Invader from the dark side

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- Weeds are often associated with high light and disturbed habitats but shade-tolerant weeds are gaining attention as serious invaders of rainforests worldwide
- The shade-tolerant Cherry Guava (Psidium cattleianum) is emerging as a serious invader of rainforest understoreys in the Wet Tropics of North Queensland, and is well-known to have the potential to displace native vegetation.
- The prognosis for control is good but incisive action is needed.

Shade-tolerant weed threatens Australian World Heritage Rainforests

Thicket-forming, shade-tolerant Psidium cattleianum spells ecological disaster for World Heritage Area rainforests. Inset: fruits (top) and dense multi-stems (bottom)

Environmental weeds typically invade open, disturbed areas or vegetation edges, and can have devastating ecological and economic consequences. The National Weeds List in Australia informs the public and land managers on weeds prioritized for management, but shade-tolerant weeds that can invade forest ecosystems are inadequately listed. Such weeds are now globally recognized for their ability to impact native vegetation. The Cherry Guava (*Psidium cattleianum*) from Brazil, a shrub of the Myrtle family (Myrtaceae), is an exceptional example.

1. Cherry Guava was probably introduced to Australia for its edible fruits. The earliest record (1940s) was in Koah, Far North Queensland. Currently, Cherry Guava infestations are found in three World Heritage Areas in Australia: the Wet Tropics in Queensland; Gondwanan Rainforests of Queensland/New South Wales, and Lord Howe Island. It is listed as a noxious weed only in NSW. There are no Australian regulations restricting import or sale.

2. The Global Invasive Species Database lists Cherry Guava among the World's 100 Worst Weeds – it tolerates shade; grows and matures rapidly; produces a heavy fruit set and seedling bank; is spread by native and feral animals; coppices extensively; and forms multi-stemmed thickets. It can displace native vegetation. Infestations in Australia appear free of natural enemies and resistant to Myrtle Rust which affects co-occurring native members of the Myrtaceae. In Hawaii, Seychelles and Mascarene Islands, natural forested ecosystems are severely impacted after introductions in the early- to mid-1800s.

3. Cherry Guava spread is ongoing, but given the recent Australian history and localized infestations, eradication may be possible with incisive intervention. Government listings and restricting import and sale are first steps. Options to eliminate infestations could combine ecotourism, volunteers and biological control agents.

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Supporting Evidence

Title	Aim	Key Results
Atlas of Living Australia.2014. URL: http://bie.ala.org.au/ (Accessed: 11 Dec 2014).	User generated search on Psidium cattleianum (Myrtaceae) in Australia to generate distribution records.	The first known record of Psidium cattleianum was from Koah in 1941. P. cattleianum has since been recorded from numerous other localities in the Wet Tropics World Heritage Area (Queensland), Gondwanan Rainforest World Heritage Area in New South Wales, and Lord Howe Island World Heritage Area. Records total 117.
Auld T.D., & Hutton I. (2004). Conservation issues for the vascular flora of Lord Howe Island. Cunninghamia 8, 490-500.	To describe the nature of the major threats to the flora of Lord Howe island and to suggest an area-based scheme for the relative conservation significance of remaining vegetation	Psidium cattleianum was highlighted as a weed of particular concern. The review concluded that while a number of threat control works are in place, the authors highlight the need to remove environmental weeds from the settlement search and removal of environmental weeds from remote areas.
Cooper W, Cooper WT. (2004) Fruits of the Australian Tropical Rainforest. Nokomis Editions, Victoria, Australia.	To provide botanical drawings and keys detailing the diversity of fruits in Australian tropical rainforests.	Psidium cattleianum is observed to be spread by native animals, in particular Cassowaries and Spectacled Flying Foxes.
Fleischmann K. (1997) Invasion of alien woody plants on the islands of Mahé and Silhouette, Seychelles. J. Veg. Sci. 8, 5-12.	To present a quick and easily method of repeatable evaluation of the state of invasion of alien woody plants and the ecological status on the Seychelles Islands.	Psidium cattleianum is listed as one of the most prominent weeds on the Seychelles islands, particularly of moist and also upland forests. Author states that the extent of the invasion is underestimated.
Global Invasive Species Database. 2014. Psidium cattleianum. http://www.issg.org/database/species/ecology.asp?si=59&fr=1&sts=sss&lang=EN [Accessed 9th December 2014]	Provides dedicated species portraits and literature compilations on invasive species	Psidium cattleianum is nominated as one of the Worsts top 100 worst weeds, and is likely to cause significant ecological or economic harm in Hawai'i and on other Pacific Islands.

