Northern Australia Quarantine Strategy survey of Cocos (Keeling) Islands and Christmas Island 21 May to 3 June 2000

Abstract

AQIS scientists from the Northern Australian Quarantine Strategy (NAQS) surveyed the Cocos (Keeling) Islands and Christmas Island from the 21 May to the 3 June on behalf of the Department of Transport and Regional Services. The survey was undertaken by G. Bellis (entomologist), J. Curran (veterinary officer), A. Mitchell (botanist and survey leader) and M. Weinert (plant pathologist).

Animal Health

Cocos (Keeling) Islands and Christmas Island

On Cocos (Keeling), blood samples were collected from 42 wild birds and poultry, and on Christmas Island from 49 wild birds and poultry for serological disease testing. Samples tested negative for Newcastle disease and avian influenza. A significant number of poultry samples were positive to infectious bursal disease (IBD), but there were no indications that the hypervirulent strain of IBD is present at these localities. Japanese encephalitis results are pending.

The risk of entry and establishment of serious animal diseases to these islands is considered to be low, given the low number and variety of animals present (with the exception of seabirds) and the isolation of these islands. From the small number of seabird samples collected it appears that they have had minimal exposure to many of the viruses that are fairly ubiquitous in other terrestrial bird populations.

Plant Health

Cocos (Keeling) Islands

A survey of these islands was conducted between the 21-27 May 2000. The team visited all the major islands in this group.

Botany
A total of 40 plant specimens were collected on these islands. Siam weed was found in dense stands on Home and West Islands. It has been there since before 1986 and is well established. It is recommended that consideration be given to eradicating this weed. A less well known

NAQS target weed *Striga angustifolia* had been recorded from West Island but could not be found. Coffee bush (*Leucaena leucocephala*) was found on Home Island from where it is recommended it be eradicated. The old quarantine station has 10 new grass weeds that are starting to spread out from its boundary. The Cocos Shire and Environment Australia are encouraging AQIS to control their spread.

Entomology

A total of 65 collections were made of insects either attacking crops, in fruit fly lure traps or in light traps. Only 1 NAQS target species, the coconut rhinoceros beetle (*Oryctes rhinoceros*) and 2 NAQS non-targeted species, the Asian tiger mosquito (*Aedes albopictus)* and crazy ant *(Anoplolepis gracilipes)* were present. The latter 2 are regarded as important quarantine pests to mainland Australia because they would likely impact Australia's agriculture industries or human health should they become established there. (Crazy ant is present in Australia, but is believed to be confined to a limited area of Northern Territory). No *Culicoides* sp. or fruit flies were collected in the traps. The larvae of a species of pyralid moth was collected defoliating Siam weed (*Chromolaena odorata)* and may be a potential biocontrol agent for this weed.

Plant Pathology

Thirty one suspected plant disease samples were collected from the Cocos (Keeling) Islands. Thirteen of the specimens have been positively identified, 14 identifications are pending and 4 samples were of indeterminate cause. None of the samples collected are believed to be of quarantine significance.

Quarantine

There is very little commercial horticulture on these islands but the accidental importation of pests, diseases and weeds, particularly from Christmas Island, would reduce the chance of one developing. The introduction of weeds would also threaten the ecology of these islands, especially Pulu Keeling NP. Importation of fresh fruit and vegetables and personal affects from either Christmas Is or Perth should be subject to full quarantine inspection as some could have come from Java. This was not imposed on the survey team on their arrival at West Is. The quarantine procedure as regards the visiting yachts is in need of review. Siam weed poses a threat to both Christmas Is and in particular the mainland, as personal affects returning to the mainland could easily harbour Siam weed seed.

Christmas Island

The survey of these island was conducted between the 28 May and 3 June 2000.

Botany

A total of 55 collections were made on Christmas Island. For such a relatively small island, Christmas Island has more than its fair share of NAQS target weeds. There are seven of these species, mile a minute (*Mikania micrantha*), fringed spider flower (*Cleome rutidosperma*), cow itch *(Mucuna pruriens*), lesser Malaysian stinkwort (*Paederia foetida*), *Piper aduncum*,

erect tar vine (*Boerhavia erecta*) and amaranth (*Amaranthus dubius*). The worst of these are the mile a minute, stinking Malaysian stinkwort and cow itch. The Flora of Australia had listed all of the above as present on Christmas Island except erect tar vine which is a new record for the island. Siam weed was not seen on the island. There are three weed species on the island; Madras thorn (*Pithecellobium dulce*), *Cordia curassavica* and *Clausena excavata* that should be considered for inclusion on the NAQS weeds target list at its next revision. It is recommended that consideration be given to eradicating erect tar vine, cow itch, itch grass, physic nut, *Piper aduncum* and Madras thorn. Coffee bush is a serious weed on the island and consideration should be given to introducing biocontrol agents to reduce the prevalence of this weed.

Entomology

A collection of 73 species of insects attacking crops or in fruit fly lure or light traps was made on this island. Included amongst the collection were 5 NAQS targeted pests; papaya fruit fly (*Bactrocera ?papayae*), *B. ?albistrigata* (both identifications are pending),, melon fly (*B. cucurbitae*), jackfruit fly (*B. umbrosa*), and citrus black fly (*Aleurocanthus woglumi)*. Two non-targeted species, crazy ant (*Anoplolepis gracilipes*) and giant African snail (*Achatina fulica*) are regarded as important quarantine pests to mainland Australia because they would likely impact Australia's agricultural industries should they become established there. An undescribed species of *Culicoides*. was collected in the light traps set near the poultry farm and at the Research Station. The larvae of a species of pyralid moth were collected defoliating the serious weed mile a minute (*Mikania micrantha*). Larvae of this species were successfully reared to adult and may have potential as a biocontrol agent for this weed.

Plant pathology

Forty suspected plant disease samples were collected. Thirty of the specimens have been positively identified, 8 are pending and 2 samples were of indeterminate cause. Four samples have been identified as citrus canker caused by the pathogen *Xanthomonas axonopodis* pv. *citri*. The pathogen is regarded as one of the most serious diseases of citrus and, although not a new record for the island, indicates that attempts to eradicate the disease after the original detection were unsuccessful. Hosts were widespread so eradication would be difficult. None of the other samples is suspected of being of quarantine significance.

Quarantine

Christmas Island has limited and, given the suite of recently imported pests, inadequate quarantine restrictions on the importation of fresh fruit and vegetables from Indonesia. This island still does not have some of the serious pests that are found in Indonesia so the situation could get worse. As a result, a pathway exists for many Indonesian fruit pests and some have indeed hitchhiked to Christmas Island, the principle of which is papaya fruit fly. The locals dislike the "dirty port" tag applied to the island by quarantine but this is largely a result of the importation of relatively cheap fruit from Indonesia. The Department of Territories and Regional Services would like to facilitate the development of a horticulture industry on the island but the pest situation has marginalised fruit growing as a possible development. If a horticulture

industry were to be developed, we recommend that stringent quarantine restrictions be imposed to stop the importation of any more pests. The main pests would then have to be controlled or eradicated. This would be expensive and whether the Christmas Island community would be prepared to bear the cost is uncertain. Christmas Island also is at risk from Siam weed on the Cocos (Keeling) Islands and travellers from there to Christmas Is should be made aware of this and appropriate quarantine measures taken.

Background

Cocos (Keeling) Islands

Geography

This island group consists of 2 atolls that are the result of the exposure of two nearby seamounts approx. 14,000 years ago. The southern atoll of Cocos consists of 26 islands whilst the other atoll consists of the single island of North Keeling approximately 24 km to the north of Cocos. Maximum relief on these atolls is approx. 9m. The Cocos (Keeling) Islands are a very remote part of Australia lying 2770 km from Perth and 900 km east south east of Christmas Island.

History

In 1825 Hare and the Clunies Ross families settled these islands and in 1886 Queen Victoria granted them to John Clunies Ross in perpetuity. The airstrip at Cocos was a very important during the Second World War as all aircraft flying to Australia had to stage through Cocos. During this colonial period, these islands were initially administered from Singapore and latterley from Sri Lanka. In 1955 the islands became a Territory of the Commonwealth of Australia and the Commonwealth purchased all the land from the Clunies-Ross family except the ancestral home in 1978. The labour force for the coconut plantations came from the Malay Archipelago and their descendents comprise the majority of the present day population of Home Island.

Environment

The climate has a distinct wet season but there is rain throughout the year with an average rainfall of 1976 mm. Temperatures are relatively constant year round with an average daily maximum of 28.7C and minimum of 24.4C. Cyclones are a regular event during the wet season but because of its relatively small size few come close to the islands. After settlement by the Clunies Ross family, all the islands except N. Keeling were cleared and planted with coconuts. After 1978 the coconut plantations were abandoned and these plantations now support an open upperstorey of planted coconuts and a dense impenetrable understorey of young coconuts and cabbage bush (*Scaevola taccada*).

Soils on the southern atoll consist of coral sand and/or coral shingle with no organic matter. Soil was brought into the various Cocos Islands to improve their horticultural prospects from Christmas Island and Singapore. The various small islands have shacks or pondoks that act as weekend retreats for the various families of the Cocos Malays from Home Island. The people keep chickens here, which are fed on a diet of coconuts and what they can forage for themselves. In the vicinity of these pondoks the land is devoid of any undergrowth and will remain so as long as the chicken populations remain at their present levels.

North Keeling Is was never cleared and supports a dense rainforest in which a large population of sea birds nest. There is also a dense humus layer over the coral shingle and sand. This island, because it has been relatively undisturbed by human activities, became the Pulu Keeling National Park in 1995.

Settlements

There are two settlements on these islands. The biggest is at Home Island where about 460 Cocos Malays live whilst there are approximately 100 people on West Island, most of whom come from mainland Australia and who predominantly work for various Australian Government Departments.

Agriculture

On Home Island the council have in consultation with the residents, developed a farm area where the residents keep chickens and grow vegetables. On West Island a small farm was developed 10-15 years ago and had fallen to disuse until recently, with new lessees starting to operate the farm as a business. Consequently, the majority of food consumed on the island is imported from Perth.

Quarantine

Delivered by Australian Federal Police (AFP) staff under the Australian Quarantine Act, which includes:

- Clearance of a weekly passenger jet service from Perth either direct or via Christmas Island.
- Inspection of travelling yachts who moor at the quarantine line at Direction Island, which is 10km north of West Island. The numbers per annum is less than one hundred.
- Inspection of cargo containers ex Perth that transit through Jakarta and Christmas Island.
- Inspection of fuel ships ex Singapore, which visit once a year

These islanders obtain their fresh and dry food from W. Australia via the weekly air service or ships. Visitors to the islands come mainly by air but yachts traversing the Indian Ocean visit the

these islands. A quarantine station was built by AQIS on West Island in 1980 to house and test exotic species and breeds of animal before importation to the Australian mainland. This was closed in about 1998. AQIS inspectors at the quarantine station were also responsible for the delivery of barrier functions to visiting ships and aircraft. As a result of the closure of the quarantine station there are no longer any AQIS employees on these islands and the barrier function has been transferred to the Australian Federal Police (AFP). Quarantine on the Cocos (Keeling) Islands is delivered under the Australia Quarantine Act.

