Management of *Chromolaena odorata* in the Douglas Shire

Simon J. Brooks[1] and Peter Logan[2]
[1] Tropical Weeds Research Centre, Department of Agriculture and Fisheries, PO Box 187, Charters Towers, Queensland 4820, Australia
[2] Douglas Shire Council, PO Box 723, Mossman, Queensland, 4873, Australia
(simon.brooks@daf.qld.gov.au)

Summary *Chromolaena odorata* (L.) King and Robinson (Siam Weed) is a serious weed across tropical and subtropical areas of Africa, Asia and multiple Pacific Islands, and was the target of a nationally cost-shared weed eradication program after it was discovered in Australia in 1994. *Chromolaena odorata* was discovered in the Douglas Shire near Mossman in 2003. At the conclusion of the broader eradication program in 2012, greater progress was being made towards its removal in this shire compared with larger infestations in other areas. Staff from the Douglas Shire, and other local stakeholders, have continued surveying and controlling known and new infestations. Ongoing localised management, mapping and record keeping provides a case study for the continuing control of this former eradication target. This discrete incursion is seen as a high priority by the shire and a threat to valuable agricultural, environmental and tourism assets. Further dispersal from infestations is likely via various recreational and agricultural thoroughfares.

Keywords Tropics, Siam weed, Daintree.

INTRODUCTION

Chromolaena odorata (L.) King and Robinson (Siam weed) is a large, multi-stemmed, perennial shrub in the Asteraceae family. It has long been recognised as one of the most invasive plants of tropical and subtropical regions of Africa, Asia and Oceania (Zachariades *et al.* 2009). It was first discovered on mainland Australia in 1994 near the towns of Mission Beach and Tully on the wet tropical coast of north-east Queensland. *Chromolaena odorata* has since been recorded across a variety of agricultural and environmental habitats and rainfall zones (Figure 1) in north Queensland, including the drier inland tropical areas of the upper Herbert River catchment, and catchments to the west of Townsville (Figure 1). In recognition of the serious threat *C. odorata* posed to tropical and sub-tropical Australia, a national, cost-shared, weed eradication program commenced in 1994.

The eradication program concluded in 2012, as more infestations were being discovered each year (Jeffery 2012), making the management of the entire incursion increasingly difficult. There were varying degrees of infestation and progress towards eradication across catchment and local government areas across the incursion. This paper illustrates the progress that has been made on the most northern part of the incursion in the Douglas Shire around the town of Mossman on the far north Queensland coast. Information on the local post eradication activities is also presented along with the risks posed by the potential spread of *C. odorata* in the Douglas Shire and further north.

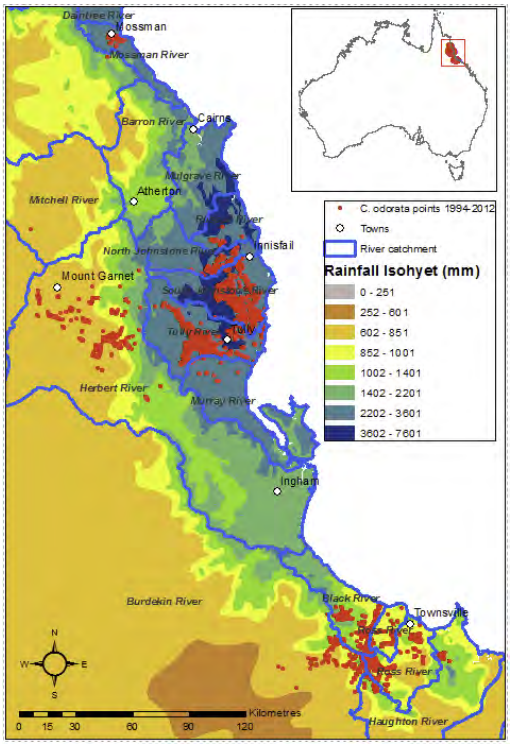

Figure 1. Overview of all recorded *Chromolaena odorata* locations 1994–2012 across river catchment boundaries and rainfall zones.

MANAGEMENT 2003–2012

Field crews searched buffer areas twice a year extending for at least 150 m around points where at least one *C. odorata* has been recorded. Additional surveys were conducted along creeks and rivers. Presence or absence data were derived from field records for every known or new waypoint. Waypoint records were aggregated into static one hectare cells (100 × 100 m). These cells are used in program reporting as 'management areas'. They were not survey units. A management area was added to the database if a new waypoint was detected beyond the boundaries of a previously known management area.