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Title	Aim	Key Results
Huenneke L. F., Vitousek P. M. (1990) Seedling and clonal recruitment of the invasive tree Psidium cattleianum: Implications for management of native Hawaiian forests. Biol. Conserv. 53, 199-211.	To investigate the reproductive ecology and seed germination physiology of Psidium cattleianum	Psidium seedlings occur on the same substrates as native seedlings, and also in undisturbed sites. Seeding and clonal growth is prolific in P. cattleianum, and the latter may partially explain its success in dominating native forests. Germination and establishment do not depend on animal dispersal, or on disturbances created by feral pigs; thus, control of the plant cannot rest entirely on control of non-native animals.
keys.lucidcentral.org, (2015) Psidium cattleianum (Strawberry Guava). [online]. Available from: http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Psidium_cattleianum_%28Strawberry_Guava%29.htm [Accessed March 10, 2015].	To describe the biological attributes of Psidium cattleianum and control measures available	Describes the invasive attributes of Psidium cattleianum, concluding that it can form dense thickets that exclude native vegetation and reduce native species regeneration.
Lorence D. H., Sussman R. W. (1986) Exotic species invasion into Mauritius wet forest remnants. J. Trop. Ecol. 2, 147-162.	Vegetation sampling in mature evergreen wet forest in Mauritius (Mascarene Islands) to assess the extent of invasion by weedy exotics	Psidium cattleianum was introduced to the Mauritius in 1822 and are the among the most dominant of exotic species at both study sites.
Martin P. H., Canham C. D., Marks P. L. (2009) Why forests appear resistant to exotic plant invasions: intentional introductions stand dynamics and the role of shade tolerance. Front. Ecol. Environ. 7, 142-149.	A synthetic review on the role of shade tolerant plants as significant invaders of forested ecosystems globally	The review debunks the assumption that undisturbed forests are highly resistant to plant invasions. At least 139 exotic plant species are known to have invaded deeply shaded temperate and tropical forest understories that have not undergone substantial disturbance. These exotics present a particular management challenge, as they often increase in abundance during succession.
Morin L, Aveyard R, Lidbetter J. (2011) Myrtle rust: host testing uunder controlled conditions. NSW Department of Primary Industries, West Pennant Hills, NSW, Australia.	To test the susceptibility to Myrtle rust in representative taxa of the Myrtaceae	Psidium cattleianum shows limited response to Myrtle Rust, in comparison to many Australian native rainforest Myrtaceae

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Shiels AB., Ennis MK, Shiels L. (2014) Trait-based plant mortality and preference for native versus non-native seedlings by invasive slug and snail herbivores in Hawaii. Biol Invasions 16, 1929-1940	Tested how traits drive gastropod herbivory on native and non-native plants (including Psidium cattleianum) in Hawaii	The study found herbivory high mortality (80-100%) on native seedlings, but significantly lower to zero herbivory and mortality on the non-native species (of which Psidium cattleianum is a tested species)
Wikler, C., Pedrosa-Macedo J. H., Vitorino M. D., Caxambú M. G., Smith C. W. (2000) Strawberry guava (Psidium cattleianum) – Prospects for biological control. pp. 659-665. In: N R. Spencer (eds.) Proceedings of the X International Symposium on Biologic	Study and review potential biocontrol agents for P. cattleianum.	Seven species found to be effective natural enemies of P. cattleianum. A number of host-specific insects have been shown to produce galls on P. cattleianum.

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