Christmas Island

Geography

This island is part of Australia's Indian Ocean Territories and is 2,600 km west of Darwin, 2600km north west of Perth (its administrative base) and 350km south of Java. The island covers about 135 km^2 and is approximately 22 km long. The island was formed 25 million years ago by the rise of a seamount. Its soils are largely calcareous and contain large amounts of phosphate. Limestone sea cliffs surround Christmas Island and landing beaches are rare. As a result, safe anchorages are in short supply, especially during the wet season, when the main anchorage at Flying Fish Cove is vulnerable to north-west swells.

History

Christmas Island was not inhabited until annexed by Britain in 1888 as a result of mining pressures and shortly afterwards the Christmas Island Phosphate company was formed to mine the island. Mining commenced in 1899 and continues to the present day. The island was briefly taken over by the Japanese in 1942. After the war, the mine and its leases was sold to the Australian and New Zealand Governments. In 1958 sovereignty was transferred to Australia.

Environment

Christmas Island is in the tropics (10 degrees south) and has a wet and dry season. The dry season however is not totally without rain. Annual average rainfall is about 2000mm. No cyclones have been recorded on the island. The island was clad with a dense rainforest until large areas were cleared for mining. Most of the plants and animals in these rainforests are found elsewhere in South East Asia. There is an endemism rate of approximately 10%, many of which are subspecies. Species introduced within the last 100 years are an unhealthily large percentage of the biota. The arrival of settlers meant the introduction of many plants and animals and these introductions seem to have continued until recently.

Settlements

Although there is an extensive road network though out the island there is only one main township on the island and this is in the north east corner. The island supports about 1300 people, about 75 % of which are descended from Chinese immigrants contracted to work in the mine. There are some minor living areas out from the main town and these are the hospital, the casino, Grant's Well and the Pink House (Environment Australia's (EA) research station). The largest employer appears to be the mining company.

Agriculture

A chicken farm is the only current agricultural business on the island. The market garden no longer produces fruit because of pest problems. Consequently, the majority of food consumed on the island is imported from either Jakarta or Perth.

Discipline specific comments are dealt with in the reports from the respective disciplines.

Quarantine

The Australian Quarantine Act does not have any legal basis on this island. Rules governing the importation of goods are covered under the Christmas Island Quarantine Ordinance. This prohibits the entry of bird products and live animals and plants to protect the unique flora and fauna of this island. See appendices for details.

Quarantine services are delivered by WA Quarantine and Inspection Service staff under contract to the Dept. of Territories. Direct flights from Perth are subject to random inspection. Giant African Snail is a significant threat to mainland Australia, and all containers are inspected prior to departure. Fresh or dry food comes from either W. Australia or Java by either air or ship. Fuel comes from Singapore.

Administrative arrangements

Personnel animal and plant survey

Glenn Bellis	Entomologist
John Curran	Veterinary Officer
Andrew Mitchell	Botanist & team leader
Matthew Weinert	Plant Pathologist

Itinerary animal and plant survey

The survey of the Cocos (Keeling) Islands was carried out using a mixture of motor vehicle and boats while on Christmas Island the survey was performed with a vehicle.

Date		Details
Fri	19/05/2000	The survey team flies to Perth
Sat	20	Team flies to Cocos via Learmonth & Christmas Is.
Sun	21	Familiarization with West Is. And practicing swimming over reefs
Mon	22	Survey of N. Keeling Is by charter boat.
Tues	23	Survey of Home Island Oceania House Townsite Markets gardens
Wed	24	Survey of West Island Quarantine Station Farm Pistol Range Yacht Club Scout Park Town site
Thur	25	Survey of S. E members of Cocos atoll group by boat: Pulu Blan Pulu Atas south end Pulu Atas north end Pulu Lubu Pulu Sipat
Fri	26	Survey of northern members of Cocos atoll group by boat: Pulu Luar Pulu Tikus West Island, Beacon Heights
Sat	27	Fly from Cocos to Christmas Islands
Sun	28	Familarization with geography of Christmas Is. Survey Pink House (EA Research Station) South Point Sugarcane stop Rumah Tinghi at the Settlement

Mon	29	Christmas Is. survey Chicken farm at the Settlement Foreshore at the Settlement Flying Fish Cove Old gardens in Poon Saan Casino The Barracks
Tue	30	Christmas Is. survey Casino Grant's Well Martin Point Road to the Dales
Wed	31	Christmas Is. survey Environment Australia nursery Drumsite village, west end Drumsite village, east end Phosphate Hill, north end of runway Ross Hill gardens Old mining area, ML 111 New phosphate driers
Thu	01/06/2000	Christmas Is. survey Kim Chey H'Ng's market garden Ross Hill gardens, south end Greta Beach Dolly Beach Near Kiat's garage, Poon Saan Poon Saan The Barracks
Fri	02	Christmas Is. survey Grants Well Kanakers Quarters near the Pink House Dales Meeting with Bill Taylor, C.I. Administrator Gordon Bennetts tomb, The Settlement
Sat	03	Christmas Island to Perth
Sun	04/06/2000	Team returns to their respective home bases

Cost estimates plant survey

Item	Cost $
Airfares	
Bellis	$2607.20
Curran	$2401.60
Mitchell	$2607.20
Weinert	$2607.20
T/A	
Bellis	$2837.90
Curran	$2837.90
Mitchell	$2511.80
Weinert	$2837.90
Vehicle Hire	
Cocos	$200
Christmas	$350

Boat Charter	
R.J. Hawke	$1840
Christie	$240
Excess Baggage	$330
Sample	
Maps	$45
Film and development	$230
Swimming equipment for access to N. Keeling	$106

Animal Survey Report

Objectives

To survey the animal populations of Cocos and Christmas Island for target pests and diseases. Given that the majority of species were avian, target diseases were Newcastle disease (ND), avian influenza (AI), hypervirulent infectious bursal disease (IBD) and members of the flavivirus group including Japanese encephalitis (JE).

Methods

Animals – Cocos Island

Animal species at the Cocos (Keeling) Island group include domestic poultry and cats, feral chickens (*Gallus gallus*) and seabird colonies. The only other terrestrial vertebrates reported from the area include geckos and rabbits. Rabbits were an early introduction that disappeared from Keeling Island, however they are still known to occur on Direction Island.

At West and Home Islands, the only two islands with permanent human habitation, there were no intensive poultry farms only small backyard flocks. Domestic poultry have also been moved from Home Island, which is the Malay settlement, to numerous fishing camps on other islands within the atoll.

Feral chickens were introduced at the end of the 1800s to a number of islands but are now confined to West Island where they are plentiful and to Horsburgh Island, where there is a small remnant population.

Domestic and feral cats are found on the two human inhabited islands, and Shire policy prohibits the importation of any further cats and dogs to Cocos (Keeling).

North Keeling Island supports a significant seabird breeding population for the central-eastern Indian Ocean, with no other breeding area within a radius of 900 km. There is estimated to be about 30,000 breeding pairs of seabirds, with Red-footed Booby (*Sula sula*) the most predominant species.

Blood samples were collected from only 10 seabirds at Keeling Island. The low sample number reflects the difficulty in catching wild birds during the non-breeding season. At Home and West Islands, 32 blood samples were collected from domestic poultry, ducks and a sick Nankeen Night Heron.

Blood samples for each bird were taken from either the right jugular vein or wing vein, transferred to 5 cc tubes with serum harvested after clot retraction and centrifugation. Sera were stored at 4^0C and then -20^0C at the Animal Health Laboratory (AHL) in South Perth until serology testing was performed.

Animals – Christmas Island

Animal species at Christmas Island include domestic poultry, dogs and cats, feral chickens (*Gallus gallus*), eight species of seabird and 10 native land birds. The only other terrestrial vertebrates reported include rats, two species of bats and several native and introduced reptiles. Some 76 migratory and vagrant birds have been recorded, and two species of sparrows have established around the township. Both bats, an insectivorous and fruit bat, are endemic to the island and it is thought that they do not migrate across 360 km of Indian Ocean to Java.

Of the eight species of seabirds, three are considered endemic. These include the endangered Abbott's booby, Christmas Island Frigate bird and Golden Bosun bird. The total population of resident seabirds is estimated at 45,000 breeding pairs.

Blood samples were taken from 19 domestic chickens and one duck at the only commercial poultry farm on the island, 21 free-living nesting Brown Booby, six tame Red-footed and Abbott's Booby, rehabilitated and released, and three domestic ducks at Environment Australia. Two feral cats were shot and autopsied.

Blood samples for each bird were taken from either the right jugular vein or wing vein, transferred to 5 cc tubes and serum harvested after clot retraction and centrifugation. Sera were stored at 4^0C and then -20^0C at the Animal Health Laboratories (AHL) South Perth until serology testing was performed.

Laboratory tests used

Haemagglutination Inhibition tests (HI) for ND at AHL were performed by standard diagnostic methods using eight HA strains of ND antigen. The HI titre was recorded as the highest dilution causing complete inhibition of HA activity.

ELISA tests at AHL for AI antibody were performed using a c-ELISA for Influenza A group antigen at a dilution of 1:10. Detection of antibody to IBD virus was tested with a standard AGID test using reagents prepared at AHL South Perth.

A flavivirus ELISA is used to screen for the flavivirus serogroup antigen at the Arbovirus Research Laboratory, University of WA. Positives are then tested for antibody to the viruses of JE, MVE and Kunjin using a monoclonal antibody ELISA test. There is currently no definitive serology test for detecting JE antibodies. This is due to the close antigenic relationship between between flaviviruses in serological assays.

In Australia at present there is no specific monoclonal antibody to identify West Nile virus. However the latest virus classification has Kunjin as a variant (sub-type) of West Nile, hence serum antibodies to West Nile would be difficult to distinguish from Kunjin.

Results

Cocos (Keeling) Islands

All birds and animals examined were in good apparent health with no history of exposure to significant animal diseases.

Testing for NDV was only possible in 38 sera due to the presence of serum haemagglutins in four sera. All 38 sera tested negative for NDV antibody by HI.

Test results for AI showed that all 42 sera were negative. Antibodies for IBD were detected in 20 of 42 sera (47%) when tested by AGID. Of these 20 sera, 18 were poultry and two Red-footed Booby. Both wild bird sera were only weakly positive to IBD virus.

Results for JE and other flaviviruses from UWA are pending.

Christmas Island

All birds and animals examined were in good apparent health with no history of exposure to significant animal diseases.

Test results for NDV on 41 sera were all negative, with 8 other sera inconclusive due to the presence of serum haemagglutins. All 49 sera were negative for AI by ELISA testing.

Antibodies for IBD were detected in 8 of 49 sera (16%) tested by AGID, one of which was a Red-footed Booby with weakly positive serology results for IBD virus and the remaining seven positives were domestic poultry.

Results for JE and other flaviviruses from UWA are pending.

Samples collected from the small intestine of a feral cat autopsied were identified as the common cat tapeworm, *Taenia taeniaformis*.

Results from the examination of the internal organs of several Giant African Snails (GAS) were negative for parasites.

Discussion

The results of this survey suggest that the bird and animal populations on Christmas and Cocos (Keeling) Islands are free of target pests and diseases including the important avian diseases, Newcastle disease and Avian Influenza.

