

Managing scale insect outbreaks in the Capricornia Cays

conserving biodiversity through pest management



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Since 1993, infestations of scale insects have affected pisonia forests on three of Central Queensland's coral cays in the Capricornia Cays National Park. First affected was Tryon Island, where most of the pisonia forest was ultimately destroyed, as natural predators failed to overcome the scale insect as expected. When scale outbreaks occurred in 2006 on Wilson and Heron islands, the Queensland Parks and Wildlife Service (QPWS) actively managed them, armed with the lessons from Tryon Island.

Using a variety of methods — primarily release of native ladybirds, a scale predator, and baiting of introduced ants which interfere with the scale predators — QPWS brought both infestations under control, and the forests recovered. Today, a revegetation program is underway on Tryon Island, and research and monitoring are ongoing across the cays. QPWS's work has implications for coral cays and atolls elsewhere in the world, where pisonia forests, already dramatically reduced by clearing, are further threatened by scale insect outbreaks.

Why our pisonia forests matter Significant and vulnerable

Pisonia grandis, a large-leaved woody shrub or tree is found almost exclusively on Indo-Pacific islands broadly between the Tropics of Cancer and Capricorn, and as far away as islands of the Seychelles, Hawaii and eastern Polynesia. In Australia only a little over 190ha of pisonia grows — and most is on the islands of the Great Barrier Reef.

- At the southern end of the Great Barrier Reef is Australia's pisonia stronghold — the Capricornia Cays — where large pisonia forests total about 135ha.
- Other Australian islands where pisonia grows are Christmas, Cocos, Cobourg Peninsula and Torres Strait islands and Coringa-Herald cays in the Coral Sea National Nature Reserve.

Pisonia is critical to the ecology of the Capricornia Cays. Developed pisonia forests help stabilise the cays, protecting them during cyclones. Pisonia trees provide shelter and breeding habitat for a variety of birds. In the Capricornia Cays, pisonia supports 75% of all nesting seabirds in the Great Barrier Reef World Heritage Area. The cays are also important breeding grounds for endangered sea turtles.

Australia's pisonia forests are internationally significant as the majority are in protected areas. About 70-80 percent of our pisonia forests are on the islands of the Capricornia Cays National Park and National Park (Scientific).

Threats to pisonia

Across the world, pisonia forests are threatened by a variety of factors. Outside Australia, pisonia is frequently cleared for plantation agriculture, development, and the mining of guano (bird droppings used for fertiliser).

In Australia, climate change — possibly increased El Nino (drought) events and rising sea levels — may be affecting some forests. Scale insect outbreaks have also wiped out or affected a number of pisonia forests in Australia and elsewhere.

More than forests at stake

Damage to the pisonia forests of the Capricornia Cays has far-reaching consequences. The forests themselves are of international significance, and permanent loss may threaten survival of the *Pisonia grandis* species. Forest decline may also affect the stability of the coral cays, and the survival of cay-dependant wildlife such as nesting turtles and seabirds. Pisonia is critical for black noddie populations which nest almost exclusively in pisonia, while dense pisonia canopies create open ground for wedge-tailed shearwaters to burrow.

People are also affected by pisonia decline: forest die-offs can limit recreational use, with visitors unable to walk or camp in affected or unsafe areas. The aesthetic impacts of dying or dead forests can dramatically affect tourist enjoyment of what are usually extraordinarily beautiful coral cays.

Pisonia forests in the Capricornia Cays provide island resorts and campgrounds with valuable protection from the sun and potentially destructive force of cyclonic winds.

Scale insect and pisonia

A balanced relationship

The soft scale insect, *Pulvinaria urbicola*, is a tiny insect (around 2–3mm long) that lives on the leaves of a number of plants, including pisonia. ‘Scale’ insects get their name from their scaly protective covers, although in ‘soft’ scales this is usually absent.



▲ Soft scale appear as greenish-brown blisters and in outbreak you can see lots of white woolly-like egg masses.

Scale insects suck sap from their host plant to survive. They also produce a sweet, sticky substance called ‘honeydew’, which is a food source for many common ant species. Ants attracted by honeydew will farm scale and often interfere with their predators; they may even move scale eggs to new sites. Our current understanding is that this mutually beneficial relationship between scale and ants is a normal, balanced situation.

