

The Status of Exotic Plants on the Cocos (Keeling) Islands, Indian Ocean.

Report to Parks Australia North, Cocos (Keeling) Islands

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1. Executive Summary

Five islands in the Cocos Islands were visited in August 2001. These were Pulu Keeling, West Island, Home Island, Direction Island, and Horsburgh Island. Species presence data were collected for Pulu Keeling during a two-day visit to the island. On the other islands, known exotic plant infestations and various vegetation communities selected by Parks Australia North Cocos Island were assessed. There were few exotics in Pulu Keeling National Park, and none were considered to be a severe environmental problem, or have the potential to become one in the near future. On the other islands, *Chromolaena odorata* (Siam Weed) [Asteraceae] has the greatest potential of all the exotic species present to cause environmental problems in the near future. On the Southern Atoll this species has a widespread distribution on two of the islands visited. It displayed high seed loads and was rapidly colonising bare and disturbed sites. While this species remains uncontained on the Southern Atoll there is a risk that it may be accidentally introduced to Pulu Keeling.

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3. Recommendations

1. Using the information provided in this report, a weed action strategy should be developed for the Cocos (Keeling) Islands. This strategy should include, but not be limited to: (i) formulating weed management programs on a site by site or species basis (ii) identifying dedicated resources for these weed management programs, (iii) developing a community education program and, (iv) ensuring there are effective quarantine measures.
2. For the Southern Atoll, the management of *Chromolaena odorata* (Siam Weed) should be given the highest priority as it has the potential to have a widespread environmental impact in the near future. This action strategy should be developed jointly with other major land managers.
3. In order to manage *Chromolaena odorata* (Siam Weed), outside funding will be required. This should be sourced as a priority. From the current starting point, eradication of Siam Weed should be attempted on Home Island, while on West Island initial actions should focus on containing current infestations with a view to reducing them and possibly eradicating them in the future.
4. Parks Australia should develop a weed action plan for Pulu Keeling that would aim to eradicate most exotic species as time and resources allow. Reducing the number of weed species on Pulu Keeling would nullify the risk of exotic plants impacting on the ecology of the island, and would enhance the environmental values of the National Park.

4. Introduction

The Plan of Management for Pulu Keeling National Park has as one of its objectives for the management of vegetation “to protect the Park from the introduction of exotic plant species and assess, monitor and if necessary control exotic species already present.” From this objective prescription 2.1.3 (c) prescribes that “a weed assessment program will be developed with the objectives of assessing, monitoring and managing existing exotic plant species as required.”

This report arises from this prescription and has as its aims to report on the exotic species on Pulu Keeling and the Southern Atoll of the Cocos (Keeling) Islands, and make recommendations as to the management of these species.

5. Flora of the Cocos Islands

Du Puy (1993) has recorded the presence of 130 plant species from several surveys conducted up until 1987. Only one species is endemic, the local pandanus (*Pandanus tectorius* var. *cocosensis*). Fifty-nine of the 130 species present have been introduced to the island and become naturalised. Approximately 20 more exotic species have been introduced to the grounds of Oceania House and the Quarantine Station and are not listed in Du Puy (1993) species lists.

5.1 Flora of Pulu Keeling

Thirty-one plant species have been previously recorded on Pulu Keeling with six of these species (17%) considered to be naturalised or exotic* (Du Puy 1993) (Table 1). During this survey, only twenty-seven of those listed species were found. Three other species, *Morinda citrifolia*, *Ipomoea macrantha* and *Mariscus javanicus*, not on the Du Puy (1993) list for the island were also found¹, while four species listed in Du Puy (1993) were not detected².

Table 5.1: Plant species recorded on Pulu Keeling (adapted from Du Puy 1993).