Serological testing for IBD showed that significant numbers of poultry had evidence of exposure to IBD virus, however there was no clinical evidence of hypervirulent strains of IBD. Only three seabirds had weak positive serology results for IBD. Given the widespread distribution of this virus, these findings suggest that sea birds in the region rarely have contact with poultry and other terrestrial avian species.

The risk of the seabird populations of Cocos (Keeling) and Christmas Island being exposed to significant avian diseases appears to be very low given the test results from this survey and the absence of other risk factors such as contact with other terrestrial and migratory species of birds.

Results from serological testing for JE and other flaviviruses including West Nile virus are pending completion at UWA.

The lack of other animal hosts on both islands minimises the risk of entry and establishment of a number of exotic animal pests and diseases of interest to NAQS that occur in SE Asia. This includes diseases such as foot and mouth disease, JE, a number of exotic pig diseases and surra.

Parasitological examination of specimens submitted from a cat and from Giant African Snails confirmed the presence of a ubiquitous species of tapeworm in cats that has rodents as an intermediate host, and the absence of shistomiad flukes in GAS. The GAS is known to be an intermediate host for the flukes that cause blood bilharzia in marine animals.

Botany Survey Report

Introduction

Cocos (Keeling) Islands

The flora of these islands is relatively depauperate. This is in part due to the lack of diverse habitats, the destruction of the original vegetation when the islands were cleared and planted to a monoculture of coconuts and to the recent origin of the islands. The soils are either coral clinker or coral sand. Most of the original plant species are ones normally associated with coral cays and are either spread by birds or are ocean drifters. N. Keeling is the only island in the group that has its original vegetation intact and is not heavily impacted by weeds. It is now the Pulu Keeling National Park.

There have been a number of collectors visiting the islands, the most notable of whom was Charles Darwin in 1836. Recent notable botanical collections and publications were carried out by D.G. Williams (1994) from collecting in 1986/7 and by DuPay for the Flora of Australia (1993) from collecting in 1991. This was the first weed survey of the Cocos (Keeling) islands.

Christmas Island

The original vegetation of Christmas Island was an evergreen rainforest with a dense canopy but almost no understorey. The flora is of Indo-Melanesian origin. It supports a diverse flora as it is a high island and has a diversity of habitats, It has been out of the sea for 25 million years and has a rainfall of 2000mm. Many weed species have been introduced onto the island, some as accidental introductions, others are garden escapes whilst others were introduced for mine site rehabilitation. All land clearing on the island has been associated with mining. There has never been any effective agriculture on the island although some surreptitious growing of citrus and other fruit occurs in the forest. Dave Powell, a past employee of Christmas Island Phosphate and Environment Australia (EA) made a huge contribution to the present day knowledge of the Christmas Island botany. Since the Christmas Island National Park was set up in 1980 the worst weeds in the mined areas have been steadily removed. EA commissioned a report into the weeds of the island and this resulted in the report by Swarbrick (1997). Mined areas are now being rehabilitated with native species that are sourced from the EA nursery in Poon Saan.

Objectives

. To survey the islands of the Cocos (Keeling) group and Christmas Island for species of quarantine significance to either Australia as a whole or West Australia.
. Conduct NAQS public awareness where appropriate.
. Provide botanical backup to the team's plant pathologist and entomologist.
. Collect specimens of all plants of interest to the team and identify them on site if possible or after the completion of the fieldwork.

. Make a record of the location of crop plants being grown for future planning purposes.

Methods

Survey sites were selected on the basis of the possibility of an organism being introduced into the area through frequent human activity such as tourist activity or mining. Specimens were pressed on a regular basis (approximately four times a day) and the placed in 70% alcohol. The specimens and paper were thoroughly wetted and sealed in a plastic bag. These specimens were then sealed in a second plastic bag so that they could be brought into Australia on a quarantine permit. These specimens were subsequently sterilized using gamma irradiated to insure that the seed is not viable. A separate herbarium label will be placed on all specimens to inform the users of this so they know that the specimens do not pose a quarantine risk and also do not waste others time DNA testing them.

Results

Cocos (Keeling) Islands.
A total of 40 specimens were collected. See Appendices for a list of this collection

Christmas Island
A total of 57 specimens were collected. See Appendices for a list of this collection

Discussion

Cocos (Keeling) Islands

Siam weed (*Chromolaena odorata*) was found on these islands. Siam weed is the most important tropical weed and has not yet managed to establish in mainland Australia. It is on the top of the NAQS Weeds Target List. A series of small infestations were found in the Tully area of N. Queensland in the mid 1990's and this is under eradication. During the survey of Cocos for the Flora of Australia Vol. 50 Oceanic Islands 2 in 1993 it appears this species was misidentified as *Eupatorium inulifolium*, another but less aggressive NAQS target weed. A specimen of misidentified Siam weed was collected by D.G. Williams in 1985 on West Island and he said the shrub was common then! Adding to this poor identification, the species was not described in the body of the text but was treated as a generic footnote. This led to this species being missed whilst scanning the flora for weeds. Unfortunately many botanists put little priority on weeds and try to ignore them. I think that this is the underlying cause of the Siam weed being missed for such a long time.

Siam weed is present in dense stands on Home and West Islands which was a surprise to the survey team. It was found on some of the smaller islands where there are no permanent habitations but only as one or two small plants. The difference between the islands that are

inhabited and those that are not, is that the inhabited islands have large areas of disturbed ground whilst the others do not. Siam weed is a species that thrives on disturbance, especially fire. Fortunately fire is not a regular feature of the Cocos environment as they have very wet, wet seasons and it usually rains during the dry season too. In my opinion Siam weed has not established effectively on the other islands because of this lack of recent human clearing. The old coconut plantations are immune from invasion by Siam weed because of dense vegetation, which consists of coconuts and cabbage bush and lack of fire.

In late 1998 or 1999 Horsburgh Island was burnt so as to aid the regeneration of the seedlings planted there. The vegetation was unusually dry due to the El Nino influence and so burning was possible. At the moment Horsburgh is very vulnerable to colonisation from Siam weed and it is very close to Home Island. The island should be searched on a regular basis for this weed for the next few years. Fire should not be used as a land management tool in this area in future. Also people who visit Horsburgh should practise strict quarantine on the clothes and effects taken to this island. Siam weed could easily be taken there during a visit, especially when the plant is seeding.

North Keeling National Park is not severely threatened by this weed as there have been no fires on this island and it has a complete rainforest canopy. Only if that canopy is disturbed would there be a risk of Siam seed threatening the biodiversity of this park. The only opportunity it may have is if the crazy ants affect the rainforest so badly that the trees start to die or if a severe cyclone knocks large areas of trees down. EA staff and others visiting this island should practise quarantine of their clothes and equipment to stop the accidental introduction of this weed onto this island.

I am unsure whether Siam weed can be eradicated from Cocos but I would recommend that a person who is familiar with the eradication of the weed such as Owen Zimel of DNR Queensland inspect the islands and suggest what an eradication program could cost. There is a large pool of unemployed people on Home Island that are keen to work

A small population of coffee bush (*Leucaena leucocephala*) was found around Oceania House and the adjoining foreshore. This is a noxious weed of coastal limestone areas, of which Cocos has an abundance. As there is a small population here it should be eradicated before it develops into the uncontrollable weed it is on Christmas Island. However removing the mature trees is only the first stage, as it will have produced masses of very hard seed, which will keep germinating for at least 5 years. Eradication is possible but authorities will have to be persistent to achieve it.

Grass weeds

The Quarantine Station is no longer in use. The animals housed there were provided with forage by developing pasture paddocks and provision of imported hay. The paddocks were planted with pasture grasses. The grass in the paddocks is no longer managed and was 0.8m

tall and spreading out under the fences. The following is a list of pasture grasses and weeds found around the Quarantine Station that are new records for the Cocos (Keeling) Islands.

Buffel grass	(*Cenchrus ciliaris*)
Guinea grass	(*Urochloa maxima*)
Milanje finger grass	(*Digitaria milanjiana*)
Molasses grass	(*Melenis minutiflora*)
Para grass	(*Urochloa mutica*)
Red Natal grass	(*Melenis repens*)
Rhodes grass	(*Chloris gayana*
Sabi grass	(*Urochloa mozambicensis*)
Signal grass	(*Brachiaria humidicola*)
	(*Desmanthus virgatus*

Some of these species probably came with the hay as contaminants (molasses grass) whilst others were planted. Most of these grasses have a weedy record in Australia and a small population of buffel grass was found at the market garden. We were shown a letter from Cocos Shire of March 2000 to AQIS Canberra requesting that AQIS stop these grass weeds spreading out of the Quarantine Station. The Australian Government is trying to sell this property at the moment. I would suggest that the paddocks and surrounding area are mown in the forthcoming wet season and then treated with Roundup© to kill the regrowth of these grasses. Unfortunately this treated area will be very bare afterwards and broad leaved shrubs and trees should be planted to stop the regeneration of the weeds.

The Flora of Australia Vol. 50 Oceanic Islands 2 lists witchweed, *Striga angustifolia* as being present on Home Island. This is a NAQS target species and is the first record of this anywhere in Australia. It was collected on the western boundary of the Quarantine Station. Part of this western boundary is a densely grassed paddock. The other half of this western boundary consists of a fence grown over with an impenetrable 3m tall mass of Siam weed and cabbage bush. I could not find *Striga angustifolia* in the grassed area and could not look in the other. I hope it has disappeared forever but a lookout should be kept for this species' reappearance.

Ipomoea obscura was found on Home Island. It is a new record of this weed on Cocos. It is a serious weed in Thailand and is a possible candidate for a revised NAQS Weeds Target List. It probably came from Christmas Island where it is common.

The Home Islanders have weekend cottages or pondoks on the smaller islands. Each of these pondoks has a considerable population of semi feral chickens. These obtain water from large utensils that harvest rain, and food from what they can forage for, plus chopped up coconuts that the owners cut up on their visits. The land surrounding these pondoks is bare for about 300m except for coconuts. There is no undergrowth and the chickens suppress any regeneration of everything except coconuts. If the vegetation of these islands were to be

returned to their original composition these large populations of chickens would have to be reduced

Christmas Island

Mile a minute (*Mikania micrantha*) is common in forest margins on the north side of the island. It festoons the trees and shrubs on the road margins from the settlement to the Pink House and to the Dales and is very common around Grants Well. It could not be easily eradicated from the island. It is easy to justify its place on the NAQS Weeds Target List. This species was being severely attacked by leaf eating caterpillars during our survey.

Lesser Malayan stinkwort (*Paederia foetida*) is a perennial vine and was present behind Drumsite and at Grant's Well. It may be present elsewhere, as it is relatively hard to see from a car. It too smothers low trees and shrubs and can grow up to 10m or perhaps more. It has fruit that birds eat and so distribute the seed and this enables this species to spread quickly. I was surprised that Swarbrick did not devote any space to this species as it as bad as mile a minute in its smothering effects.

Amaranth (*Amaranthus dubius*) was seen in very scattered populations in disturbed situations. It should be taken off the NAQS Weeds Target List as we have never seen it as a serious weed anywhere in the region.

Fringed spider flower (*Cleome rutidosperma*) was seen in scattered populations in disturbed areas where it was a minor weed. This species is in the 'very serious threat category' with Siam weed and mile a minute on the NAQS Weeds Target List. Its recent appearance in Darwin and aggressive behaviour here suggests that this species prefers habitats that have less than 2000mm rainfall with distinct dry seasons.

