WEEDS OF NATIONAL SIGNIFICANCE

LANTANA

(Lantana camara)

Strategic Plan

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Supporting information about the National Weeds Strategy, Weeds of National Significance and progress to date may be found at www.weeds.org.au where links and downloads provide contact details for all species, their management committees and copies of the strategy.

This strategy was developed under the leadership of the Dept of Natural Resources, Queensland with full cooperation of all the States, Territories and Commonwealth of Australia.

Comments and constructive criticism are welcomed as an aid to improving the process and future revisions of this strategy.

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CONTENTS

EXECUTIVE SUMMARY

Lantana, *Lantana camara* is a much-branched thicket forming shrub originating in the tropics and subtropics of America. Since its introduction and distribution as an ornamental plant in the 1840s, lantana has spread to infest 4 million hectares. Whole ecosystems and many species are now threatened and despite extensive efforts at control, lantana remains a major weed. Lantana continues to invade habitats and to increase its density. It is now speculated that given appropriate conditions, lantana could expand its range considerably in the Northern Territory, Western Australia, Queensland and New South Wales.

Lantana thrives in warm, high rainfall, environments where it grows along forest edges, penetrates disturbed rainforest and invades open eucalypt woodlands, tree plantations and pastures. Some varieties are also poisonous to livestock. It forms dense thickets that exclude native species through shading and allelopathic effects, leading to complete dominance of the understorey and eventually the canopy. The thickets also impede access, alter fire regimes and reduce amenity and property values.

Lantana is constantly evolving through commercial introduction or breeding of new varieties. The new varieties add genetic diversity to the weedy forms, potentially increasing their weediness, and compromising the potential for future biological control. Lantana is very widespread and current control measures are not effective.

This strategy was developed in consultation with representatives from local and state governments, conservation agencies and community groups. Major challenges for effective management of lantana include the continued planting of some varieties, the high costs of control and the inaccessibility of many infestations.

The vision for lantana management:

The community working together to contain the range and minimise the impacts of lantana.

The National Strategy for Lantana Management has five closely linked goals that will be achieved through implementing a range of strategies:

1 Minimise impact

- Develop best practice guidelines
- Implement biological control
- Investigate alternative control methods
- Identify strategic management areas

2 Prevent the sale

- Investigate lantana biology
- Phase out the sale and distribution of all non-sterile varieties
- Recommend suitable alternatives

3 Increase community awareness

- Gain support for the National Weed Strategy
- Foster a culture of information sharing and innovation
- Remove public sources of hybridisation
- Target the whole community (on-going, long term)

4 Prevent spread

- Determine level and extent of current infestations
- Halt all imports of lantana species
- Reduce lantana's competitive advantage
- Report new infestations
- Investigate the ecology of lantana
- Investigate the dynamics of spread

5 Coordinate management

- Develop cooperative management frameworks at all levels
- Manage implementation of this Strategy
- Maximise the availability and use of resources.

The extent to which these outcomes are met will be evaluated as part of a five-year cycle of review and will determine the success of this plan.

THE CHALLENGE

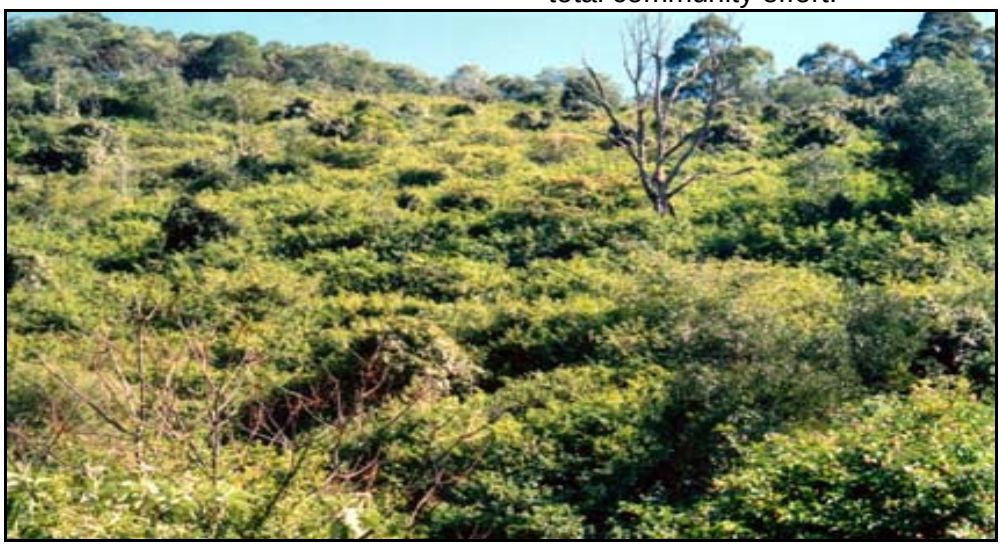
Lantana (*Lantana camara*) is one of Australia's worst weeds and the cost to the Australian community is increasing. It is widespread along coastal and sub-coastal areas from north Queensland to southern NSW. Despite extensive and lengthy efforts to control it, its control now beyond the ability of many individual landholders, and without sustained commitment by the whole community lantana will continue to invade new habitats.

The impacts of lantana infestations are significant as this plant can affect: biodiversity, fire regimes, livestock health, recreational and amenity values and production costs for agriculture and forest industries. Not all impacts are negative, lantana provides habitat for fauna, especially birds and butterflies and income to the horticultural industry. The cost of lantana infestations, however, outweighs the benefits. Until the community accepts this conflict, it is unrealistic to expect a change in attitudes or commitment to lantana management and control.