Reporting of management areas commenced in 2009. Previously, a buffered infestation-based system was used. Under the buffer system, infestations could expand and merge to create uneven sizes so all historical data had to be recalculated each year (Brooks 2017). The management area system provided a consistent spatial and temporal scale for reporting on field activities. Data collected prior to 2009 was re-analysed using this new scale. However, its implementation required a finer scale collection of location data, which was reflected in recording of more management areas in 2010 surveys (Figure 2). Every 12 months, point records are summarised to allocate a status of 'control' = plants present, or 'monitoring' = plants absent for each management area. Management areas only entered a monitoring phase when absence data was recorded in the last 12 month period. Management areas relapsed to the control phase if plants were found.

By 2012, there were 134 management areas, with at least one plant present once. However, 46% were in a monitoring phase with no plants present for between one and seven years (Figure 2).

MANAGEMENT 2013–2016

Douglas Shire Council control activities have included controlled burns, foliar herbicide application and physical control of isolated plants, as was also the case between 2003 and 2012. Small C. *odorata* plants and seeds on the soil surface can be controlled by fire (S. Brooks, unpubl. data). Controlled burns have been conducted in 2013 and 2015 on the Mowbray Range (the eastern most points on Figure 3) to aid population suppression along with other control measures. Flowering plants are readily detectible from the air in late May and June. Aerial surveys have been conducted annually targeting *Hiptage benghalensis* (L.) Kurz. and *C. odorata* in cooperation with Queensland Parks and Wildlife Service. Ground activities have also been assisted by Jabalbina Rangers, landholders, Terrain NRM and Biosecurity Queensland.

The Douglas Shire Council has been using an internal electronic database to record dates, resources and multiple categories of control activities in a 'reason(s) to visit' field from 2013 to 2016. These records are on a broad property scale, including multiple 'lot on plans'. Where properties were visited and 'survey' or 'check-up' was recorded as the 'reason to visit' and there was no treated area or method, these were considered to be *C. odorata* absence records. Where 'fire-burn' was a reason to visit, plants were assumed to be present. The broader scale of control records were not directly comparable to the pre-2012 records and were analysed separately. Control and monitoring phases were allocated annually to each property, using the same process described for management areas. The broader scale of data collection meant only a quarter of properties have progressed to a monitoring phase in 2016 (Table 1). Large and

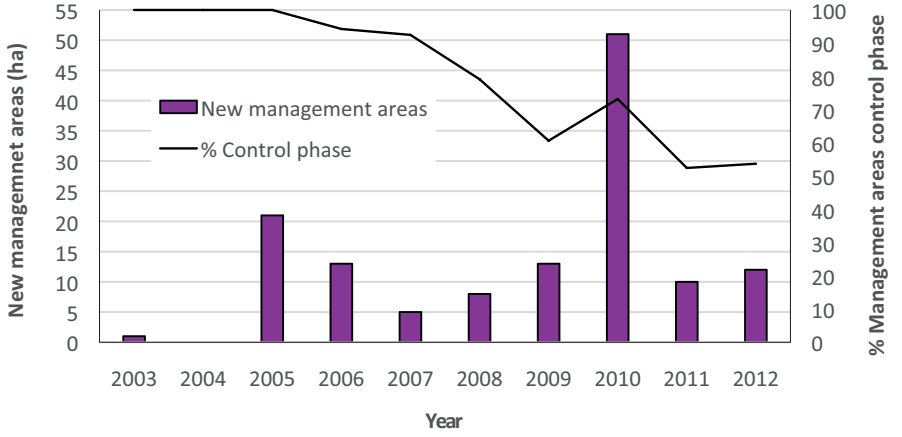

Figure 2. Discovery of new *Chromolaena odorata* management areas (1 ha each) and the percentage of management areas with plants (control phase) at yearly intervals in the Douglas Shire.

unevenly sized infestations were one of the reasons for moving to a management area reporting system during the initial eradication program (Brooks 2017).

Annual summaries of information from the Douglas Shire Council database including the number of property visits, total area treated (spray and manual control) and hours on sites are shown (Table 1). There were 355 visits recorded, where 83 recorded no treatment, 10 were associated with fires and half of the remaining 263 control visits treated between 1 and 50 m^2 of *C. odorata*. The small treated areas, absence records and total work hours show that the Shire has continued to invest in survey, as well as control activities. Visits are concentrated in May, June and July, but also occur between January and October.

Additional waypoints have been recorded through ground and aerial surveys. Ground surveys and points can also be instigated by verifying a public report of *C. odorata*, resulting from local awareness activities including display specimens and social media. The waypoints are a comparable scale to the eradication program data and could be used to extract management area locations, aggregated between 2013 and 2016.