Piper aduncum is a tall invasive shrub that is on the NAQS Weeds Target List. It is in the 'posing a threat category'. About 20 plants were found near the market garden. In lowland PNG it is the major weed of slash and burn agriculture. In my opinion it is a 'sleeper' weed here and should be eradicated whilst it is possible.

Physic nut (*Jatropha curcas*) was found in a small population behind Drumsite. It is a weed elsewhere in the world. It is another 'sleeper' weed that should be eliminated whilst this is still possible.

We made a serious attempt to find *Mucuna albertisii* but were unsuccessful due to what must have been very effective control measures against this species. During this search we saw large areas of an old regeneration area (ML111) that had been taken over by calopogonium (*Calopogonium caeruleum*). This species is growing up to the tops of mid sized trees and weighing their canopies down and is in my opinion a threat to the regeneration of forest where it occurs.

Cow itch (*Mucuna pruriens*) was found adjacent to the chicken farm at 'The Settlement'. There were perhaps 2 plants. I somehow managed to get some of its irritant hairs on my hands even though I did not handle any pods directly. This caused me some distress! This species is on the NAQS Weeds Target List as a species 'posing a serious threat'. Its position is justified and this species is currently in low numbers and should be eradicated.

Erect boerhavia (*Boerhavia erecta*) is a NAQS Weeds Target Listed species. It is in 'posing a threat category' and is a weed of roadsides and waste places. It spreads aggressively. A population of about 20 plants was found near Gordon Bennett's tomb. A more thorough survey of the area needs to be conducted and if the population is low, this species should be eradicated.

Coffee bush (*Leucaena leucocephala*) is the major weed of disturbed situations on Christmas Island. It does not serve a useful purpose here and biological control agents should be introduced to try and minimise its huge impact.

Itch grass (*Rottboellia exaltata*) was present in very low populations at the Casino and because it is such an anti social obnoxious weed it should be removed whenever possible to eradicate it from the island.

Ipomoea obscura is a major weed of roadsides on the island and it is not listed as an introduction in the Flora of Australia. Be that as it may, it is a serious weed here and in Thailand where it impacts on low plantation and annual crops. I think this species should be considered for addition to the revised NAQS Weeds Target List.

Cordia curassavica is a mid-shrub with seeds that are bird distributed. It has been very invasive on Christmas Island. In disturbed situations where there is no upper storey, this weed is always present. This species should be considered for addition to the revised NAQS Weeds Target List.

Madras thorn (*Pithocellobium dulce*) has a weedy reputation and a small patch of this species is adjacent to the water tanks at Poon Saan. This species should be eradicated as it is possible to do this at the moment. This species is worth considering for the revised NAQS Weeds Target List.

Clausena (*Clausena excavata*) is a 10m tree that was introduced onto Christmas Island for unknown reasons but where it has become a serious weed. It should be considered for the revised NAQS Weeds Target List.

Feral fruit trees

Japanese cherry (*Muntingia calabura*), papaya (*Carica papaya*) and guava (*Psidium guajava*) have become serious weeds on the island. They are found along all the major and minor tracks were there has been regrowth. They are probably the main hosts of fruit fly. Various species of citrus are found on the island but these are tended by locals. Most have probably been planted.

References

Flora of Australia Vol. 50 Oceanic Islands 2 Australian Government Publishing Service, Canberra (1993)

Swarbrick, J.T. Environmental weeds and exotic plants on Christmas Island, Indian Ocean. A report to Parks Australia. (1997)

Williams, D.G. Vegetation and flora of the Cocos (Keeling) Islands.. Atoll Research Bulletin No 404. Chapter 6. Issued by the National History Smithsonian Institution Washington USA (1994)

Entomology Survey Report

Introduction

The insect fauna of Christmas and the Cocos (Keeling) Islands has been surveyed sporadically over the past 100 years (see CSIRO 1990, Campbell 1966). The relative lack of an agricultural service on these islands, due in part to a lack of commercial agriculture, has resulted in an incomplete knowledge of the pest fauna present. In fact, only one survey for such pests has been undertaken on Christmas Is (Campbell 1968) and 2 on the Cocos (Keeling) Islands (Campbell 1952; 1966).

Objectives

- survey for plant pests of quarantine significance
- collect specimens of NAQS targeted pests and other pest insects for reference collections

To document the pest status of plants of economic or other importance

Methods

A representative number of important plant species at each site were examined for plant pests. Particular attention was given to searching for NAQS targeted species and collection methods that maximise the chances of detecting these pests were employed. This included sweep netting foliage and inflorescences and examining foliage and fruit for insect damage. Specimens of targeted, known and unknown pests were taken for subsequent identification and lodgement in the NTDPI&F entomology museum.

Insects causing damage to host plants or their fruit were collected. Insects observed in large numbers on a host were also collected on the presumption they were feeding on the host. Attempts were made to gauge the infestation levels and damage caused by all pests collected but this proved difficult for many of the specimens. Some information on the status of pests was obtained from local people but the lack of an official body responsible for agriculture made the task of assessing the status and date of initial incursion of pest fauna difficult.

People living at sites visited were asked about the health of their plants and their awareness of quarantine issues. Where possible, advice on particular plant health problems being experienced was given.

Soft bodied and extremely small insects were collected into 70% ethanol. Large, hard bodied adults were killed by freezing and subsequently pinned and preserved with naphthalene. Immature stages, including galls suspected of being caused by insects, were collected live into sealed plastic bags with sufficient host material to allow these insects to complete their life cycle. Representatives of these immature stages were also preserved in 70% alcohol. Any immature specimens that had not completed their life cycle by completion of the survey were preserved in 70% alcohol.

Honey bees: Honey bees were collected opportunistically at flowers and samples of brood were examined wherever possible for parasitic mites.

Fruit Flies: A set of 3 Steiner traps (Trimedlure, ME and CUE lure) were run on Home and West Islands in the Cocos (Keeling) Is and at the Research Station, Drumsite, Grant's Well, the Dales and at the market garden on Christmas Island. Specimens of infested fruit were also collected. Larvae from infested fruit were killed in hot water and preserved in 70% ethanol.

Biting midges: A mini-light trap was set in proximity to poultry, for at least one night on West and Home Islands in the Cocos (Keeling) Is and at the Research Station (in rainforest) and at the poultry farm in Settlement on Christmas Island. Specimens collected were preserved in 70% ethanol.

Results

Targeted Pests

Christmas Island

Giant African snails (*Achatina fulica*) were seen in a wide range of habitats and appeared to be well established.

Aleurocanthus woglumi (citrus blackfly) was commonly found on the underside of citrus leaves throughout the island but rarely in high infestations. One lime tree in Silvertown was heavily infested with both sooty mould and *A. woglumi* but with few other homopterous pests. This insect is generally associated with leaves but can also infest fruit and this is the most likely means by which it arrived on Christmas Is.

The lack of mango fruit on trees prevented their collection for examination for presence of *Deanolis sublimbalis* (red-banded mango caterpillar).

Although no-one knew of any bee keepers on the island, specimens of European honeybee, *Apis* mellifera, presumably from a feral nest, were collected foraging at flowers in Drumsite. Parks Australia rangers had also collected one specimen in rainforest on the western side of the island. No other honeybees were seen. As the nest of these bees was not located it was not possible to examine brood for parasitic mites.

No targeted *Culicoides* sp. were collected in any of the light traps.

Cocos (Keeling) Islands

No specimens were collected of *Oryctes rhinoceros* but this pest is well known from these islands (Campbell 1966) and the characteristic damage it causes to coconut fronds was common. No other targeted pests were collected.

Fruit flies

Christmas Island

The trap baited with trimedlure yielded no flies at any site suggesting that medfly, *Ceratitus capitata*, is not present. This species is present in Perth from where much fresh fruit and vegetables are imported to Christmas so it is a little surprising that the fly has not also been imported.

The identity of the most populous fruit fly on the island is yet to be confirmed but is either *Bactrocera frauenfeldi* or its Asian equivalent *B. albistrigata.* The latter species is very common in Indonesia while *B. frauenfeldi* has not been recorded west of Papua New Guinea so *B. albistrigata* is the more likely candidate. The huge populations of this fly, many thousands per trap, are suggestive of it being a recent introduction. These species breed in a relatively narrow range of fruits – *Syzygium* sp. and *Terminalia cattapa*, (both species) and breadfruit (*Artocarpus artilis)*, mango (*Mangifera indica), Manilkara kauki* and guava and possibly also banana and papaya (*B. frauenfeldi* only). *Syzygium* sp. were quite common in disturbed areas all over the island providing a plentiful supply of breeding material.

A species of fruit fly belonging to the dorsalis complex, probably papaya fruit fly *B. papayae*, was common in all traps with up to 100 individuals in a single collection. This fly was present in rainforest near the Dales, relatively distant from human habitation, indicating that it was surviving away from horticulture which is contrary to the behaviour of this species in Queensland. The presence of many feral guava, japanese cherry, citrus and papaya plants along roadsides, however, may provide sufficient breeding material to allow these populations to exist without relying on native fruit.

A single specimen of jackfruit fly, *B. umbrosa* was collected and one other was seen on a trap. Melon fly, *B. cucurbitae*, was similarly uncommon and collected only from the market garden and at Flying Fish Cove although all cucurbit fruit seen growing on the island had been bagged, presumably as protection from this fruit fly. This is the only species previously recorded from the island (Campbell 1968) so the others are likely to have arrived since the last survey in 1964. Three "*Dacus* spp." fruit flies were collected during the CSIRO survey in 1990 and although their specific identity is yet to be confirmed it is likely they belong to three of the species collected during this survey

Two collections were made of infested fruit; one from a feral papaya fruit near South Point and one from a carambola in Drumsite. These are yet to be identified but are both likely to be *B. ?papayae* as the other species do not usually breed in these hosts.

The 4 species collected on Christmas Is are the most common fruit flies in festing commercial fruit in Java and with the volume of imported fruit and vegetables from Jakarta it is not surprising that these species have also been imported. The reason medfly has not been imported from Perth remains uncertain but stricter packing regimes in Perth or unsuitable medfly habitat on the island may offer some explanation.

Cocos (Keeling) Islands

No fruit flies were collected in traps set on Home Is or at the market garden on West Island.

Other Pests

A total of 73 and 63 collections were made from Christmas Is and the Cocos (Keeling) Islands respectively during this survey. Many of these specimens are yet to be identified, but it is not anticipated that there will be any further findings of targeted species.

Christmas Island

The banana stem weevil, *Cosmopolites sordidus*, was collected from banana corms at Flying Fish Cove and at the market garden in reasonably high numbers. This species can be a serious pest of bananas and is widely distributed in banana plants in Asia and Australia. Neither Campbell (1968) nor CSIRO (1990) make mention of this weevil on the island suggesting a

relatively recent introduction. The cryptic habits of this weevil (all stages live inside banana corms) mean that a dedicated effort is required to detect its presence and this may have been beyond the scope of the more recent survey and consequently overlooked.