Lantana is continuing to invade new areas. It is sold by the horticultural industry in a wide range of colours and growth forms. It continues to be used extensively in landscape design in public and private gardens from where it is spread by fruit-eating birds and animals.

Land use planning policies which create; vegetation corridors, buffer strips or pockets of reserved land in rural residential land provide habitat for lantana or encourage its spread. Although lantana has been studied for many years, the ecological parameters that limit its distribution and range are unknown. Similarly, the expression of toxicity in some varieties is not understood. Some varieties of lantana are restricted from sale due to flower colour, however, most if not all of the varieties can hybridise with each other increasing the genetic variability of the species. Some commercial varieties were previously thought to be sterile but may produce seed or cross with other forms. The continual increase in the genetic variability compromises biological control of lantana and increases it's adaptability to new environments.

There are many landholders and community groups actively trying to control the spread or reduce the impact of lantana. These activities are not coordinated at regional or national levels although there are linkages with local pest management activities. Funding for many of these groups is from grants delivered on an annual basis making planning difficult and increasing disillusionment when ongoing funding is not provided. Recognising the significant effort and resources required for controlling and managing lantana across its current extent, the challenge for this strategy is to efficiently draw together the available resources and maximise the results of the total community effort.



A dense lantana infestation in coastal shrubland

1 BACKGROUND

Lantana is a weed in 47 countries and has been described as one of the world's worst weeds. It infests millions of hectares of grazing land globally and is of serious concern in 14 major crops including coffee, tea, rice, cotton and sugarcane. It is a weed of national significance because of its widespread distribution and impact on agricultural industries and biodiversity. Lantana has been described as the blackberry of northern and eastern Australia because it is readily spread by birds and forms a dense, impenetrable thicket, which smothers native vegetation and pasture.

1.1 The biology of lantana

The term "lantana" describes an aggregate species, *Lantana camara,* which contains several hundred wild and cultivated forms or varieties. At least twenty-nine varieties have become naturalised in eastern Australia and nineteen of these are economically significant. A member of the family *Verbenaceae,* the genus consists of over 160 species; only three have been brought to Australia. The others species are *L. montevidensis*, known as creeping lantana. and an increasing weed problem in coastal Queensland and *L. tiliifolia.* Actions within the strategy will also affect these species.

Lantana is a multi-branched shrub forming thickets 2-4 m high but capable of climbing up to 15 m with the support of vegetation. Lantana has square shaped stems covered in short, curved and hooked prickles. It has a shallow root system containing a short taproot with laterals branching out to form a root mat. The leaves are opposite, 2-10cm long, ovate to lanceolate, bright green on the upper surface and pale and hairy on the underside; the margins are toothed. The leaves and stems have a strong aromatic odour when crushed.

Flowers form in dense clusters and vary in colour from red/yellow, orange/pink and white depending on the type, maturity and location. Flowering occurs when soil moisture, high air humidity and high temperatures prevail, allowing almost year-round flowering and fruit production in many areas. Flowering will also generally occur 4-6 weeks after a 25mm rainfall event. (Figure 1). Insects with a long proboscis such as butterflies pollinate the flowers. There is little evidence of self-pollination. About half of the flowers will develop a single-seeded fleshy berry, borne in clusters, that turn from green to shiny purple/black when ripe. Typically, there may be several thousand fruits /m^2 /year.

Germination rates are generally low. Fresh seeds need warm temperatures for germination but will germinate throughout the year if sufficient moisture is available. The passage of seeds through the gut of animals improves germination and up to 50% viability may be maintained if seeds are stored in dry conditions for up to 6 months. Germination is reduced in low light conditions eg. understorey of intact rainforest.

Lantana is mostly spread by fruit-eating birds, and some animals, which void the seeds in their droppings. Activities that increase light intensity and soil temperature stimulate the germination of the deposited seed. Human disturbances; cultivation or road construction, changed fire regimes and feral animal activity, such as rabbit burrowing, encourage the spread of lantana.

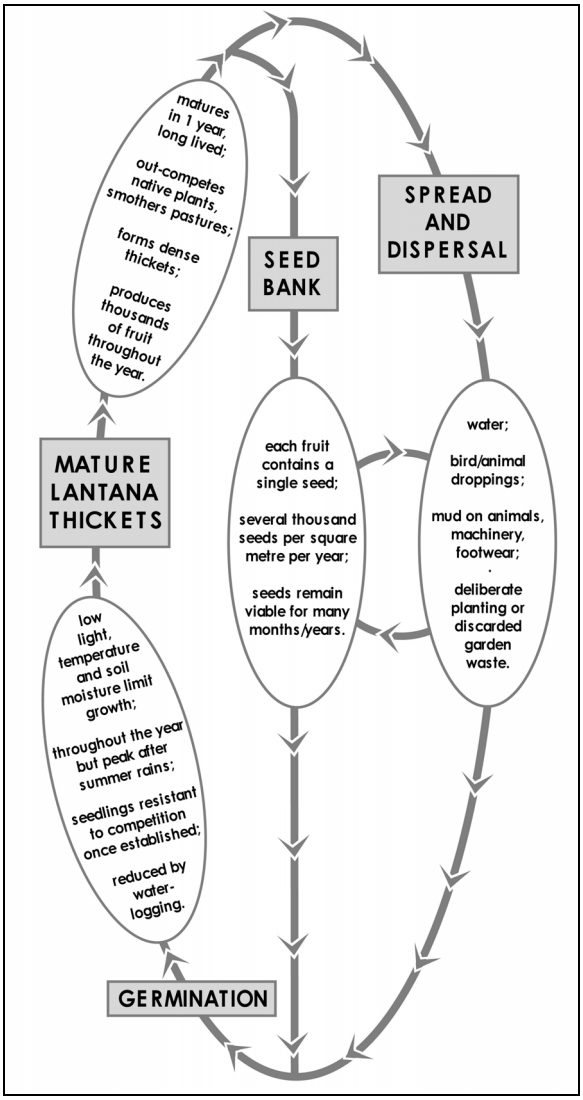


Figure 1. Life cycle of lantana.