<i>Acalypha lanceolata</i> *	<i>Achyranthes aspera</i>	<i>Allophylus cobbe</i>
<i>Argusia argentea</i>	<i>Boerhavia repens</i>	<i>Boerhavia albiflora</i>
<i>Caesalpinia bonduc</i>	<i>Calophyllum inophyllum</i> ²	<i>Canavalia cathartica</i>
<i>Carica papaya</i> *	<i>Cleome gynandra</i> ²	<i>Cocos nucifera</i>
<i>Cordia subcordata</i>	<i>Dicliptera ciliata</i>	<i>Erythrina variegata</i>
<i>Hernandia nymphaeifolia</i> ²	<i>Ipomoea macrantha</i> ¹	<i>Laportea aestuans</i>
<i>Lepturus repens</i>	<i>Mariscus javanicus</i> ¹	<i>Morinda citrifolia</i> ¹
<i>Paspalum vaginatum</i>	<i>Pemphis acidula</i>	<i>Physalis minima</i> *
<i>Pisonia grandis</i>	<i>Portulaca oleracea</i> *	<i>Premna serratifolia</i>
<i>Rivina humilis</i> *	<i>Scaevola taccada</i>	<i>Sesuvium portulacastrum</i>
<i>Sida acuta</i> ²	<i>Stenotarphum micranthum</i>	<i>Thalassia hemprichii</i>
<i>Triphasia trifolia</i> *		

Williams (1994) listed the presence of these three extra species mentioned above (*Morinda citrifolia*, *Ipomoea macrantha* and *Mariscus javanicus*), during his survey on Pulu Keeling. He also recorded the presence of *Terminalia catappa*, *Ipomoea pes caprae* ssp. *brasiliensis*, *Clerodendrum inerme*, *Acalypha indicum*, and *Guettarda speciosa*, none of which could be found during this survey.

6 Exotic Plant Species in Pulu Keeling National Park

The six exotic or naturalised plant species on Pulu Keeling are: *Acalypha lanceolata*, *Triphasia trifolia*, *Physalis minima*, *Portulaca oleracea*, *Carica papaya*, and *Rivina humilis*. These species are discussed in more detail below and ranked, in terms of management effort, from the easiest to eradicate to the most difficult.

6.1 *Acalypha lanceolata* (Euphorbiaceae), a small erect herb, has been recorded in the past as common on Pulu Keeling in *Pisonia grandis* forest (Du Puy 1993). Seed dispersal would be facilitated by water and gravity and would be limited to short distances, unless birds are using this species for nest-building material. Numbers of individuals have since decreased between this survey and Du Puy (1993) reference, indicating that this species is not regenerating in large numbers at present. However, this species was bearing flowers and fruit at the time of the survey, and it is a common weedy species on Christmas Island, India, Indo-China, Malesia, New Guinea, and the Pacific Islands (Du Puy 1993). This exotic herb can be easily and quickly eradicated from Pulu Keeling by uprooting individuals. If fruit is present, bagging individuals and later burning them with their fruit will destroy them. This species is not currently on any known list of noxious, invasive, or threatening plant species.

6.2 *Triphasia trifolia* (Rutaceae) is a medium-sized woody shrub on Pulu Keeling. It occurred in several small clumps in *Pisonia grandis* forest and possessed flowers and fruits. Young seedlings were also present beneath parent shrubs. No dispersal of this species away from the parent shrubs was apparent. The fruit of this species usually relies largely on animal vectors for its dispersal, and there are none on Pulu Keeling (except the possibility of very limited movement by land crabs), which explains the lack of expansion in its distribution. This species can be easily and quickly eradicated from Pulu Keeling by uprooting young non-fruiting individuals, digging out larger individuals, or stumping them and immediately spraying the stump with 2% Garlon in diesel. Any fruit present can be easily collected, bagged and later destroyed. This species is

currently listed as a plant threat to Pacific ecosystems (PIER 2001), and an alien plant invader of natural areas (PCA Alien Plant Working Group 2001) .