Several specimens of fruit piercing moth (*Eudocima ?fullonia*) were collected at light and feeding on a rotting guava fruit at the research station. These moths breed on vines belonging to Menospermaceae of which 2 species are naturally occurring on Christmas Island so it is possible these moths are also native. There are several species of fruit piercing moth, including *E. fullonia*, on mainland Australia. Much of the citrus fruit damage attributed by locals to fruit fly was in fact due to the feeding of this moth.

The banana aphid *Pentalonia nigronervosa* was collected from young banana plants at the market garden. Some of these plants were exhibiting deformed leaves possibly from a result of aphid attack or, more likely, infection with cucumber mosaic virus.

The occurrence of crazy ant, *Anoplolepis gracilipes*, on Christmas Is and its effect on the environment are documented (O'Dowd et al 1999). The distribution of this ant was patchy and did not appear to adversely affect horticultural plants on the island possibly because it was more abundant in native vegetation.

The larvae of a pyralid moth was collected defoliating the serious weed *Mikania micrantha*. These were successfully reared to adult and may have potential as a biocontrol agent for this weed.

An undescribed species of *Culicoides* belonging to the Shermani group was collected at the poultry farm in Settlement and in native vegetation near the research station. This species is not known from SE Asia nor from Australia and is therefore likely to be endemic to Christmas Is. Species belonging to this group are not known as vectors of any disease.

Cocos (Keeling) Islands

Banana stem weevil was collected from the corm of a fallen banana plant at the market garden on West Island. Many of the plants seen on Home Is were propped up to prevent them falling over and this is likely due to infestation by this weevil although no weevils were collected from this island. Burrowing nematode damage was also observed at the market garden on West Is and may be responsible for the falling plants on Home Island. Campbell (1966) makes no mention of this weevil on these islands, suggesting it has arrived since that time.

A woman growing sugarcane on Home Island was asked about borers. She said that borers were present there some time ago but now had disappeared. No evidence of borers was seen in any plants inspected. Campbell (1966) makes no mention of sugarcane borers on these islands.

The buprestid citrus borer, *Agrilus marmoreus* Deyrolle, "occurred commonly on lime trees" on Home Island in 1952 and again in 1964 (Campbell 1966). No evidence of this insect was seen during this survey.

Crazy ant, while present in the Northern Territory, is regarded as an important quarantine pest and this ant was present on all islands visited, including North Keeling Island.

The Asian tiger mosquito, *Aedes albopictus*, was ubiquitous on all islands visited, even uninhabited ones. This vector of dengue and yellow fever is exotic to mainland Australia and is the target of a national monitoring program at all sea ports.

Two European honey bee hives were being managed on the market garden on West Is. One of these had been disturbed just prior to this survey and consequently had absconded. Approximately 100 brood cells were collected from the remaining hive and these were examined for parasitic mites. None were seen.

The larvae of a pyralid moth was collected defoliating the serious weed *Chromalaena odorata*. These were successfully reared to adult and may have potential as a biocontrol agent for this weed.

No *Culicoides* sp. were collected in either light trap collection set near poultry on Home Is and on West Is.

Discussion

Christmas Island

A significant number of NAQS targeted organisms and non-targeted but important species were observed during this survey. Clearly Christmas Island contains a range of pests exotic to mainland Australia and this combined with regular air traffic to Perth emphasises its strategic importance to mainland Australian quarantine.

It is difficult to ascertain the likelihood of insect pests reaching northern Australia from Christmas Is. There is considerable circumstantial evidence to suggest that some insects, for example *Culicoides* sp., have arrived in the NT from Indonesia as aerial plankton (Dyce 1982) and that exotic viruses transmitted by these insects have been introduced in the same manner (Gard and Melville 1989). Whether this means of dispersal is available to other insects is unknown although it has been suggested that the leucaena psyllid, *Heteropsylla cubana*, and the mango leafhopper *Idioscopus nitidulus* arrived in the NT as aerial plankton presumably from nearby islands in Indonesia. It is therefore conceivable that other pests with a similar behaviour, body shape and size to these, along with any diseases they may carry, could also arrive in this manner.

The suite of pests on Christmas Is is a subset of that in Indonesia and therefore poses no greater risk to mainland Australian quarantine than Indonesia. Christmas Is is, in fact, geographically more distant from mainland Australia than most of Indonesia and is not a source of illegal fishing or immigrant vessels to the mainland and consequently presents a lower risk pathway for incursions of this nature than most parts of Indonesia.

The introduction of pests from Christmas Is via authorised air or sea craft is controlled by AQIS border operations and the risks should not differ to those posed by other origins.

The paucity of surveys of this type from Christmas Is make it difficult to estimate the potential for movement of pests from western Indonesia to Christmas Is. The presence of pest fruit fly species which are common in Java, in particular the apparent recent introduction of *Bactrocera ?albistrigata*, would suggest that a pathway for introduction of fruit-infesting pests via imported fruit from Java exists and that other pests may eventually make their way to Christmas Is. The presence of tramp organisms such as giant African snail and crazy ant and of less mobile, non-fruit-infesting pests such as banana stem weevil is also indicative of a pathway for such pests to arrive. A potential pathway for entry of pests from Perth also exists although there was no evidence that any pests have arrived in Christmas Is from Perth. It is possible that pests do arrive from Perth but are unable to establish due to the very different climatic conditions between Perth and Christmas Is.

The only insect recorded from the Cocos (Keeling) Islands that has not also been recorded from Christmas Is is the coconut rhinoceros beetle *Oryctes rhinoceros*. This species is common throughout the Cocos (Keeling) Islands (Campbell 1966) but is not very likely to hitch a ride to Christmas Island on the weekly passenger flight.

There is little commercial agriculture practised on Christmas Is. A number of householders grew vegetables and fruit trees in their yards and there is one market garden producing a variety of fruit. The presence of a range of significant pests is already causing problems for these people and the proposed plans of the island's administration to increase agricultural production will need to consider pest control and quarantine issues. In particular, papaya fruit fly will need to be controlled or eradicated. Eradication of this and the other fruit fly species would be difficult and expensive but not impossible. There are several people in both QDPI, AgWA and NT DPI&F with experience in eradicating fruit flies who could be approached for an estimate of costs. Eradication should not, however, be considered until appropriate measures are taken to prevent re-introduction.

Despite the presence of the more common fruit-infesting pests from Java on Christmas Is, there are still sufficient serious pest species in Java and Perth that have not yet arrived on Christmas Is to warrant implementing measures to prevent their entry.

Cocos (Keeling) Islands

By comparison with Christmas Island, these islands are relatively free of pests, particularly targeted species and species exotic to the mainland Australia. These islands are very remote from the Australian mainland so the chances of natural spread of insects to the mainland is low. The introduction of pests from these islands via authorised air or sea craft is controlled by AQIS border operations and the risks should not differ to those posed by other origins.

The Cocos (Keeling) Islands are vulnerable to incursions from a variety of sources including Christmas Is, Perth and, to a lesser extent, from other countries in the region. It is probably too remote from any of these places to receive pests by natural dispersal but traffic from illegal immigrants, aircraft from both Christmas Is and Perth, and especially yachts as these islands are visited by the majority of yachts travelling across the Indian Ocean.

There is little commercial agriculture practised on these islands. A number of householders grew vegetables and fruit trees in their yards and there is one market garden producing a variety of fruit and vegetables on both Home and West Islands. Nevertheless, these market gardens provide an important source of affordable fresh fruit and vegetables to the residents of these islands and consequently warrant protection of the relatively pest-free status they currently enjoy.

Results still pending

Many insect specimens, including the specific identity of some of the trapped fruit flies, await identification. These will be completed in due course and a supplementary report will be produced.

References

Campbell TG (1966) Entomological survey of Cocos (Keeling) Islands with special reference to the insects of medical, veterinary, agricultural and forestry significance. CSIRO Division of Entomology Unpublished Report, 32 pp.

Campbell TG (1968) Entomological survey of Christmas Island (Indian Ocean) with special reference to the insects of medical, veterinary, agricultural and forestry significance. CSIRO Division of Entomology Unpublished Report, 48 pp.

CSIRO (1990) CSIRO Entomological survey of Christmas Island. Unpublished Phase 2 report ANPWS Consultancy Agreement. 67 pp.

Dyce AL (1982) Distribution of *Culicoides* (Avaritia) spp. (Diptera: Ceratopogonidae) west of the Pacific Ocean. In *Arbovirus Research in Australia – Proceedings of the 3rd symposium,* pp 35-43.

Gard GP and Melville LF (1989) The evolution of bluetongue in Australia. In *Arbovirus Research in Australia – Proceedings of the 5th symposium,* pp 303-305.

O'Dowd D, Green PT, Lake PS (1999) Status, impact and recommendations for research and management of exotic invasive ants in Christmas Island National Park. Unpublished report commissioned by Parks Australia North.

Plant Pathology Survey Report

Introduction

Cocos (Keeling) Islands

There are no published lists of plant diseases available for Cocos island and little is known of the plant health status of the Cocos (Keeling) Island group. With the importation of labour from the Malay Archipelago during the period when the islands were operated as a coconut plantation by the Clunies-Ross family the possibility that exotic plant pathogens were imported on soil and propagating material is high.

Christmas Island

There have been few (one?) surveys of plant pathogens of Christmas Is. The lack of commercial agriculture on the island and consequent lack of an agricultural service partially explains the dearth of information on plant health. With its proximity to Java and constant importations of fruit and vegetables from Jakarta and Perth via air, the probability of an incursion by an exotic pathogen is high. This is evident by the presence of citrus canker (*Xanthomonas axonopodis* pv *citri*) on the island, Shivas (1987).

General

Several important crop species are grown on these islands so knowledge of the plant pathogens affecting these plants has relevance to mainland Australian quarantine as they may provide a possible stepping stone for introduction to the mainland. Although most of the food consumed on these islands is imported, the crops grown there form an important source of fresh and affordable food and the introduction of pathogens of bananas and citrus in particular could have a marked effect on the island communities.

Objectives

1. Survey sites containing commercial plant species in the area for the presence of exotic plant diseases.
2. Document the occurrence and pest status of commercial plant species in the survey area.

3. In the absence of commercial plant species, examine native plant and weed hosts were examined for diseases.
4. Enhance quarantine awareness and provide disease control options where warranted amongst inhabitants of the survey area.

Methods

People living at the survey sites were asked about the health of their plants and given a brief overview of the NAQS project and why we were present. If possible advice was given on particular issues or contacts provided of people who could provide such advice.

At each site a representative sample of plants of commercial significance were thoroughly examined for the presence of plant diseases. Using a hand lens specimens were examined for signs of the disease for preliminary diagnosis prior to collection. In the absence of commercial plant species native plant and weed hosts were examined in the same manner and specimens collected. All aboveground plant parts were examined and in the case of displaying disease symptoms with no obvious aboveground signs the roots of were examined. Specimens showing symptoms of infection with viruses, citrus greening or phytoplasma were finely chopped and dried in sealed vials over calcium carbonate. All other specimens were dried in a plant press.

Specimens were imported into Australia under AQIS permit number 200001915 and were declared and inspected at Perth Airport by Western Australian Quarantine staff upon arrival.

Prior to examination in the laboratory all dried herbarium specimens were gamma irradiated at 25 KGY by Steritech, South Gippsland Highway Dandenong, Victoria.