After becoming dominant in small gaps or edges, lantana may gradually spread as a consequence of increased intensity and frequency of fires, which may kill understorey species, or by its climbing and strangling growth habits that cause further damage and reduction of the canopy. Lantana often dominates the secondary succession and allelopathic chemicals released into the soil prevent the germination and competition from some other plant species. Lantana plants can also reproduce vegetatively, sprouting from stems that take root, by layering, or by planting woody cuttings into moist soil.

Under suitable conditions of warm temperatures and high rainfall, lantana is long-lived. It does not tolerate waterlogging, salinity, prolonged drought, or shading by taller evergreen plants. The shoots are frost sensitive and temperatures below 5^{o}C prevent lantana growth. Rich volcanic and well-drained clays are ideal soils for lantana but it will grow in sandy soils if there is adequate soil moisture.

'Sterile' forms of lantana

Lantana is an aggregate species that no longer genetically matches the lantana found in its native range, due to both natural and horticultural hybridisation. There are now reputedly over 650 forms or varieties worldwide. These varieties vary in flower colour, hairiness of leaves, spininess of stems, toxicity and growth form. Some of these varieties are hybrids, crosses with other lantana species. Horticulturists have developed varieties that are largely sterile, however, they can produce viable pollen and occasionally seeds; they also spread vegetatively (Rees 1999). Interbreeding between naturalised and commercial forms will continue to produce new genetic varieties. Consequently, new forms are becoming increasingly dissimilar to the original parent plants by evolving in Australia.

1.2 History of spread

Lantana is native to the tropical and sub-tropical regions of Central and South America. Australia's first record of lantana was in 1841 at the Adelaide Botanic Gardens. By the 1860's it was naturalised lantana in Brisbane and Sydney (Swarbrick *et al*. 1998) and in the Big Scrub area in NSW (Byron Shire Council *pers comm*.). By 1897, lantana had become "a huge rambling shrub and a most troublesome weed" which had spread to form "impenetrable thickets on the banks of streams, deserted farms and the edges of scrubs" around Sydney.

Lantana currently covers more than 4 million hectares across Australia. It is widely distributed east of the Great Divide, from Mount Dromedery in southern New South Wales to Cape Melville in North Queensland, with isolated infestations in the Top End of the Northern Territory. It is present in all

States and Territories as a garden ornamental but has not naturalised to any extent in Victoria, South Australia, Western Australia or Tasmania.

Lantana is generally considered to have reached its potential range but continues to invade new habitats within the range and increase its density. There are anecdotal reports of lantana increasing its altitudinal range (above 700m) and colonisation of drier areas. Anecdotal evidence also suggests that lantana significantly increased its westward range in southeast Queensland as a response to a series of wet years in the early 1970's. It is now sited at the headwaters of major west flowing catchments and there is speculation as to its ability to spread further west along the riparian corridors given the appropriate climatic conditions. In the Northern Territory it is speculated that the recent series of very wet years led to a rapid expansion of lantana (within its range) along the coastal dune systems and into the vine thickets around suburban Darwin. If extreme climatic events drive the distribution and not climatic averages then many areas need to be taking preventative action now.

The potential distribution of lantana has been modelled using CLIMEX based on the air temperature tolerance and rainfall found in its native range (Figure 2.). The model confirms that excellent habitat conditions occur along the east coast of Australia but also predicts that suitable habitat extends across Cape York, the northern Top End of the Northern Territory, the Kimberly of Western Australia and the southern coasts of Western Australia.

The CLIMEX model does not include management regimes such as use of fire. The extreme dry season, and/or the annual burning regime, may have prevented the spread of lantana into the extensive open savannah woodlands of the Top End. In eastern Indonesia, however, where lantana is a serious invader, there are areas as dry or drier than the Top End that also experience annual fires. This suggests that lantana may be a 'sleeper' rather than simply unsuited to this area.

The ecological limits of lantana are not defined and it may be more appropriate to model distribution based on soil temperature and soil moisture. For example, when small volumes of irrigation (simulating flooding) are applied to the CLIMEX model it pushes the westward distribution boundaries into the floodplains and drainage channels of western Queensland. The implications are that given adequate rainfall/flood events, lantana could spread significantly further west of its current east coast range.

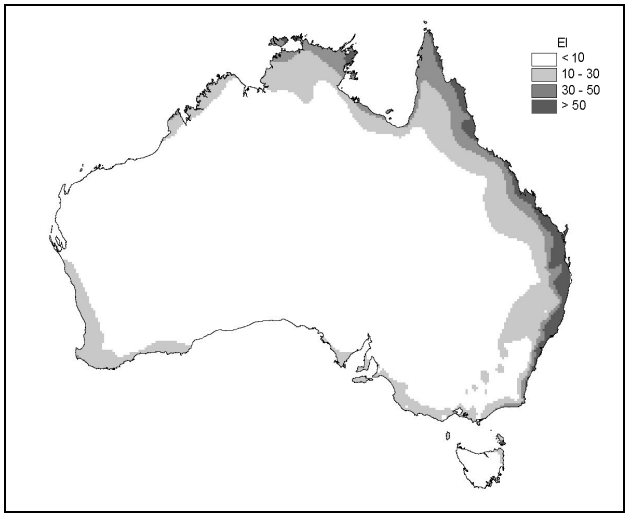


Figure 2. Potential distribution of Lantana
(Data is splined from a CLIMEX prediction. EI =Ecoclimatic index. EI < 30, low potential for permanent population, EI > 50, potential for permanent population is very high.)