Scale insects seem to occur naturally throughout healthy pisonia forests in very low numbers — less than one or two scale to a leaf. For the most part, their numbers appear to be held in check by natural factors, especially predators such as native ladybirds and parasitic wasps.



◀ *Pisonia* forests play a critical role in the ecology of the Capricornia Cays, which are places of extraordinary beauty and ecological diversity.

When the balance goes wrong

Sometimes, however, the number of scale insects in a pisonia forest explodes, creating an ‘outbreak’. In response to the increased food supply, outbreaks are also accompanied by an explosion in the number of ants — particularly the introduced African big-head ant *Pheidole megacephala* in the Capricornia Cays.

Under the stress of such large numbers of scale, pisonia trees respond as if drought-stressed and drop their leaves. Scale eggs are plentiful and their highly mobile larvae will move, or be blown or carried on to other trees. The original trees start to recover and form new leaf buds, but are soon recolonised by scale and ants. Pisonia trees can go through a number of defoliations, over several months or a couple of years, before eventually dying if the outbreak continues.

A global problem

Since the early 1990s, scale outbreaks are known to have occurred on three of the islands of the Capricornia Cays National Park: Tryon, Wilson and Heron. During the same period, scale outbreaks have also affected pisonia forests elsewhere. The pisonia forest on Coringa Island in Australia’s Coral Sea was completely destroyed by scale insect during the 1990s. Scale has also severely damaged pisonia forests on Bird Island in the Seychelles and Palmyra Atoll in Hawaii.

Scale insect outbreaks are a threat to pisonia forests worldwide. The work of QPWS in managing scale on the Capricornia Cays is vital not just for the protection of Queensland’s islands, but for cays and atolls across the world.



▲ *Pisonia grandis* leaf, African big-head ants *Pheidole megacephala*, and soft scale insect *Pulvinaria urbicola*.

Managing outbreaks in the Capricornia Cays

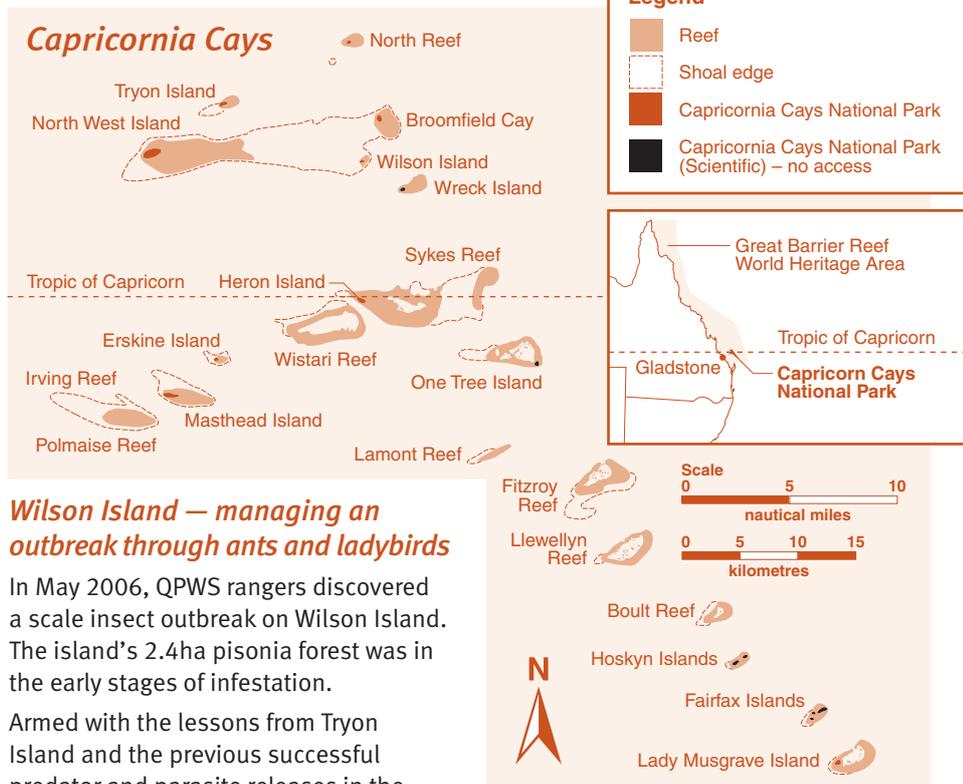
Tryon Island – growing a new pisonia forest

In August 1993, an outbreak of the scale insect was detected in Tryon Island's pisonia forest. At this time, Tryon's pisonia covered nearly half the island.