Dried specimens were examined under a stereomicroscope for disease signs and microscope slides were made of fruiting bodies. Dried specimens will be lodged with Dr Roger Shivas at the QDPI Herbarium in Brisbane with the Department of Conservation and Land Management Herbarium in Perth.

Samples showing phytoplasma-type symptoms were sent to Dr. Karen Gibb at the Northern Territory University (NTU) for testing and samples showing viral-type symptoms were sent to Dr John Thomas at the Department of Primary Industries Queensland (DPIQ) at Indooroopilly. A citrus sample with symptoms of Citrus Greening was sent to Sarah Jacobsen, NAQS Mareeba. Fresh samples of leaves with suspected citrus canker, *Xanthomonas axonopodis* pv. *citri*, were airfreighted to the Plant Quarantine Station at Eastern Creek for analysis by Dr. Deborah Hailstones from Agriculture New South Wales (AgNSW). All samples were transferred under AQIS permit. Rex Pitkethley, Barry Conde and Andrew Daly from NTDPIF also provided assistance in disease identification.

Results

Cocos (Keeling) Islands

A total of 31 suspected plant disease samples were collected from the Cocos (Keeling) Islands (see appendices). Currently 13 of the causal agents have been identified, 14 identifications are pending and the remaining 4 specimens could not be identified. None of the pathogens identified is of quarantine significance and none remaining specimens are suspected of being of quarantine significance.

Christmas Island

A total of 40 suspected plant disease specimens were collected from Christmas Island (see appendices). Currently 30 of the causal organisms have been identified, 8 identifications are pending and 2 specimens could not be identified. Four samples of the targeted disease citrus canker were collected from 2 different sites. Confirmation of the identity of this pathogen was by Dr. Deborah Hailstones AGNSW. None of the remaining specimens are suspected of being of quarantine significance.

Discussion

Cocos (Keeling) Islands

Agriculture on the settled islands consists of small garden plots on Home Island with some fruit trees planted around houses, while West island supports a semi commercial farm with the occasional domestic planting. All of the plant diseases collected on agricultural crops are common diseases and for most of them no controls are warranted.

The majority of agricultural plants on the island were examined for the presence of pathogens. With the poor quality soil of the island the majority of problems appeared to be nutritional. Citrus trees are reasonably common and quarantine protocols currently in place at the Cocos (Keeling) Island airport should be increased to prevent the spread of citrus canker from Christmas to the Cocos (Keeling) Island.

At the West Is market garden, root samples from banana were examined and the presence of burrowing nematode (*Rhadophilis* sp.) was determined on symptoms only. Symptoms of this nematode are quite distinct and a reasonably reliable method of identification ((Jones, 2000). Due to the problems with importing fresh root specimens to Australia no specimens were collected for positive identification. The nematode weakens the root system and causes the plants to blow down in windy weather. This is possibly the worst plant pest on the islands which in conjunction with the banana weevil borer has the ability to greatly reduce plant productivity. Control of the nematode is not usually practiced in small holding situations due to the expense of the required treatments but it may be warranted in the West Is market garden.

Coconut plants on all islands were examined for signs of the targeted disease coconut cadang-cadang viroid but no symptoms of the disease were seen.

Christmas Island

Agriculture on Christmas Island consists of small garden plots around the settlements. A small market garden has previously operated, but is currently inoperative. An area has been set aside near the market garden for future horticultural development. The island inhabitants also have small plots, mainly containing fruit trees, scattered throughout the rest of the island, many of which may be now abandoned.

The presence of citrus canker (*Xanthomonas axonopodis* pv. citri) confirms Shivas (1987). Discussions with island residents and during the most recent Western Australia Joint Operations Group meeting suggested that there had been an attempt to eradicate this disease by burning the tree at the original infestation site however this was unsuccessful. With citrus trees dispersed widely over the island and many in small plots hidden away in the rainforest it would be difficult to eradicate the pathogen from the island. An infestation at the Parks Australia nursery on seedling lime trees destined for transplant is of concern. The second site on the road to the Dales is a tree well known by local residents with fruit from the tree often moved around the island. Fresh specimens suspected of being infected with the disease were imported as dried samples and samples stored in bacterial lysate medium have proven to give false negative results (Dr. D Hailstones, pers. comm.)

Three strains of the pathogen are recognised and bacterial lysates from the specimens will be DNA fingerprinted by Dr. Deborah Hailstones to determine strain identity. As the host species was lime, it is likely to be the most virulent strain, which is common in Asia and is of most concern to Australia (AQIS Plant Quarantine Fact Sheet No. 12).

No other pathogens of quarantine significance were detected. The majority of powdery mildew species have been identified only as *Oidium* sp., as none of the sexual stages of the pathogens were found. Specimens CI125b, 126, 127 are most probably *Sphaerotheca fusca*, a very common powdery mildew disease.

All other pathogens collected are only of minor importance with control not warranted in commercial or home garden situations.

Citrus exocortis viroid was diagnosed on symptoms only from a single tree at Grant's Well. This disease is found in most citrus growing areas and is only apparent on trees grafted on to trifoliate orange or citrange rootstocks. Trees become stunted and the presence of the virus denoted by cracking and scaling of the bark below the bud union. The virus is graft transmissible and tree removal or replacement is the only control option (Persley, 1993, Browning et al, 1995).

A banana sucker showing the symptoms of cucumber mosaic virus or infectious chlorosis was found at the market garden. The plant exhibited typical symptoms of the severe strain of the disease, including necrosis of the cigar leaf and pronounced deformation of older leaves. The disease is transmitted by aphids from alternate hosts and is more of a problem in juvenile and replant situations. The disease is ubiquitous and is not regarded as a quarantinable pathogen. Aphids collected on the plant were *Pentalonia nigronervosa,* which is not a vector of the disease, however the disease is transmitted by approximately 60 species of aphids which are only transitory on banana plants. (Persley, 1993, Jones, 2000, Dr. J. Thomas pers. comm.). Unfortunately no specimens were collected to confirm the disease identity.

Anecdotal evidence from gardeners and local people suggested that root knot nematode (*Meloidogyne* sp.) was a severe problem on the island. Several root specimens of tomato, a very susceptible crop, were examined however no signs of root knot nematode were found.

General

The majority of the plant pathogens on the NAQS target list are already present in Indonesia (Centre for Plant Quarantine, Indonesia, 1997). Currently fruit and vegetables are flown into Christmas Island from Jakarta which provides a direct pathway for the introduction of exotic plant pathogens. Although not all hosts on the target lists are grown on the islands surveyed severe diseases of banana, citrus, sugarcane, maize and coconut, all of which are important plants on the islands, could be introduced by this pathway. With the islands mainly dependant of fresh fruit and vegetable supplies from Perth there is also the possibility that plant diseases present in Western Australia may be introduced into Christmas and Cocos (Keeling) Islands.

Although by no means exhaustive, the survey provided an opportunity to update the current published lists of the fungal flora and plant pathogens for Christmas Island (Shivas, 1987, Shivas and Hilton, 1990 and Reid, 1969) and to compile the first plant disease index for the Cocos (Keeling) island group.

References

Australian Quarantine and Inspection Service, Plant Quarantine fact Sheet No. 12 Citrus Canker

Browning, H.W., McGovern, R.G., Jackson, L.K., Calvert, D.V. and Wardowski, W.F. (1995) Florida Citrus Diagnostic Guide. Florida Science Source Inc. Forida.

Centre for Agricultural Quarantine, Indonesia. 1997 draft. List of important plant pests already reported in Indonesia.

Jones, D.R., ed. (2000) Diseases of Banana, Abaca and Enset. CAB International, London.

Persley, D., ed. (1993) Diseases of Fruit Crops. Queensland Government Press, Brisbane.

Reid, D.A., (1969) A list of the Fungi collected from Christmas Island (Indian Ocean) by D.A. Powell in Shivas (1990)

Shivas, R.G., (1987). Citrus Canker (*Xanthomonas campestris* pv. *citri*) and Banana Leaf Rust (*Uredo musae*) at Christmas Island, Indian Ocean. Australasian Plant Pathology 16:38-39.

Shivas, R.G., and Hilton, R.N., (1990) Collections of Fungi from Christmas Island, Indian Ocean. Kingia 1 (3): 295-301.

Appendices

BOTANY

Cocos, Keeling Group

During the survey 40 plant specimens were collected and are as follow:

Collector	No	Species name	Location	Weed	Importance
A.A. Mitchell	6205	*Lepturus xerophilus*	N. Keeling	No	Endemic sp
A.A. Mitchell	6206	*Canavalia cathartica*	N. Keeling	No	Endemic sp
A.A. Mitchell	6207	*Achyranthes aspera*	N. Keeling	No	Endemic sp
A.A. Mitchell	6208	*Dicliptera ciliata*	N. Keeling	No	Endemic sp
A.A. Mitchell	6209	*Stenostaphrum micranthum*	N. Keeling	No	Endemic sp
A.A. Mitchell	6210	*Boerhavia albiflora*	N. Keeling	No	Endemic sp
A.A. Mitchell	6211	*Paspalum vaginatum*	N. Keeling	No	Endemic sp
A.A. Mitchell	6212	*Triphasia trifoliata*	N. Keeling	Yes	Minor weed
A.A. Mitchell	6213	*Acalypha sp.*	N. Keeling	Yes	Minor weed
A.A. Mitchell	6214	*Euphorbia chamaesyce*	Oceania Hous	Yes	Endemic sp
A.A. Mitchell	6215	*Ipomoea obscura.*	Oceania Hous	Yes	Major weed
A.A. Mitchell	6216	*Psidium strawberry guava*	Oceania Hous	No	Hortic. sp
A.A. Mitchell	6217	*Acalypha indica*	Oceania Hous	Yes	Minor weed
A.A. Mitchell	6218	*Sporobolus fertilis*	Oceania Hous	Yes	Minor weed
A.A. Mitchell	6219	*Zephyranthus rosea*	Oceania Hous	Yes	Minor weed
A.A. Mitchell	6220	*Clerodendron sp.*	Oceania Hous	Yes	Minor weed
A.A. Mitchell	6221	*Kyllingia polyphylla*	Oceania Hous	Yes	Mod. weed
A.A. Mitchell	6222	*Abutilon sp.*	Oceania Hous	No	Endemic sp
A.A. Mitchell	6223	*Chromalena odorata*	Market garden	Yes	Major weed
A.A. Mitchell	6224	*Lagenaria siceraria*	Market garden	No	Hortic. sp
A.A. Mitchell	6225	*Cenchrus ciliaris*	Q Station	Yes	Major weed
A.A. Mitchell	6226A	*Chloris gayana*	Q Station	Yes	Mod. weed
A.A. Mitchell	6226B	*Digitaria milanjiana*	Q Station	Yes	Mod.? weed
A.A. Mitchell	6227	*Brachiaria humidicola*	Q Station	Yes	Mod. weed
A.A. Mitchell	6228	*Melinis repens*	Q Station	Yes	Major weed
A.A. Mitchell	6229	*Desmanthus virgatus*	Q Station	Yes	Minor weed
A.A. Mitchell	6230	*Breynia disticha*	Q Station	Yes?	Hortic.plant
A.A. Mitchell	6231	*Lepidium virginicum*	'The Farm'	Yes	Minor weed
A.A. Mitchell	6232	*Conyza bonariensis*	'The Farm'	Yes	Minor weed
A.A. Mitchell	6233A	*Cynodon arcuatus*	'The Farm'	Yes	Mod?. weed
A.A. Mitchell	6233B	*Hippobroma longiflora*	'The Farm'	Yes	Poisonous
A.A. Mitchell	6234	*Zoysia matrella*	Pistol Range	Yes	Minor weed
A.A. Mitchell	6235	*Urochloa mutica*	Q Station	Yes	Major weed
A.A. Mitchell	6236	*Melenis minutiflora*	Q Station	Yes	Major weed
A.A. Mitchell	6237	*Urochloa mosambicensis*	Q Station	Yes	Mod. weed
A.A. Mitchell	6238	*Algae sp.*	West Is.	Yes	Minor weed
A.A. Mitchell	6239	*Ischaemum muticum*	Pulu Luar	Yes	Mod.? weed
A.A. Mitchell	6240	*Ipomoea obscura*	Pulu Luar	Yes	Major. weed
A.A. Mitchell	6241	*Heteropogon contortus*	Pulu Luar	Yes	Mod. weed
A.A. Mitchell	6242	*Chromalaena odorata*	West Is	Yes	Major weed