1.3 A weed of national significance

The impacts of widespread lantana infestations are significant as this plant can affect: biodiversity, fire regimes, livestock health, recreational and amenity values and production costs for agriculture and forest industries. Not all impacts are negative, lantana provides habitat for fauna, especially birds and butterflies and income to the horticultural industry. The cost of lantana infestations, however, outweighs the benefits.

Environmental:

- Present in 165 Queensland reserves, including 5 threatened plant communities and 1 Ramsar site.
- Identified by the QEPA as a potential threat to more than 60 plant and animal species of conservation significance.
- Its presence in all rainforest remnants of north coast New South Wales make it the region's most widespread rainforest weed.
- A major threat to the remnants in southeast Queensland and the Wet Tropics World Heritage Area, especially along the margins where lantana increases wild fire damage.

- Responsible for increases the nitrate levels in the soil and forest litter leading to improved growth of this weed and other exotic species.
- Spreads in eucalypt forests, particularly in microhabitats such as moist gullies and areas subject to regular disturbance activities.
- Shades out most grasses and herbaceous plants to form dense thickets.
- Changes to the floristic composition, fuel loads and burning patterns
- Affects coastal beach scrubs, in better-drained paperbark understorey and especially on the better soils of vine thicket sites. In the Northern Territory it has recently spread along the coastal dunes and margins of monsoon vine thickets close to Darwin.
- The open vine thickets of the Forty Mile Scrub in north Queensland are now more prone to fire damage because of lantana infestations.

Primary production:

- Annual Queensland pastoral losses due to lantana estimated at $7.7 million, comprising 1500 animal deaths, reduction in performance, loss of pasture and lantana control costs.
- Total control costs incurred by primary industries in Queensland estimated to be more than $10 million per year.
- Decreased pasture production due to displacement of pasture grasses.
- Uncultivated pastures or neglected properties are readily invaded.
- Animal manure facilitates the germination and establishment of new seedlings.
- Restricted the access and movement of animals, humans and vehicles.
- Decline of traditional dairying/beef industries on the NSW and Queensland hinterlands and the expansion of rural subdivisions have resulted in many marginal grazing lands being abandoned and invaded by lantana.
- Lantana persists along riparian corridors, roadsides and fence lines in more intensively managed areas providing a seed source.
- Livestock poisoning occurs in young animals or when animals are newly introduced to lantana infested pastures. For example a Gatton farmer has lost 5 head in recent years. He treats 2h of lantana a year at the cost of 1 cattle beast needed to purchase chemicals.

Forestry and forest management:

- Lantana is an important weed of commercial hoop pine plantations in southeast Queensland and eucalypt plantations in New South Wales.
- Open canopy of eucalypt plantations permits lantana to establish and persist as a prolific understorey monoculture affecting production and re-establishment after clear felling.
- The total cost for plantations is estimated to be in excess of $0.5 million annually.
- Increased road and fire trail maintenance costs.
- Lantana is the most significant weed in terms of native forest management in NSW State Forests. To minimise disturbance during logging, and to protect sensitive riparian and native forest areas, NSW State Forests is required to mark exclusion areas with paint or tape. This activity is impeded by lantana and gives rise to a significant occupational health and safety issues.
- Hazard reduction burning is often impossible to achieve, while, thickets burn intensively under severe bushfire conditions where the dry canes provide a fuel continuum into the forest canopy, fuelling crown fires.
- A NSW Forests study demonstrated that one form of eucalypt die-back occurred where lantana provides nesting sites for bell miners (*Manorina melanophrys*). These birds aggressively defend territory against other insectivorous birds resulting in an increase in leaf feeding insects. Trees become weekend and susceptible to secondary stresses in woodborers or fungal decay.

Tourism, recreation and amenity:

- Thickets restrict access, vision and visual amenity, and the general variety and quality of the bushland recreational experience.
- Increase fire hazards and management costs.
- Indirectly this affects local tourism and affiliated industries.

Transport corridors:

- Infests; roadsides, railway land, utility easements, restricting access and imposing control costs.
- Lantana is one of the eight most troublesome weeds in NSW affecting railway land.

Direct costs of control activities:

There are no accurate details of the national cost of controlling lantana because it is difficult to partition lantana control work from other weed or land management routines, however, indications can be taken from the following agencies and individuals:

- NSW National Parks – over $100,000 per annum,
- Ergon (QLD electricity company) Mackay region – $46,000 per annum in keeping lines and easements clear,
- QPWS (Monto and Wide Bay-Burnett) – more than $50,000 per annum,
- Maroochy Shire Council (QLD) – more than $30,000 per annum,
- QDPI Forestry (SEQ) – up to $30,000 in one exotic pine plantation centre and $130,000 in a hoop pine plantation centre and
- Emu Creek Catchment Group (south east QLD) – estimates that eight million dollars is needed to clear up light to scattered infestations in the catchment.

Horticultural industry benefits

- Lantana is an ornamental plant, used particularly in low maintenance plantings and for the flowers ranging from pale cream/white to any colour of the rainbow except green. Plantings add significant colour in low maintenance and high disturbance sites.
- The 'sterile' forms are preferred for their compact shape, non-prickly foliage and longer lasting flowers (fewer fruit are formed).
- It is unknown what level of income is derived from sales of lantana, however, it has been widely distributed across Australia and a number of varieties are still sold.