This was the first known scale outbreak in a pisonia forest of the Capricornia Cays, and one of the world's earliest records. Expectations were that natural predators – ladybirds and parasitic wasps – would bring the outbreak under control. At various points the forests appeared to be recovering, with previously affected trees showing new growth. Ultimately the repeated scale infestations killed many pisonia, taking 7–8 years before scale numbers subsided. Even after the outbreak had ended, the forest did not regenerate as might have been expected. Today, 90 percent of Tryon Island's original pisonia forest has gone.

All is not lost, however. Once it became clear that the forest could not recover naturally, QPWS began a revegetation program. Trial plantings in 2004 and 2005 indicated a need for more detailed investigations, and a more comprehensive trial began in July 2006. QPWS staff and a team of volunteers are working to determine the most effective techniques for regenerating pisonia. A successful ant-baiting program has also significantly reduced Tryon Island's introduced ant population, with no visible effects on native species.

Tryon Island (along with Coringa Island in the Coral Sea) also gave QPWS important insights into effective management of scale outbreaks. The main lesson was that like a wildfire, once underway, outbreaks of this kind apparently will not subside before most, if not all, the island's pisonia is gone.



Wilson Island – managing an outbreak through ants and ladybirds

In May 2006, QPWS rangers discovered a scale insect outbreak on Wilson Island. The island's 2.4ha pisonia forest was in the early stages of infestation.

Armed with the lessons from Tryon Island and the previous successful predator and parasite releases in the Coral Sea, QPWS responded quickly. In early June ant bait was used to almost eliminate the introduced ants on the island. Two weeks later, 5000 native ladybirds (*Cryptolaemus montrouzieri*) were released. Ladybirds are natural scale predators, frequently seen in low numbers on the Capricornia Cays.

Surprisingly, however, by early August, the outbreak had continued to spread, and 90 percent of Wilson Island's forest was affected. Unusually cold winter temperatures might have prevented the ladybirds from reproducing. In August, 2500 more ladybirds were released, this time successfully reproducing in September's warmer spring temperatures. By early October, scale numbers had started to fall under pressure from the now several hundred thousand ladybird larvae and adults. By early December 2006, the outbreak was over and the forest was in recovery.

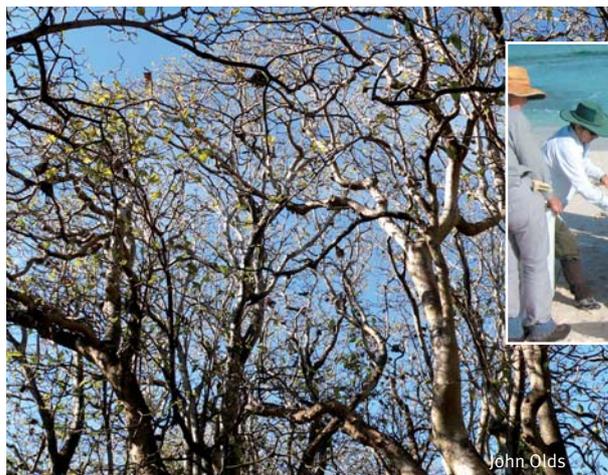


▲ Native ladybirds *Cryptolaemus montrouzieri* are natural predators of scale, and central to managing outbreaks.

Heron Island – early detection and success

Also in May 2006, staff from Heron Island resort contacted QPWS regarding a suspected scale outbreak on a small group of pisonia trees within the resort area (most of the island's 13.6ha forest was unaffected). Pruning and ant baiting immediately controlled the outbreak on the lower leaves of affected trees and Heron Island's parasitic wasps did the rest.

QPWS has learned that detection of outbreaks at the earliest possible stages is essential. Detection must then be followed by intervention to bolster natural enemies of scale and reduce interference from ants to help pisonia forests survive. This information was crucial in managing an outbreak on Wilson Island.



- ▲ Volunteers help with Tryon Island's pisonia revegetation program.
- ◀ Scale outbreaks can devastate a pisonia forest.