Christmas Island

During the survey 55 plant specimens were collected and are as follow:

Collector	No	Species name	Location	Weed	Importance
A.A. Mitchell	6243	*Cordia curassavica.*	S. Point	Yes	Major weed

A.A. Mitchell	6244	*Pipterus argentus*	S. Point	No	Endemic sp.
A.A. Mitchell	6245	*Urena lobata*	Nr. Blowholes	Yes	Mod. weed
A.A. Mitchell	6246	*Asystasia gangetica*	Settlement	Yes	Mod. weed
A.A. Mitchell	6247	*Datura sp*	Lily Beach	Yes	Minor weed
A.A. Mitchell	6248	*Asystasia sp.*	Chicken Farm	Yes	Mod. weed
A.A. Mitchell	6249	*Mucuna pruriens*	Chicken Farm	Yes	Major weed
A.A. Mitchell	6250	*Canavalia sp.*	Settlement	No	Endemic sp.
A.A. Mitchell	6251	*Sporobolus fertilis*	Settlement	Yes	Minor weed
A.A. Mitchell	6252	*Digitaria sanguinalis*	Fly Fish Cove	Yes	Mod. weed
A.A. Mitchell	6253	*Cayratia pedata*	Fly Fish Cove	No	Endemic sp.
A.A. Mitchell	6254	*Clausena excavata*	Fly Fish Cove	Yes	Major weed
A.A. Mitchell	6255	*Asystasia cf. cheloniodes*	Poon Saan	Yes	Mod. weed
A.A. Mitchell	6256	*Tinospora crispa*	Poon Saan	Yes	Mod. weed
A.A. Mitchell	6257	*Asclepiadaceae sp.*	Poon Saan	No	Cult species
A.A. Mitchell	6258	*Rottboellia exaltata*	Casino	Yes	Major weed
A.A. Mitchell	6259	*Thumbergia laurifolia*	The Barracks	No	Cult species
A.A. Mitchell	6260	*Ocimum basilicum*	Casino	Yes	Minor weed
A.A. Mitchell	6261	*Cleome rutidosperma*	Casino	Yes	Mod. weed
A.A. Mitchell	6262	*Panicum sp.*	Casino	Yes	Minor weed
A.A. Mitchell	6263	*Urochloa mutica*	Casino	Yes	Major weed
A.A. Mitchell	6264	*Paederia foetida*	Grants Well	Yes	Major weed
A.A. Mitchell	6265	*Mikania micrantha*	Grants Well	Yes	Major weed
A.A. Mitchell	6266	*Phyllanthus sp.*	Grants Well	Yes	Minor weed
A.A. Mitchell	6267	*Hydrocotyle sp.*	Grants Well	Yes	Minor weed
A.A. Mitchell	6268	*Cymbopogon citratus*	Grants Well	No	Cult species
A.A. Mitchell	6269	*Amaranthus dubius*	Grants Well	Yes	Minor weed
A.A. Mitchell	6270	*Claoxylon indicum*	Grants Well	No	Endemic sp.
A.A. Mitchell	6271	*Leucas zeylanica*	Grants Well	Yes	Minor weed
A.A. Mitchell	6272	*Claoxylon indicum*	Martin Point	No	Endemic sp.
A.A. Mitchell	6273A	*Oplismenus compositus*	Martin Point	No	Endemic sp.
A.A. Mitchell	6273B	*Conzya sumatrensis*	Nursery	Yes	Minor weed
A.A. Mitchell	6274	*Ipomoea obscura*	Drumsite	Yes	Major weed
A.A. Mitchell	6275	*Stylosanthes humilis*	Drumsite	Yes	Minor weed
A.A. Mitchell	6276	*Centrosema pubescens*	Drumsite	Yes	Minor weed
A.A. Mitchell	6277	*Blumea sp.*	Drumsite	No	Endemic sp.
A.A. Mitchell	6278	*Paederia foetida*	Drumsite	Yes	Major weed
A.A. Mitchell	6279	*Jatropha curcas*	Drumsite	Yes	Mod. weed
A.A. Mitchell	6280	*Artemisia vulgaris*	Drumsite	Yes	Minor weed
A.A. Mitchell	6281	*Manihot glaziovii*	Phosphate Hill	Yes	Endemic sp.
A.A. Mitchell	6282	*Ipomoea mauritiana*	Ross Hill Gdns	No	Endemic sp.
A.A. Mitchell	6283	*Anisomeles malabarica*	Ross Hill Gdns	No	Endemic sp.
A.A. Mitchell	6284	*Castilla elastica*	Ross Hill Gdns	Yes	Major weed
A.A. Mitchell	6285	*Calopogonium caeruleum*	ML 111	Yes	Major weed
A.A. Mitchell	6287	*Sorghum halepense*	Phosph. Dryer	Yes	Major weed
A.A. Mitchell	6288	*Piper aduncum*	Market Grden	Yes	Major weed
A.A. Mitchell	6289	*Hyptis capitata*	Market Grden	Yes	Endemic sp.
A.A. Mitchell	6290	*Ischaemum muticum*	Dolly Beach	Yes	Mod. weed
A.A. Mitchell	6291	*Achyranthes aspera*	Dolly Beach	No	Endemic sp.
A.A. Mitchell	6292	*Aristolochia littoralis*	Kiats Garage	Yes	Mod.weed
A.A. Mitchell	6293	*Illigera appendiculata*	Near Nursery	No	Endemic sp.
A.A. Mitchell	6294	*Eclipta prostrata*	The Barracks	Yes	Minor weed
A.A. Mitchell	6295	*Strongylodon lucidus*	Near Nursery	No	Endemic sp.
A.A. Mitchell	6296	*Ischaemum nativitatis*	The Dales	No	Endemic sp.
A.A. Mitchell	6297	*Boerhavia erecta*	Bennetts Tmb	Yes	Major weed

A.A. Mitchell	6298	*Stachytarpheta cayennensis*	Pink House	Yes	Minor weed
A.A. Mitchell	6299	*Saccharum officinarum*	Pink House	No	Cult species

Plant Pathology

Cocos (Keeling) Islands

Number	Site	Host	Organism	Important
CK1	North Keeling	*Pisonia grandis*	*Septoria* sp.	
CK2	Home Island	*Cyperus rotundus*	*Puccinia* sp.	
CK3	Home Island Supermarket	*Stachytarpheta jamaicensis*	*Oidium* sp.	
CK4	Home Island Beachfront	*Terminalia catappa*	*Colletotrichum* sp.	
CK5	Oceania House	*Triphasia trifolia*	pending	
CK6	Oceania House	*Chromolaena odorata*	*Cercospora* sp.	
CK7	Oceania House	*Syzygium aqueum*	pending	
CK8	Oceania house	*Argusia argentea*	pending	
CK9	Arkries garden	*Musa* sp.	pending	
CK10	Home Island Gardens	*Colocasia esculenta*	pending	
CK11	Akries Garden	*Musa* sp.	*Deightoniella torulosa*	
CK12a	Home Island Gardens	*Saccharum officinarum*	pending	
CK12b	Home Island Gardens	*Saccharum officinarum*	pending	
CK13	Home Island Gardens	*Saccharum officinarum*	pending	
CK14	Home Island Gardens	*Musa* sp.	pending	
CK15	Home Island Gardens	*Lagenaria siceraria*	*Oidium* sp.	
CK16	Home Island Gardens	*Citrus* sp.	pending	
CK17	Home Island Gardens	*Euphorbia* sp.	*Leveillula taurica*	
CK18	Home Island, Gardens	*Cymbopogon citratus*	indeterminate	
CK19	Home Island, Gardens	*Cocos nucifera*	*Phyllosticta* sp.	
CK20	Home Island, Gardens	*Lablab purpureus*	*Colletotrichu*m sp.	
CK21	Quarantine Station West Island	*Terminalia catappa*	pending	
CK22	Cocos Farm	*Musa* sp.	pending	
CK23	Cocos farm	*Musa* sp.	pending	
CK24	Yaght Club West Island	*Cocos nucifera*	*Phyllosticta* sp.	
CK25	Cocos farm	*Mangifera indica*	*Colletotrichum gloeosporiodes*	
CK26	Pulu Blan	*Triumfetta repens*	indeterminate	
CK27	Pulu Labu	*Guettarda speciosa*	indeterminate	
CK28	Pulu Sipat	*Hibiscus tiliaceus*	*Colletotrichum* sp.	
CK29	Pulu Sipat	*Cocos nucifera*	indeterminate	
CK30	Pulu Sipat	*Cocos nucifera*	pending	

Christmas Island

Number	Site	Host	Organism	Important
CI1	South Point	*Bidens pilosa*	*Cercospora bidentis*	
CI2	South Point	*Saccharum officinarum*	pending	
CI3	Acker Trading	*Carica papaya*	*Corynespora casiicola*	
CI4	Acker Trading	*Gyrocarpus americanus*	*Colletogleum* sp.	
CI5	Acker Trading	*Pisonia grandis*	*Septoria* sp.	
CI6	Acker Trading	*Asystasia* sp.	pending	
CI7	Acker Trading	*Acalypha* sp.	*Cercospora* sp.	