Other benefits

Whilst there may be some benefits from lantana, it must be recognised that they are massively out weighed by the negative impacts.

- Lantana thickets create a substitute habitat, providing food and shelter for some animal species including; bandicoots, whipbirds, quail, wrens, birdwing butterflies and the vulnerable bird (*Ternix melanogaster*), the black-breasted button quail.
- The habitat is not as diverse as the natural system but it provides structural complexity in the absence of an understorey that might be lacking in other land-use alternatives.
- Lantana thickets in one Queensland reserve are critical for the survival of young bush turkeys.
- Benefit rainforest communities by preventing grass invasion of disturbed rainforest.
- Acts as a green manure to regenerate worn out land by creating a thick humus layer.
- Suppresses other annoying, intractable and competitive weeds.
- In bush regeneration projects, where native protective 'edge' species are removed, lantana can form a useful temporary buffer by restricting access and shielding natives from desiccating or salt laden breezes.

1.4 Legislative controls

Lantana is declared in only two states. More declaration that is widespread has been prevented by lack of feasible control methods and the extent of current infestations. Some local governments in New South Wales, Maclean Shire and Greater Taree City Council, declare pink/red varieties as W2 (the plant to be fully and continuously suppressed and destroyed) while others list it as a W3 (prevent spread and to reduce its numbers and distribution). The legislation is enforced in Eurobodalla, the southern most infestation. Northern Territory prohibits lantana's introduction and requires control of its growth and spread in some areas. Local governments in Queensland have listed lantana with various control levels under local laws.

1.5 Control to date

Within its range, lantana is generally widespread and often receives a lower priority for resources because it is not recognised as an emerging threat or because the resources available are small in relation to the scale of the problem. Consequently,

allocation of funding is often to other high priority weed species where greater strategic advances are possible.

Integrated management

There is no blanket control regime for lantana control because the species occurs across many different land-uses, ecosystems and land management goals. A range of lantana control methods is available; each has inherent risks that need to be managed. In some cases it will not be economically feasible, or physically possible, to undertake control without biological control or the use of fire, however, control has been achieved in many situations using a range of methods in conjunction with revegetation and sustained, long-term, follow-up control.

Physical Control

- Hand or manual removal of lantana produces less soil disturbance than mechanical methods but seedlings tend to escape and survive.
- Mechanical removal, (heavy machinery) creates a larger disturbance and results in higher germination rates. Either method is usually limited to smaller infestations and requires revegetation with suitable cover species.
- Burning is still being developed as a control tool but is the most economical method for broad scale lantana control. High lantana mortality was achieved in southeast Queensland with early summer when lantana is actively growing (warm days, low humidity, good soil moisture). Winter burning, when lantana is not actively growing and conditions are drier and colder however is not successful.
- Risks associated with using fire that need to be managed include the: potential destruction of rainforest, acceptability of a blackened forest (temporary), safety for the public (of paramount concern) and damage to plantation or commercial forest timbers.
- The staged removal of lantana, followed by revegetation with appropriate species, will reduce erosion, impacts on the area's ecology and susceptibility to weed invasion, including the re-establishment of lantana. Bared soil under lantana can produce a considerable natural regeneration, although this will depend on age of the thicket and distance too seed sources. Revegetation is a long-term process and requires commitment to on-going monitoring and follow-up treatment.
- Planting rainforest species to form a shady canopy can reduce lantana and restore rainforest clearings in the longer term.
- Grazing properties require the rapid establishment of a vigorous pasture, such as kikuyu and Rhodes grass, to out-compete lantana, this has been a very effective technique.

Chemical control

A number of herbicides are registered for control of lantana. The cost is an impediment to treating large infestations. Genetic variation in lantana also creates mixed responses to herbicide treatments, with red-flowering forms tending to be the most difficult to control as demonstrated in Eurobodalla where many recommended herbicides consistently fail although they do result in leaf drop. Basal bark and cut stump applications can be used for larger plants with each stem usually requiring treatment. Spraying usually kills plants less than two metres high.

A typical battle

Landholders commonly spend considerable time and money in trying to maintain a 'tidy' weed free property. A typical owner of a steep, scrub block in southeast Queensland with lantana infestations may spend $3000-5000 per year on control. Commonly a combination of physical crushing and burning is used to clear the thickets before revegetating with pasture species and follow-up spraying. Lantana work commences in September, when conditions are still dry, using a dozer to crush the lantana. This dries for 4-5 weeks depending on conditions and is then burnt. The area is fenced to exclude stock and hand sown with a mixture of pasture grasses. Regrowth is monitored and sprayed in successive years. Based on a 4 hectare infestation initial clearing costs ~$92/ha, pasture establishment $155/ha (depending on seed varieties used). The regrowth requires three follow-up sprayings and the costs vary depending on the spray and the need to hire a spray rig ($56/hr including labour of one operator). Using 2,4-D ($19/ha) for the first spray with follow-up spraying using Grazon ($41/ha) or a Tordon/2,4-D mixture ($39/ha), the process of lantana removal and pasture establishment could take 3 years or more.

In very steep country where access is limited, landholders resort to helicopter spraying with glyphosate to achieve a knockdown before burning, sowing and follow-up spraying. Heli-spraying costs around $184/ha, depending on the herbicide used.

Extension and education

In a unique partnership, the Nursery Industry Association of Australia, the CRC Weed Management Systems and the State Nursery Industry Associations are developing an initiative called 'Garden Plants Under the Spotlight'. The initiative aims to educate the community about suitable plant selections and the potential for some species to become garden escapes. A list of 52 species has been nominated for use as case studies and this includes lantana.