6.3 *Physalis minima* (Solanaceae) is a small erect herb found in *Pisonia grandis* forest in very low numbers, however there is one location in the middle of the island in open grassland, near the lagoon where it is found in much higher densities with flowers and fruits. Its seeds are dispersed by frugivorous animals, wind, and possibly water. Again, there are no animal vectors on Pulu Keeling (except the possibility of very limited movement by land crabs) for this species, however, in open areas wind will assist its dispersal. This species can be quickly and easily eradicated from Pulu Keeling by uprooting individuals. Any fruit present can be collected, bagged and later destroyed. This species is currently listed as an environmental weed in Australia (Swarbrick & Skarratt 1994), a weed in Queensland by the DPI (Kleinschmidt & Johnson 1977), and as a species requiring control in the Kakadu National Park.

6.4 *Portulaca oleracea* (Portulacaceae) is a small prostrate herb found in open and grassland areas on Pulu Keeling near the inner lagoon. This species has a wide distribution in open areas on Pulu Keeling, but was present in low numbers. Flowers and fruits were observed during the survey. *P. oleracea* is known as a pantropical weedy species (Du Puy 1993), a weed in Queensland by the DPI (Kleinschmidt & Johnson 1977), an alien plant invader of natural areas (PCA Alien Plant Working Group 2001), and a species requiring control in the Kakadu National Park. More effort would be required to eradicate this exotic herb from Pulu Keeling than for the first three species mentioned above due to its widespread distribution. Individuals without fruit can be destroyed by uprooting. If fruit is present, individuals should be bagged and later burnt.

6.5 *Carica papaya* (Caricaceae) is a small tree found throughout *Pisonia grandis* forest on Pulu Keeling. It has a very clumped distribution and is currently thriving due to the elevated light intensities in the understorey (caused by the damaged nature of the upper *Pisonia grandis* canopy). It is listed as an alien plant invader of natural areas (PCA Alien Plant Working Group

2001). An eradication program for this species will require moderate resources, and implementation on a regular basis over several years. Young plants can be left to self-thin due to the very clumped nature of their distribution. Older male plants can be left untouched. If eradication is attempted, efforts should focus on mature fruit-bearing plants (before their fruit ripen) which can be easily destroyed by stumping and the stump sprayed immediately with 50% Glyphosate.

6.6 *Rivina humilis* (Phytolaccaceae) is a small erect herb found in high numbers throughout *Pisonia grandis* forest on Pulu Keeling. At the time of the survey it was flowering and fruiting prolifically. This species is widespread and in high densities in the understorey largely due to birds collecting the tops of this plant (with fruit) for nest-building material. This species is currently listed on the Plant Threats to Pacific Ecosystems (PIER 2001), and a weed in Queensland by the DPI (Kleinschmidt & Johnson 1977). *Rivina humilis* will be difficult to eradicate from Pulu Keeling due to its high density, wide distribution and its association with nesting-building birds. If eradication is attempted it will require considerable resources and an intensive effort, especially in terms of time and people.

7. Exotic Plant Species on Islands of the Southern Atoll

Approximately 47% of the species on the southern atoll are exotic, in contrast to Pulu Keeling with only 17% exotics. Of the four islands visited during this survey, Direction Island and Horsburgh Island were relatively free of exotic species that could cause moderate or severe environmental problems in the near future. However, Home Island and West Island are not as fortunate. The Quarantine Station and the Oceania House grounds are two areas with many exotic invasive species that will spread if the grounds are not maintained or rehabilitated.

7.1 *Chromolaena odorata* (Siam weed) [Asteraceae] is by far the most aggressive colonising exotic species present on these two islands and will continue to spread into open and disturbed areas. Of all the other southern atoll islands, Direction and Horsburgh Island are the most susceptible to invasion by Siam weed from Home and West Island due to the prevailing winds and human visitation. If it is found on either of these islands, early eradication is strongly recommended. It is unlikely that Siam weed on Home and West Island can be eradicated with existing resources, particularly due to its widespread distribution, prolific seed production, the island's windswept nature, and the current rate of vegetation disturbance and clearance. However, additional resources should be sourced and a management plan implemented.

