxic to bees, aquatic and estuarine invertebrates. |
| Difenacoum | Difenacoum PW Block Bait, Ratsnip | **difenacoum** (an indirect anticoagulant) | Black rat, Norwegian rat, House mouse | Harmful if swallowed or skin and eye contact. Highly toxic to birds, mammals and aquatic organisms. |

| Pesticides & Herbicides | Other Names | Active Ingredients | Pests & Weeds | Precautions |
|---|---|---|---|---|
| DRC 1339 * | Starlicide | **starlicide** (3-chloro-p-toluidine hydrochloride, CPTH) | Pest birds (Indian myna, Turtle dove, House sparrow, Indian house crow, Magpie…) | Highly toxic to birds and aquatic invertebrates. Low in toxicity to mammals. |
| Dursban | Lorsban, Brodan, Detmol UA, Pyrinex, Chlorpyrifos | **chlorpyrifos** (an extremely toxic crystalline organophosphate) | Crazy ant, other Ants, Borers, Bark beetles, Spider mites, Termites, Cockroaches, Fleas… | Poisonous if swallowed, harmful or fatal in prolonged or repeated contact with skin or by inhalation. Extremely toxic to humans, wildlife, fish and other aquatic organisms. |
| Epsom salt * | Magnesium sulfate | **magnesium (sulphate) sulfate** | Slug and snail | Harmful if swallowed or inhaled or by prolonged or repeated skin contact. |
| Fipronil * | Regent, Frontline | **fipronil** (a broad-spectrum phenylpyrazole) | Crazy ant, other Ants, Beetles, Cockroaches, Fleas, Ticks, Termites, Mole crickets, Thrips, Rootworms, Weevils… | Harmful if swallowed. Highly toxic to bees, birds, small mammals, fish and aquatic invertebrates. Very low in toxicity to earthworms, soil micro-organisms and aquatic plants. |
| Flocoumafen | Storm Secure Wax Block, Stratagem Securable Wax Block | **flocoumafen** (an indirect anticoagulant) | Black rat, Norwegian rat, House mouse | Harmful if swallowed in large quantities. Moderately toxic to birds and mammals. Very low in toxicity to fish and other aquatic organisms. |
| Gramoxone | Paraquat | **paraquat** (N,N′-dimethyl-4,4′-bipyridinium dichloride) | Broad-leaved trees and shrubs and grasses | Harmful if swallowed or inhaled or skin and eye contact. Highly toxic to mammals. Moderately toxic to birds. Slightly toxic to many aquatic organisms. Low in toxicity to bees. |
| Hydramethylnon* | Amdro, Maxforce Ant and Insect Bait | **hydramethylnon** (an organic chemical compound) | Crazy ant, other Ants, Cockroaches, Crickets | Harmful if swallowed or after short-term skin contact. Highly toxic to fish and aquatic invertebrates. |
| Karate * | Warrior, Demand | **lambda-cyhalothrin** (a synthetic pyrethroid) | Melitoma beetle, Melon fruit fly, Caterpillars, Aphids, Thrips, Plant bugs, Bean pod borer, Beetles... | Harmful if swallowed or skin and eye contact. Highly toxic to bees, fish and other aquatic organisms. Low in toxicity to large mammals and birds. |
| Malathion | Mercaptothion, Cythion, Carbofos, Maldison | **malathion** (an organophosphate parasympathomimetic) | Scale insects, Mealy bugs, Medfly, Melon fruit fly, Diamond back moth, Spiralling whitefly, Aphids, Leaf miners, Housefly… | Harmful if swallowed or inhaled or skin and eye contact. Highly toxic to bees, fish and other aquatic organisms. |