The National and State Weedbuster Programs in conjunction with State and local governments, have developed a range of popular weed identification cards, and these include lantana.

All is not lost?

Areas of southeast Queensland in the 750-1250 mm rainfall band support the distinctive Araucarian 'dry rainforest' community. Typically, these forests were logged and many were burnt and cleared for agriculture or grazing. Lantana began invading these forests at the end of the nineteenth century and many thickets persist today. Anecdotal reports show rainforest succession overtaking and replacing the lantana.

The Queensland EPA has been monitoring a 6 ha site near Maryborough. It was logged in the 1950's and mostly cleared for grazing in the late 1960's. At this time, woody vegetation comprised 12% of the area, lantana thickets 83% and pasture 5%. Since 1972, woody vegetation has gradually returned to the site such that in 1996, woody species formed a total cover of 54% and the species mix suggests that rainforest comparable to that of surrounding areas will eventually re-establish at the site.

The success of the dry rainforest regeneration may be attributed to a number, or combination, of factors, including:

- maintenance of several remnant trees used by fruit eating birds,
- a close source of rainforest propagules,
- leaf drop and desiccation of lantana during dry periods while native bush is more robust,
- protection from fire and
- lantana's vigour and competitive advantage being reduced during dry periods.

Biological control

Since 1914, 28 insects have been introduced to control lantana in Australia. Of these, 17 species have established with 4 regarded as effective. Insects that have caused significant damage are:

- *Ophiomyia lantanae*, a seed-feeding fly (north Queensland to southern NSW);
- *Teleonemia scrupulosa*, a sap-sucking bug (dry areas from north Qld to Sydney);
- *Uroplata girardi*, a leaf mining beetle (north Queensland to Sydney); and,
- *Octotoma scabripennis*, a leaf-mining beetle (Rockhampton to Sydney).

No agents to date have established south of Sydney, the ability of agents to establish and control lantana has been affected by climatic variation and the large number of lantana varieties in Australia. Some agents have also

displayed differences in their preferences for particular varieties. Lantana is able to withstand stress by dropping its leaves restricting activities of control agents such as leaf feeding insects.

1.6 Principles underlying the plan

This Strategy is based on the recognition and acceptance of four principles outlined in the National Weeds Strategy:

- Weed management is an essential and integral part of the sustainable management of natural resources and the environment, and requires an integrated, multidisciplinary approach.
- Prevention and early intervention are the most cost-effective techniques that can be employed against weeds.
- Successful weed management requires a coordinated national approach, which involves all levels of government in establishing appropriate legislative, educational funding and coordination frameworks in partnership with industry, landholders and the community.
- The primary responsibility for weed management rests with the landholders/land managers but collective action is necessary where the problem transcends the capacity of the individual landholder/land manager to address it adequately.

1.7 Process followed

Participation and consultation of all stakeholders is paramount in the development of a successful strategy. The National Strategy for Lantana Weed Management is a product of 6 months of planning and public consultation (Figure 3). It has been developed through the Lantana National Strategy Workshop (Brisbane, 16/17 May 2000), attended by thirty government and community, industry and conservation representatives from New South Wales and Queensland.

The Workshop was advertised via the electronic list server, ENVIROWEEDS, which reaches over 400 people involved in weed management nationally. A questionnaire was also mailed to respondents and other interest groups to obtain additional information on lantana distribution and impacts. Over forty replies and submissions were received.

Draft strategies were forwarded electronically to individuals and groups who expressed interest during the development process. Many of these individuals provide links to major stakeholder networks through their membership databases.

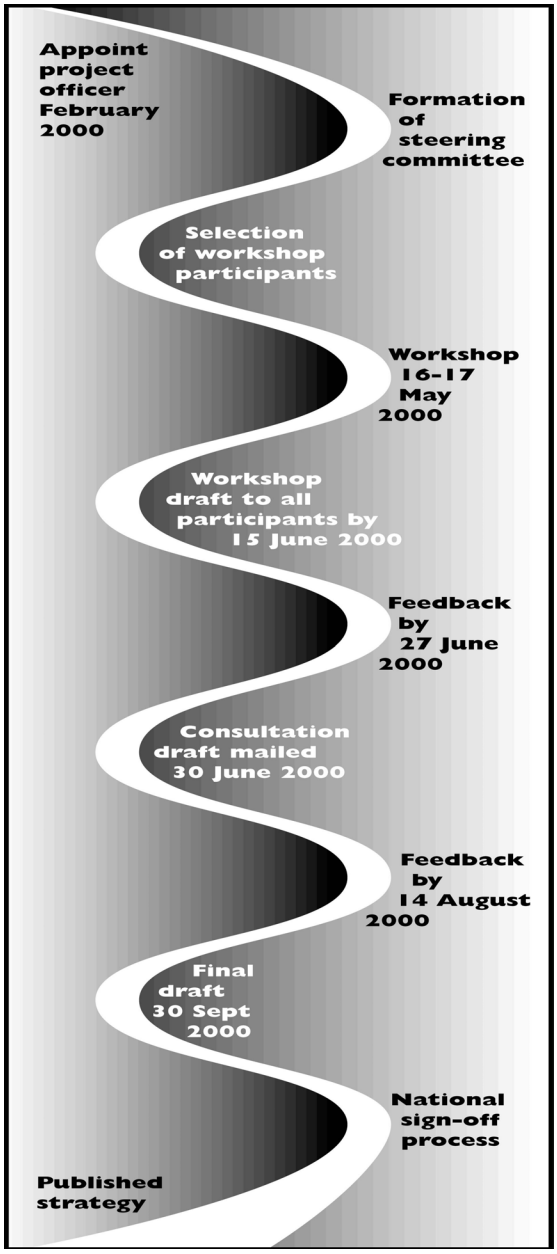


Figure 3. Strategy development process.