For a species that is considered to be primarily wind-dispersed, *C. odorata* has repeatedly been observed spreading along creek lines (Brooks *et al.* 2017). In the Douglas Shire, plants have also been found near farm tracks, cane headlands, grazing land, and in forested areas (Figure 3), underlying the need for effective chemical control measures for a range of situations (Vitelli *et al.* 2018, and references there-in).

Table 1. Annual *Chromolaena odorata* data from Douglas Shire field records.

	2013	2014	2015	2016
Properties	29	33	38	39
Monitor %	20.7	21.2	34.2	25.6
Total visits	90	85	115	65
Work hours	717	1309	1580	1286
Treated area (ha)	2.13	9.57	8.06	8.87

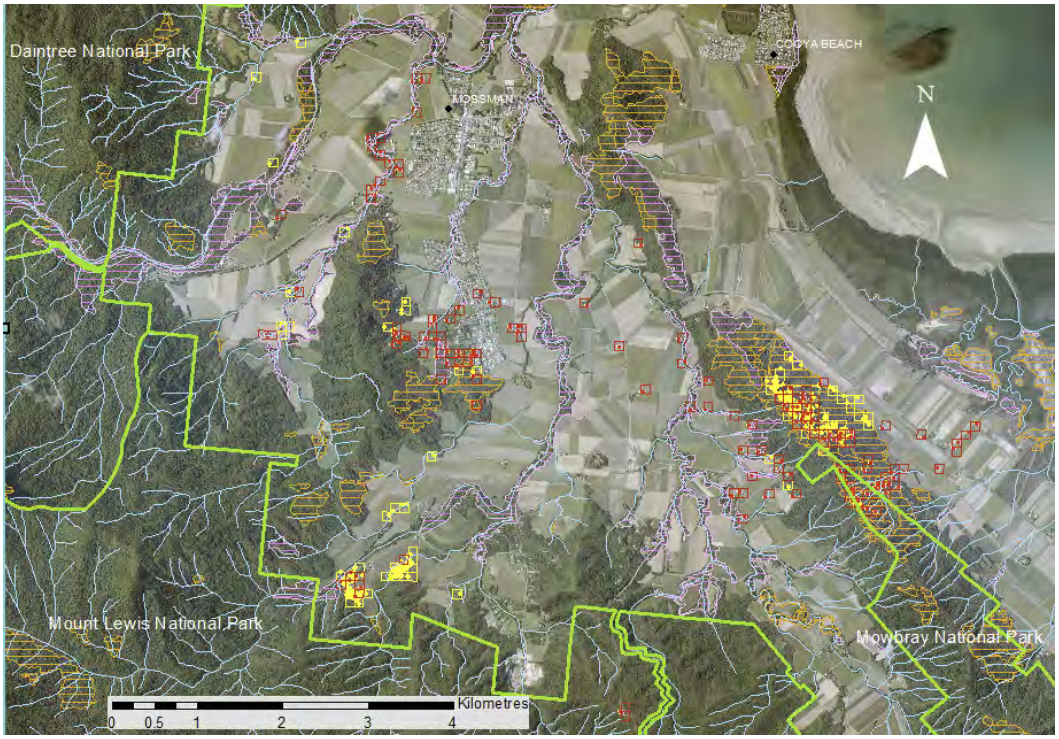

Figure 3. Location of *Chromolaena odorata* waypoints and management areas prior to 2012 (red) and after 2012 (yellow) near the town of Mossman in northern Queensland. Map also shows water courses (blue lines) endangered regional ecosystems (purple hash), 'of concern' regional ecosystems (orange hash) (see text) and national park boundaries (green line). Ecosystems are classified by their biodiversity status (Queensland Herbarium 2016).

MANAGING FUTURE RISKS

Since 2003, there has been substantial investment in on-ground control of *C. odorata* by a range of agencies in the Douglas Shire. The difficult task of removing this disparate incursion is highlighted by the recording of new points and active areas of seedling recruitment annually to 2016. While the eradication program concluded in 2012, the risk posed by this species remained and Douglas Shire Council saw the need to coordinate and continue survey and control activities. *C. odorata* is included in the shire's biosecurity plan, raising awareness of the highest priority weeds in the area, as it remains a threat to valuable local agricultural, environmental and tourism assets.