| Pesticides & Herbicides | Other Names | Active Ingredients | Pests & Weeds | Precautions |
|---|---|---|---|---|
| Metaldehyde snail pellets | Antimilice, Limatox, Meta, Slug-Tox, Ortho Metaldehyde 4% Bait | **metaldehyde** (a molluscicide) | Slug and snail | Harmful if swallowed or inhaled or skin and eye contact. Moderately toxic to mammals, birds and aquatic organisms. |
| Nemacur | Fenamiphos, Bay 68138 | **fenamiphos** (a systemic organophosphate nematicide) | Banana root borer, Nematodes, Citrus root weevil | Poisonous if swallowed, harmful or fatal in prolonged or repeated contact with skin or by inhalation. Extremely toxic to humans, wildlife, fish and other aquatic organisms. |
| Nomolt | Teflubenzuron, Dart, Calicide, Nemolt | **teflubenzuron** (a non-systemic insect growth regulator) | Diamond back moth, Caterpillars, Beetles, Flies, Housefly, Mosquito larvae… | Highly toxic to fish and other aquatic organisms and bees. Low in toxicity to mammals. |
| Orthene * | Acephate | **acephate** (an organophosphate foliar) | Scale insects, Mealy bugs, Spider mites, Thrips, Caterpillars, Aphids, Leaf beetles, Leaf miners, Root weevils, Whiteflies.. | Harmful if swallowed or inhaled or skin and eye contact. Highly toxic to bees. Moderately toxic to birds. Low in toxicity to fish. |
| Primicid | Fernex, Pirimiphos-ethyl | **pirimiphos-ethyl** (an organophosphate) | Banana root borer, other soil pests (dipterous maggots, rootworms and wireworms) | Poisonous if swallowed, harmful or fatal in prolonged or repeated contact with skin or by inhalation. Extremely toxic to humans, wildlife, fish and other aquatic organisms. |
| Rogor | Cygon, Dimethoate | **dimethoate** (a systemic organophosphate) | Mealy bugs, most Scale insects, Spiralling whitefly, Caterpillars, Aphids, Thrips, Leaf miners, Mites, Psyllids… | Harmful if swallowed or skin and eye contact. Toxic to wildlife, bees, fish and aquatic invertebrates. |
| Round up | Glyphosate, Accord Herbicide, Rodeo Aquatic Weed and Brush Herbicide | **glyphosate** (an isopropylamine salt) | Broad-leaved trees and shrubs and grasses | May cause slight skin or eye irritation. Slightly toxic to aquatic organisms. Low in toxicity to birds, mammals, bees and fish. |
| Sorba 050 match* | Lufenuron, Fluphenacur, Match | **lufenuron** (an insect growth regulator) | Diamond back moth, Caterpillars, Mites, Thrips, Beetles, Aphids, Whiteflies… | Harmful if swallowed or inhaled or skin and eye contact. Highly toxic to crustaceans. Slightly toxic to fish and bees. Low in toxicity to mammals. |
| Spinosad * | GF-120 NF Naturalyte Fruit Fly Bait, Conserve, Comfortis | **spinosad** (a natural fermentation product of a soil bacterium *Saccharopolyspora spinosa*) | Fruit flies, Caterpillars, Thrips, Leaf miners, Spider mites, Fire ants, Leaf beetle larvae… | May cause slight eye irritation. Slightly toxic to aquatic organisms. Low in toxicity to birds, mammals and fish. |

| Pesticides & Herbicides | Other Names | Active Ingredients | Pests & Weeds | Precautions |
|---|---|---|---|---|
| Thuricide | *Bacillus thuringiensis,* B.t., DiPel | ***Bacillus thuringiensis*** (a naturally occuring soil bacterium) | Diamond back moth, other moths, butterflies, certain beetles and some flies depending on the B.t. subspecies being used | Toxic to bees and earthworms (used according to product labels). Low in toxicity to birds, mammals and fish. |
| Ultracide | Suprathion, Supracide, Methidathion | **methidathion** (a non-systemic organophosphate) | Scale insects, Mealy bugs, Aphids, Mites, Thrips, Spiralling whitefly… | Harmful if swallowed or inhaled or skin and eye contact. Highly toxic to humans, mammals, birds, bees and aquatic organisms. |
| Vertimec * | Affirm, Agri-Mek, Zephyr, Abamectin, Avermectin | **abamectin** (a natural fermentation product of a soil bacterium *Streptomyces avermitilis*) | Diamond back moth, Spiralling whitefly, Aphids, Mealy bugs, Mites, Leaf miners, Thrips, Psylla… | Highly toxic to bees and fish and other aquatic invertebrates. Low in toxicity to mammals and birds. |
| Vigilant * | | **picloram** (a potassium salt) | Broad-leaved trees and shrubs and climbing creepers | May cause slight skin or eye irritation. Low in toxicity to birds, mammals, bees and fish and other aquatic organisms. |

(*) Pesticide or herbicide not listed under SECHDULE 1 of the PESTICIDES CONTROL ACT, 1996, but has been used in Seychelles post-1996.