Over 40 responses were received from interested parties from three states and across a wide range of interest groups. Most groups were supportive of the direction and content of the strategy but concerns were raised about the feasibility and impact of preventing the sale of all lantana cultivars. Many groups saw this as essential, however, for the success of a strategy on this species.

The Strategy will be implemented through the Lantana Management Group who will provide the management framework for lantana as a Weed of National Significance and advise the National Weeds Strategy Executive Committee on progress (terms of reference are available from the National Weeds Strategy Executive Committee).

1.8 Relevance to other strategies

The National Strategy for Lantana Weed Management has been established to provide a framework for coordinated management of lantana across the country. Complementary linkages can be found in a range of existing resource management initiatives at all jurisdictional levels shown in the table below.
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Table 1: Policy and strategy linkages

Scope Scale	Natural Resource Management	Pest Management	Weed Species Management
National	National Strategy for Conservation of Biodiversity National Strategy for NRM National Strategy for Ecological Sustainable Development	National Weeds Strategy; Weeds of National Significance	Weeds of National Significance strategy
State	State Biodiversity and Natural Resource Management Strategies Forest policies.	State Weed Strategies Queensland Government Policy on Management of pests on state lands	Lantana Biological Control Task Force
Regional	Regional NRM Plans	Regional Pest Management Strategies	Specific weed control plans (NSW)
Catchment	Catchment Management Strategies	ICM Pest Management Strategies	
Local	Landcare plans Conservation corridor plans Riparian vegetation management plans Bushcare plans	Local Government Pest Management Plans (Qld.)	Local weed control plans (NSW)
Property	Property Management Plans National Parks Management Plans (NT).	Property Pest Management Plans National Park Weed Management Strategies (NT)	Property weed management plans

2 STRATEGIC PLAN

VISION

The community working together to contain the range and minimise the impacts of lantana.

2.1 Minimise impact

Desired Outcome

Effective and efficient control methods available for all situations.

Background

Lantana is distributed within many ecosystems, across a wide climatic range and many biogeographic regions. Blanket management options are not feasible given the diversity of land uses and the differing land management goals within this extensive range. There is considerable interest and commitment to biological control because of its potential sustainability but it must be recognised as being one part of an effective integrated control package. Most current control options are very expensive to the landholder, especially in relation to returns per hectare. A suite of management options and combinations is available, however, best practice information is not accessible to assist in identifying, choosing or planning control programs.

Some lantana control programs offer years of data and experience. It is important to recognise the areas where considerable control efforts have taken place and to maintain effective control in areas that the community have identified as having high priority. If the control has not been effective it shouldn't be continued. Areas that are not yet invaded should be seen as priority places for good management to prevent invasion (see also 2.4).

Strategy	Actions	Responsibility	Rank
2.1.1 Develop best practice guidelines	Develop action matrix of best practice options Identify factors influencing lantana management including; ecosystems, land use, land type, cultivars, density, legislation and information gaps Identify, document and facilitate delivery of best practice management for all situations and sites	State agencies, landholders, community groups, nursery industry	1
2.1.2 Implement biological control	Increase efforts to research and distribute biological control agents, including possible native agents	State agencies, local government, landholders and community	1
2.1.3 Investigate alternative control methods	Investigate other land management techniques that may reduce the spread of lantana including alternative land uses such as farm forestry Investigate and extend integrated management systems Investigate incentives for innovative management projects	All community State agencies State/Federal agencies to oversee	2
2.1.4 Identify strategic management areas	Review and evaluate areas where control programs have already been undertaken Identify high priority areas and take appropriate action: • lantana free areas within potential range • conservation (return species or ecosystems) • amenity (public access, visual amenity) • production (primary industry, tourism)	State agencies & local government. Community groups, State government, industry	2

2.2 Prevent the sale

Desired outcome

Reduction in the genetic diversity of the weedy lantana forms.

Background

Lantana's ability to hybridise is commercially exploited to produce a wide range of phenotypes with a variety of colour and growth forms for the horticultural industry. Australia only has a small proportion of the genetic diversity of lantana and the development and promotion of new varieties is adding to the genetic diversity of lantana. This has direct implications for biological control as it compromises the ability to find agents that will attack the new phenotype. To contain the constant evolution of new phenotypes and to stop increasing the plants weediness, it is necessary to prevent breeding between existing wild forms and the horticultural releases.

Responsible and positive action can be achieved through promotion of alternative species and by withdrawing support for weedy species. There are native and exotic species with similar attributes to lantana that offer potential as alternative garden plants. The changing of community attitude towards planting lantana is covered in 2.3.

Strategy	Actions	Responsibility	Rank
2.2.1 Investigate lantana biology	Identify all the varieties that can crossbreed with wild lantana forms to form non-sterile hybrids	NIAA, QDPI, NSWAg, DNRE, QDNR	1
2.2.2 Phase out the sale and distribution of all non-sterile varieties	Undertake feasibility study of the economic impact of withdrawing all non-sterile lantana species from sale, cultivation and distribution, including an economic impact statement	Joint responsibility of Strategy Management Group and NIAA	1
	Develop a phase out strategy	Strategy Management Group	
	Prepare consistent legislation across all States/Territories to prevent sale, cultivation and distribution	Lead State Agencies	
	Enforce legislation	Lead State Agencies	
	Remove and destroy lantana stocks after phase in of legislation	Lead State Agencies	2
2.2.3 Recommend suitable alternatives	Develop and promote a list of suitable alternative species for replacing lantana including recommendations that cover both regions, ecosystems and situations in which lantana is currently used	Lantana Management Group, NIAA, catchment management groups, local government	2

2.3 Increase community awareness

Desired Outcome

Community attitudes and actions reflect the severity of lantanas impacts.