CI8	Settlement	*Polyscias scuttelaria*	*Cercospora* sp.	
CI9	Kampong	*Musa* sp.	*Deightoniella torulosa*	
CI10	Acker Trading	*Pisonia grandis*	*Septoria* sp.	
CI11	The Pink House	*Musa* sp.	*Uredo musae*	
CI12	The Pink House	*Melochia umbellata*	*Phyllosticta* sp.	
CI13	Kampong	*Macaranga tanarius*	indeterminate	
CI14	Casino	*Muntingia calabura*	*Pseudocercospora* sp.	
CI15	Casino	*Erythrina variegata*	pending	
CI16	Grant's Well	*Mangifera indica*	*Colletotrichum gloeosporioides*	
CI17	Grant's Well	*Paederia foetida*	*Cercospora* sp.	
CI18	Grant's Well	*Persea americana*	*Pseudocercospora* sp.	
CI19	Grant's Well	*Citrus* sp.	*Mycosphaerella citri*	
CI20	Road to Dales	*Citrus aurantifolia*	*Xanthomonas axonopodis pv. citri*	Y*
CI21	Road to Dales	*Citrus aurantifolia*	*Xanthomonas axonopodis pv. citri*	Y*
CI22	Parks Australia Nursery	*Citrus aurantifolia*	*Xanthomonas axonopodis pv. citri*	Y*
CI23	Parks Australia Nursery	*Citrus aurantifolia*	*Xanthomonas axonopodis pv. citri*	Y*
CI24	Kim Chey's House	*Musa* sp.	pending	
CI25a	Drumsite	*Capsicum annuum*	*Cercospora capsici*	
CI25b	Drumsite	*Vigna unguiculata*	*Oidium* sp.	
CI26	Drumsite	*Abelmoschus esculentus*	*Oidium* sp.	
CI27	Drumsite	*Cucumis melo*	*Oidium* sp.	
CI28	Poon Saan	*Leucaena leucocephala*	pending	
CI29	Poon Saan	*Musa* sp.	*Mycosphaerella musae*	
CI30	Poon Saan	*Carica papaya*	*Corynespora casiicola*	
CI31	Poon Saan	*Musa* sp.	*Mycosphaerella musae*	
CI32	Kim Chey's	*Musa* sp.	pending	
CI33	Kim Chey's	*Musa* sp.	pending	
CI34	Parks Australia Nursery	*Musa* sp.	*Phyllosticta musarum*	
CI35	Parks Australia Nursery	pending	pending	
CI36	Nursery Lookout	*Illigera appendiculata*	pending	
CI37	Dolly's Beach	*Ipomoea pes-caprae*	*Cercospora ipomoeae*	
CI38	Grant's Well	*Strongylodon lucidus*	*Cercospora* sp.	
CI39	Kim Chey's	*Piper aduncum*	*indeterminate*	
CI40	The Pink House	pending	*Phyllachora* sp.	

Y* indicates a NAQS target organism.

Christmas Island Quarantine Regulations

TERRITORY OF CHRISTMAS ISLAND

Christmas Island Quarantine Service
Mobile: 019 105 888

Fax: 091 647 468
Phone: 091 647 456

LIST OF PROHIBITED GOODS

The following list of goods are prohibited (not allowed) entry into the Territory of Christmas Island from all countries except Australia.

This list is not concise and should only be used as a guide, if you are unsure of the goods you intend to import or the goods you have on your shelves are prohibited please check with the Christmas Island Quarantine officer.

It is the responsibility of the importer to be aware of goods that have a prohibited or restricted (allowed entry under conditions) status, this can be done by establishing and maintaining an Quarantine import file.

The importer has a responsibility to advise their overseas agents of goods that are prohibited, and to ensure the goods are not consigned to Christmas Island.

The importer must declare all goods that have been consigned to them, by means of producing a complete detailed inventory (**in English**) of the entire consignment and hand the inventory to the Christmas Island Quarantine Officer a minimum of 24 hours prior to the arrival of the ship/aircraft importing the goods.

Prohibited goods list

The Christmas Island Quarantine Ordinance prohibits the importation into the Territory of Christmas Island all Egg and Egg products, live Poultry and Poultry products/live Bird and Bird products, feathers, nests of birds, products derived from or containing egg and poultry but not limited to the items below in any form if it would be likely to introduce an infectious or contagious disease or a disease or pest affecting humans, animal or plants namely bird disease particularly Newcastle Disease and Avian (bird) Influenza.

Poultry & Bird means: Chicken, Duck, Quail and Pheasant etc.

Poultry and Poultry Products:

All Birds Nest products in the raw state	Prohibited
Birds Nest other (as in soup)	Prohibited
* Birds Nest products bottled, canned as in liquid less than 10% of Birds Nest	Restricted permit required
Examples of chicken/duck products	Prohibited
Chinese sausage containing chicken/duck	Prohibited
Frankfurts,	Prohibited
Pies,	Prohibited
Burgers	Prohibited
Buns as in pou,	Prohibited
Feet,	Prohibited
Offal,	Prohibited
Whole or in pieces cooked or uncooked,	Prohibited
Fresh or Frozen,	Prohibited
Chicken dim sim,	Prohibited
Chicken curry,	Prohibited
Chicken floss	Prohibited
Pate, waxed, salted, canned or uncanned	Prohibited

Egg and Egg Products

Eggs raw as in fresh	Prohibited
Pasteurised whole egg or egg yoke products (pulp)	Prohibited
Unprocessed products (ie not cooked) containing	Prohibited
Raw egg ingredients	Prohibited
*Egg jam Cooking certificate required	Restricted permit required

Lemon curd with egg	Prohibited
Liqueurs containing less than 10% egg	Restricted permit required
Contains more than 10%	Prohibited
*Mayonnaise containing less than 10 % egg	Restricted permit required
contains more than 10%	Prohibited
moon cake containing whole egg	Prohibited
Egg powder	Prohibited
Canned eggs	Prohibited
Egg roll	Prohibited
Egg flake	Prohibited
Egg lecithin	Prohibited
Ice cream with egg content more than 10%	Prohibited
Eggs pickled	Prohibited
*Egg shampoo with egg containing more than 10%	Prohibited
Egg shell as ornaments	Prohibited
Eggs preserved/salted	Prohibited
Egg cartons (used)	Prohibited
Egg tofu	Prohibited

These are an example only

*Noodles with egg content, commercially manufactured are permitted providing the label states egg content is less than 10%.
Noodles with egg content above 10% or non commercially manufactured or label not provide percentage of egg are Prohibited.

Products that are permitted entry with no restrictions: Liquid chicken essence, chicken stock cubes.

Items marked with * are prohibited unless:
(1) an import permit is provided together with
(2) cooking certificates
(3) manufactures declaration giving processing details
(4) labels state percentage of content

Feathers

Feathers as in feather dusters, fishing flies, re – stuffing pillows, feathers as in decorations on ornaments etc., are Restricted.
All importations of feathers must be free from bird tissue (skin, meat) and must be commercially manufactured.

Date 28/11/96

SUMMARY OF CHRISTMAS ISLAND PLANT AND ANIMAL QUARANTINE REQUIREMENTS

The wish of importers to conform with the Territory of Christmas Island's Quarantine requirements is greatly appreciated. While it is not possible to present all details in a concise manner, a selection of products that are regularly imported has been assembled in this brochure. Importers are urged to check periodically with the Christmas Island Quarantine Officer to ensure the information is still current and for enquiries on products that may not appear in the brochure.

Private importers are not required to obtain an import permit for any products with the exception of Live Plants, Live Animals and Cut Flowers. Private importers are reminded that all plant and animal products including foodstuffs must be declared on their Customs/Quarantine declaration on arrival in Christmas Island.

Commercial importers must obtain an import permit for all products listed in this brochure and any other products that may be of plant and/or animal origin.

Mandatory Treatments

Certain goods, including those listed below are subject to mandatory treatments immediately following import unless satisfactory evidence is produced that the goods were given the prescribed treatment before export.

Fumigation with methyl bromide or sulfurly fluoride or heat treatment.

Antique furniture
Bamboo and cane – goods made wholly or partly of
Dunnage unless re – exported
Woodenware from Asia and South – east Asia

Devitalisation

Cut flowers capable of propagation; including roses, carnations and chrysanthemums.

The following products may be imported subject to inspection on arrival:

- Bamboo
- Bay leaves
- Beans
- Biscuits
- Bombay duck (fish product)
- Chicken essence
- Chinese medicines – Prohibited if containing seeds that may germinate
- Coffee beans
- Coriander seed
- Cumin seed
- Curry powder
- Cuttlefish – dried
- Fish – dried
- Fruit – all types
- Garlic – dried
- Herbs
- Lentils
- Mushrooms – dried
- Nuts – peanuts, cashews etc
- Oysters – dried
- Papadams
- Plums – dried
- Prunes
- Rattan – artefacts, furniture etc
- Rice
- Rice crackers
- Shellfish – cooked or dried, includes prawns, shrimps, crabs etc
- Shrimp paste

- Spices
- Vegetables – all types
- Wooden articles

Any contamination found on inspection i.e. insects, soil etc. will require treatment, at the importers expense, to remove the contamination. If treatment facilities are not available then the goods will be destroyed.

The following products may be imported subject to the conditions as stated:

• All meats – pork, beef, mutton	-	must be cooked or frozen
• Chinese sausages	-	must be cooked
• Egg jam	-	cooking certificate required
• Egg noodles	-	subject to manufacturers declaration giving processing details
• Liquid chicken essence	-	permitted
• Sharks fin	-	permitted
• Vegetable/fruit seeds	-	must be in a commercial packet
• All manufactured tinned/jars of food	-	must not contain chicken or duck meat or egg – remainder permitted

The following products are prohibited importation into Christmas Island from the North:

• Aircraft food	-	no aircraft food is permitted to leave the aircraft
• Birds nest (edible)		
• Birds nest (other)		
• Birds nest drink	-	cerebos brand ex Thailand or Amoy brand ex Singapore – permitted
• Chicken meat	-	cooked or uncooked
• Duck meat	-	cooked or uncooked
• Egg cartons		
• Eggs	-	whole or parts
• Egg shells		
• Moon cakes	-	containing egg yolk

Import permits are required prior to the importation of the following:

• Live plants	-	must be free from soil
	-	must be free from insect pests
	-	application to be referred to ANCA for consideration of plant species
• Live animals	-	for information on live animal imports please contact Christmas Island Quarantine Officer
• Cut Flowers	-	must be known to be incapable of propagation
	-	carnations, chrysanthemums, gypsophila and roses need

to be treated on arrival to render incapable of propagation – for details on treatment required please contact Christmas Island Quarantine Officer.

Wildlife Protection Act

Under the Wildlife (Regulation and Exports and Import) Protection Act, 1982, controls apply to the export and import of certain wildlife and wildlife products. Over 110 countries are signatories to the law which are designed to control the inappropriate taking and subsequent import and export of wildlife. These controls are an important element of effective international nature conservation.

The following wildlife is subject to the Act:

- Import and Export of live animals and their products, including ivory, dolphin and whale products, sea turtles, butterflies, native birds and animals, live fish and corals. Some examples of items sold abroad which could not be imported include handbags and shoes made from crocodile skin, turtle shells, skins of endangered animals such as tigers, jewellery made from whales.

- Shells including dead shells, cannot be imported or exported to or from Christmas Island without a permit. Permits may be issued to residents of Christmas Island returning to the mainland with personal shell collections.

- Import and export of a wide variety of live native plants including orchids, cactus, aloe, daffodil, palms and cycads.

- Import and export of medicines if they contain parts, products or derivatives of animal or plants protected under this Act, including tiger, monkey, musk deer, monkeys, orchids, elephant, crocodile, bear and American ginseng.

If you would like more information about controls under this Act, products that may not be listed and permits which may be available please contact the Christmas Island Quarantine Officer or the Australian Nature Conservation Agency.

Note: Commercial importers must obtain an import permit for all products listed in this summary.

"All persons arriving on Christmas Island are reminded that if they are carrying goods that may be subject to Quarantine then they must declare these goods on their customs/quarantine declaration form. It is an offence to attempt to smuggle quarantinable goods into Christmas Island and severe penalties apply".