What causes outbreaks? **Researching the cause**

The causes of scale outbreaks are still unclear. QPWS is exploring a range of possibilities. It is likely that a number of factors combine to cause an outbreak.

A natural phenomenon?

Scale outbreaks could be caused by natural declines in the number of natural predators, such as native ladybirds and parasitic wasps. This is most likely on smaller cays, where lower diversity means there may be few or no hosts, including scale, for natural predators and parasites.

Introduced ants?

Introduced ants have been found at the site of scale outbreaks in Australia and elsewhere. Their role in farming scale and interfering with natural parasites and predators may be central to maintaining an outbreak. In the Capricornia Cays, the African big-head ant *Pheidole megacephala* is associated with all outbreaks, whereas in the Coral Sea it is the guinea ant *Tetramorium bicarinatum*.

Genetic variation?

Pisonia may have slightly different genetic strains on different islands, which may be more or less resistant to scale attack. There may also be different genetic strains of scale that are more or less resistant to predators.

Seabird decline?

Seabirds nourish pisonia forests by providing large amounts of nutrients, nitrogen, phosphorous and calcium through their droppings. If seabirds are absent or in decline, pisonia forests may suffer nutrient stress, making them more vulnerable to scale attack. Climate change is likely to be a key factor in changes to seabird populations.

Drought?

During drought, plants are water stressed. Stressed plants are more susceptible to insect attack and in some cases drought favours insects.

Where to from here? **An ongoing effort**

Managing and researching scale insect outbreaks in the Capricornia Cays is an ongoing effort.

On Tryon Island, revegetation will require many more years of planting, sampling and monitoring. Across the Capricornia Cays, QPWS is monitoring scale and ant populations to help detect and prevent further outbreaks. Staff are also monitoring pisonia forest distribution and any changes that may arise from past scale infestations. Data collected from all this fieldwork is then analysed and incorporated into the research being carried out by QPWS scientists and its partners.

QPWS staff are also developing procedures and promotional campaigns to reduce the spread of pests between islands in the Capricornia Cays.

A collaborative effort

QPWS is collaborating with a range of respected institutions in its work on scale insect outbreaks.

The *Queensland Herbarium* is contributing information about cay soils and the health of pisonia forests, and reporting on cay vegetation communities. Queensland's *Department of Primary Industries and Fisheries* is providing expert entomological advice, and assistance in analysing, sorting and collecting data on ants and other invertebrate fauna. The *Australian Government Department of the Environment and Water Resources* is sharing its knowledge on managing scale outbreaks on the pisonia in the Coral Sea cays.

A global outcome

The QPWS research on scale outbreaks is of international significance. Scale insects are a global threat to pisonia. Research being carried out here will provide vital information on the best way to respond to an outbreak, including optimal methods of ant control and predator release. In addition, Tryon Island's revegetation work will determine the best methods for regenerating scale-ravaged pisonia forests.

All QPWS findings are being documented and shared as quickly as possible with the international scientific community.

How you can help **Report suspected infestations**

If you find an infestation of scale insects on any island of the Capricornia Cays National Park, please phone the QPWS Gladstone. Do not try to remove the insects or leaves from the trees.

Support our work

Organisations can support the important research, monitoring and revegetation being conducted by QPWS by sponsoring our work, or joining us as partners. For more information on the benefits you can share by working with us, call the pisonia project officer in QPWS Rockhampton.

Individuals can register to volunteer at the Capricornia Cays national parks by calling the QPWS Gladstone. You will be contacted when a vacancy becomes available in our volunteer programs for the cays.

Spread the word, not the problem

Tell other people — for example, travellers, resort guests, local residents — about the importance of 'biosecurity' in protecting the future of our unique island environments. It is very easy to unintentionally spread a pest through simple, day-to-day activities. Just one dirty boot can carry the seeds of a problem from island to island in a frighteningly short time.

Encourage anybody who is about to leave the mainland to visit an island, or is moving between islands, to check their clothing, especially footwear, for pests such as seeds or insects, and to remove any pests by brushing them off. Also ensure food, camping equipment, building materials and any other equipment being transported is free from vermin of any kind.

Together, we can safeguard the future of *Pisonia grandis* and the coral cays.



For further information

Visit us online at www.derm.qld.gov.au or phone on **1300 130 372**.