Endangered regional ecosystems (Queensland Herbarium 2016) in relation to *C. odorata* infestations have been illustrated (Figure 3). There are records of *C. odorata* within areas of endangered regional ecosystems 7.3.10a (a mesophyll vine forest) and 100–200 m away from 7.3.23a (simple-complex semi-deciduous notophyll to mesophyll vine forest) and 7.3.17 (a complex mesophyll vine forest). Endangered lowland rainforest ecosystems such as these occur as narrow fragments of creek-line vegetation, outside of reserves and amongst agricultural land. The edges of these thin strips of vegetation are susceptible to damage by a range of invasive plants including *C. odorata*. The spread of *C. odorata* along creek line vegetation, headlands and farm tracks (Figure 3) could facilitate on-going invasion into sugar cane and other horticultural crops. Isolated points show the potential for water and vehicles to spread this weed (Figure 3).

Many different vegetation types are present on reserved and unreserved vegetation in this area. South of Mossman, *C. odorata* has been recorded in endangered regional ecosystem 7.3.12b (a *Eucalpytus*, *Corymbia* and *Melaleuca* open forest with a well-developed vine forest understory) (Figure 3). In, and to the north of, the Mowbray National Park, *C. odorata* has been recorded within 'of concern' regional ecosystem 7.11.49 (a *Eucalyptus* and *Corymbia* open forest to woodland on metamorphic foothills) and endangered 7.11.16a (a *Eucalyptus portuensis* K.D.Hill and *Corymbia intermedia* (R.T.Baker) K.D.Hill & L.A.S Johnson open forest to woodland). Within 100 m of the southeastern most *C. odorata* points (Figure 3) is a small area of endangered regional ecosystems 7.11.39a (grassland dominated by *Themeda triandra* Forssk.). These examples demonstrate the different types of vegetation where *C. odorata* has been (or soon could be) recorded, and where it will continue to invade if not controlled. These open forest vegetation types may be suitable areas to periodically utilise fire, in conjunction with conservation and other land management objectives.

Elsewhere, *C. odorata* has spread into open, partly shaded and riparian vegetation along the North Johnstone River in the Wet Tropics World Heritage Area (C. Roach, pers. comm.). Currently, small infestations (the western most points on Figure 3) are approximately two km east of the entrance to the Mossman Gorge in the Daintree National Park, an essential component of the local tourist infrastructure. Local, state and indigenous groups are also controlling the spread of the wind-dispersed invasive vine *H. benghalensis* into the Mossman Gorge World Heritage Area from the east of the National park.

In addition to wind and water dispersal, *C. odorata* can also be spread by recreational and agricultural vehicles and equipment, locally and between catchments (Brooks *et al.* 2017). An isolated infestation was found near Mount Lewis, 16 km west of Mossman in 2014 and is being surveyed and controlled by Queensland Parks and Wildlife Service. Other isolated plants in Mareeba and Tableland Shires were found since 2013, with larger infestations found around Lake Tinaroo in 2017. These discoveries indicate an expanding presence on agricultural and recreational land uses, with the further spread of *C. odorata* from local infestations also possible via recreational and agricultural activities north to Cape York Peninsula.

Regardless of the scale, progressing infestations to an absence phase requires both effective control and evidence of absence. The shire's record system provides a basis for tracking treatments and human resources. By inferring absence, it provides a coarse guide to the progress in removal of *C. odorata* from the Douglas Shire and reducing the many risks this weed poses.

ACKNOWLEDGMENTS

Data presented was diligently collected by field staff from a range of local and state agencies.

REFERENCES

Brooks, S.J. (2017). What can I do with weed control data? Proceedings of the 14th Queensland Weed Symposium, ed. T. Sydes, pp. 119-25. (Queensland Weed Society, Brisbane).

Brooks, S.J., Setter, S.D. and Gough, K.L. (2017). Siam weed dispersal mechanisms? Proceedings of the 14th Queensland Weed Symposium, ed. T. Sydes, pp. 153-8. (Queensland Weed Society, Brisbane).

Jeffery, M. (2012). Eradication: lessons learnt from 17 years of the National Siam weed eradication program. Proceedings of the 18th Australian Weeds Conference, ed. V. Eldershaw, pp. 92-5. (Weed Society of Victoria, Melbourne).

Queensland Herbarium (2016). Regional Ecosystem Description Database (REDD). Version 10.0 (December 2016) (Dept of Science, Information Technology and Innovation, Brisbane).

Vitelli, J.S., Panetta, F.D., Madigan, B.A. and Van Haaren, P.E. (2018). Chemical options for the control of Siam Weed (*Chromolaena odorata*) in natural ecosystems. *Ecological Management and Restoration* 19, 88-93.

Zachariades, C., Day, M., Muniappan, R. and Reddy. G.V.P. (2009). *Chromolaena odorata.* In 'Biological Control of Tropical Weeds using Arthropods'. eds R. Muniappan, G.V.P. Reddy, and A. Raman. pp. 130-62. (Cambridge University Press, New York).