7.2 Excerpt from *DNR Pest Facts Info Bulletin (1997)*.

***Chromolaena odorata* (Siam Weed) [Asteraceae]**

THE PROBLEM

Siam weed is considered one of the world's worst tropical weeds due to its quick invasion and establishment in many countries, outcompeting pastures, crops and native vegetation. If established in Australia, Siam weed will seriously degrade large areas of the wet/dry tropic savanna grasslands, and conservation areas.

Growth

Siam weed can outcompete and smother crops and native vegetation because of its phenomenal growth rates (20 mm/day or 5 m/year) and its ability to scramble up into taller plants to a height of 20 m. It also produces huge numbers of wind borne seeds (>80 000 seeds/plant). Siam weed readily invades remnant patches of rainforest, creek and riverbank vegetation. It also grows under dense rainforest canopies but less vigorously.

Fire Hazard

In the dry season, dense thickets of Siam weed could cause more frequent and intense bushfires.

Health Issues

Siam weed may also cause skin complaints and asthma in allergy-prone people.

Habit / Form

The plant dies back in the dry season but reshoots after rain. Regrowth also occurs rapidly after destruction by fire or slashing. Within 8-10 weeks of flowering masses of small brown seeds are produced, each with a tuft of white hairs allowing it to be carried by the wind and water. Seeds are also have tiny barbs that stick to clothing, footwear, animals, vehicles and machinery. Most seeds germinate immediately after rain, though some seeds appear to remain dormant for several years.

WORLDWIDE DISTRIBUTION

It is now a major pest widespread in central and western Africa, tropical America, India and south-east Asia. It is still spreading rapidly, particularly through the Philippines, south-west China and South Africa. Especially worrying is its spread in out near neighbours Papua New Guinea and eastern Indonesia.

CONTROL

Although biological control research has been initiated, no effective agents have been found so far. Biological control has generally been unsuccessful overseas. Chemical control at the correct rates results in excellent kills (Table 7.1). Due to the wind dispersed nature of this species, suppression of this species should start on islands and in areas upwind of the infestations.

Table 7.1: Herbicides registered for the control of Siam Weed.

Chemical	Produce Name	Rate	Comments
Picloram + Triclopyr	Grazon DS	1:300 parts water (3.3mL per 1L water + BS 1000 wetting agents @ 10 mL per 100 L water	Overall spray, spraying to point of runoff
Triclopyr	Garlon 600	1:60 parts diesel (17 mL per 1 L diesel)	Basal bark

IMPORTANT: Always read the label before using any pesticide. All chemicals MUST be used strictly in accordance with the registered label for the product. Whilst all care has been taken by the Department of Natural Resources in preparation of the pest fact, neither the Department nor its officers or staff accept any responsibility for any loss or damage which may result from any inaccuracy or omission, or from the use of the information therein.

7.3 Other exotic species

Other exotic species that should have their populations suppressed, managed, or be eradicated from areas where their populations are not managed, are: *Leucaena leucocephala*, *Muntingia calabura*, *Spathodea campanulata*, *Adenantha pavonia*, *Ceiba pentandra*, *Tecoma stans*,

Ipomoea obscura, *Cenchrus echinatus* and *Ricinus communis*. All these species are in low enough numbers to be quickly eradicated. If opportunities arise to reduce the populations of other exotic species in the lists below, it should be utilised.

Table 7.2: Cocos (Keeling) Islands exotic plant species that are considered noxious, threatening, or invasive and the lists on which they appear.

(a) 100 of the World's Worst Invasive Alien Species List (2000)

Spathodea campanulata

Imperata cylindrica

Leucaena leucocephala

Chromolaena odorata

(b) Australian Noxious Weed List for Australian States and Territories (2000)

Cenchrus echinatus

Chromolaena odorata

Pithocellobium dulce

Ricinus communis

Senna occidentalis

Stachytarpheta jamaicensis

(c) Weeds Target List by NAQS (2001)

Chromolaena odorata

Spermacoce assurgens

Striga angustifolia

(d) Plant Threats to Pacific Ecosystems (PIER) Database (2000)

<i>Acacia farnesiana</i>	<i>Muntingia calabura</i>
<i>Adenanthera pavonia</i>	<i>Panicum repens</i>
<i>Brachiaria mutica</i>	<i>Passiflora foetida</i>
<i>Casuarina equisetifolia</i> ssp. <i>equisetifolia</i>	<i>Pithocellobium dulce</i>
<i>Ceiba pentandra</i>	<i>Rhynchelytrum repens</i>
<i>Cenchrus ciliaris</i>	<i>Ricinus communis</i>
<i>Cenchrus echinatus</i>	<i>Rivina humilis</i>
<i>Chloris barbata</i>	<i>Spathodea campanulata</i>
<i>Chromolaena odorata</i>	<i>Sorghum bicolor</i>
<i>Chrysopogon aciculatus</i>	<i>Syzygium jambos</i>
<i>Cynodon dactylon</i>	<i>Tamarindus indica</i>
<i>Eleusine indica</i>	<i>Tecoma stans</i>
<i>Imperata cylindrica</i>	<i>Triphasia trifolia</i>
<i>Leucaena leucocephala</i>	

(e) Alien Plant Invaders of Natural Areas (PCA Alien Plant Working Group) database (2000)

<i>Acacia farnesiana</i>	<i>Imperata cylindrica</i>
<i>Brachiaria mutica</i>	<i>Leucaena leucocephala</i>
<i>Carica papaya</i>	<i>Muntingia calabura</i>
<i>Casuarina equisetifolia</i> ssp. <i>equisetifolia</i>	<i>Ricinus communis</i>
<i>Chloris barbata</i>	<i>Sorghum bicolor</i>
<i>Cenchrus ciliaris</i>	<i>Triphasia trifolia</i>
<i>Cenchrus echinatus</i>	
<i>Cynodon dactylon</i>	
<i>Eleusine indica</i>	

7.4 Options

Three simple measures that can be undertaken to suppress exotic species populations on the southern atoll are: regular mowing of open grassed areas (particularly the exotic grassland at the Quarantine Station), destruction of mature fruiting individuals and seedlings, and **most importantly**, replanting native species. As a general principle for controlling weeds that are relatively widespread, weed control should be concentrated in areas that are more ecologically intact, so that native species can recolonise treated areas, and weed infestations in highly disturbed areas should be controlled last. Because the Southern Atoll is highly disturbed, it may be a matter of initially concentrating on smaller infestations so that the area can be rehabilitated with native species.

It is strongly recommended that fire NOT be used as a tool to control exotic plants on the Cocos Islands as it is not a naturally occurring phenomenon, it will disturb the island's ecology, and will provide more exposed areas for invasion by exotic species. If eradication of exotic species is attempted, physical removal, or the application of appropriate herbicides is recommended.

Contact a major supplier of herbicides on the mainland for appropriate herbicides and applications for each species. Efforts should be made by all organisations on the Cocos Islands to prevent the clearance and disturbance of vegetation. Clearing vegetation will only provide more areas for invasive exotic species to move into, and on the coastal fringe, destabilise the substrate and promote further erosion.

Information signs about Siam weed and the problems it can cause should be erected on the piers of Home and West Island. These signs should also explain some simple quarantine procedures that the public can undertake when travelling between islands to prevent the spread of exotic species. Similarly, info-bulletins on the same topics need to be distributed to all organisations involved in vegetation clearing and organisations transporting equipment and people between the islands. The airlink from Christmas Island needs comprehensive quarantine management as this

island has many other invasive species that are not present on the Cocos Islands. Strengthening of quarantine procedures and skills on the Cocos Islands will benefit all, “as prevention is better than cure”, when dealing with invasive species.

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