Background

Lantana management fits within the total package of pest management (Table 1). The National Weed Strategy provides for a sustained level of commitment to weed management in the long term. Commitment to the National Weeds Strategy is also paramount to acceptance of lantana as a weed of national significance.

The principles underpinning this Strategy identify the need for collective action and that responsibility for lantana management falls on the total community. This includes all levels of government, industry, land-owner/manager, urban and rural residents. Creating awareness of the impacts of lantana must therefore cross all sectors of the community as well as targeting specific stakeholders. Within the nursery industry it is important to recognise that the NIAA represents a small, but significant number of wholesalers and retailers and that there are many other members of the industry ranging from super market chains to garden clubs. Government agencies use varieties of lantana in areas of harsh conditions for aesthetic and low maintenance gardens. This not only allows pollination of pest varieties, it encourages the public to plant the species. Local and state government have a responsibility to educate the public, their own staff and contractors to grow local or non-invasive introduced species.

Awareness of the issues surrounding lantana will lead to a change in community attitudes to planting this and other weedy species. It is important to recognise that there are also other methods of reducing the potential for the development of infestations such as avoiding overstocking and effective management of bush remnants.

Television is a prime mechanism for extending weed information but is limited by commercial considerations. Other examples of activities that can contribute to better weed management and understanding in the community include; Weedbuster Week activities, fact sheets, posters, free plant schemes, voluntary conservation agreements and weed control rate rebates.

Strategy	Actions	Responsibility	Rank
2.3.1 Gain support for the National Weed Strategy	Canvass the nursery and allied industries professional associations including advertising in professional journals. Communicate NWS goal/objectives to all stakeholder groups and their members	Commonwealth and State/Territory agencies, Landcare, ICMC	1
2.3.2 Foster a culture of information sharing and innovation	Form a "Communications Committee" (representatives from interest groups/organisations) Develop, implement and monitor a Communication Plan	Lantana Management Group Communication Committee	1
2.3.3 Remove public sources of hybridisation	Replace existing public lantana plantings and prevent future plantings Enforce legislation on preventing sale/distribution	State and Local government agencies Regulatory agencies	2
2.3.4 Target the whole community (on-going, long term)	Develop an on-going, long-term education campaign using a suite of products and messages. Highlight the impacts of lantana, its distribution and spread	NIAA, government agencies, Weedbuster groups All levels of govt, industry and community groups	2

2.4 Prevent spread

Desired outcome

Prevent new lantana infestations.

Background

Lantana is now so widespread that new infestations often go unnoticed. Very little is known about the distribution of the different phenotypes or the ecological factors driving its distribution. Without an understanding of the ecological limitations it is not possible to predict where lantana might spread or to provide management strategies for these areas. As long as new genetic material is constantly introduced lantana's potential to spread will increase.

Areas within the Northern Territory and Western Australia are considered vulnerable to invasion by lantana, but this may considerably underestimate the potential distribution if anecdotal evidence proves correct.

Biological control offers the ability to weaken the plant and reduce its capacity to flower/seed/fruit. It is potentially an important method in reducing the vigour of lantana thickets to permit other species to establish.

Strategy	Actions	Responsibility	Rank
2.4.1 Determine level and extent of all current infestations	Identify a uniform mapping system (all WONS species) and develop guidelines for information collection Map and monitor distribution and density of all forms of lantana	NWSEC Community/catchment groups to feed back to state agencies	1
2.4.2 Halt all imports of lantana species	AQIS to review importation of *Lantana* sp. AQIS includes all lantana species on prohibited list	AQIS AQIS	1
2.4.3 Reduce competitive advantage	Increase efforts afforded to biological control	State agencies	1
2.4.4 Report new infestations	Assess existing systems for reporting new weed infestations and adopt or modify Strategically control new and isolated infestations	Management group Land managers	1
2.4.5 Investigate the ecology of lantana	Develop a better understanding of the ecological and biological parameters that determine distribution	State research agencies, universities and bird societies	2
2.4.6 Investigate the dynamics of spread	Review historical data to identify sources and agents of spread Document and map historical spread of lantana phenotypes	State agencies, universities and bird societies State agencies	3

2.5 Coordinate management

Desired outcome

Management is coordinated at all levels.

Background

Table 1 highlights the linkages between management plans and strategies. To be effective, this Strategy must be able to be implemented at the local level and therefore requires a hierarchy of complementary plans to support it at the regional, State and National levels, or the catchment and local government levels, as appropriate.

More critically, implementation relies on long-term commitment of resources. These resources need to be made available in an appropriate and timely manner to enable efficient and effective action. Approaches for funding should be co-ordinated to highlight the level of commitment and to maximise the chance of funding support. The development of a management group to oversee this Strategy can facilitate such coordination. Fragmentation of control effort both spatially and through time should be avoided.

Strategy	Actions	Responsibility	Rank
2.5.1 Develop cooperative management frame works at all levels.	Develop and implement State, regional, catchment, and local level management plans in partnership with all stakeholders in appropriate working groups.	State agencies, Local government; Land Councils, Community	1
	Ensure objectives of each planning level are consistent and meet local level needs. Utilize: • Regulatory & planning instruments; • Governments set good examples, • Incentives to encourage participation; and, • Linkages to catchment and local vegetation management plans.	Landholder, ICMC, Landcare, Local government	2
	Incorporate the actions from catchment and local lantana management plans into individual property management plans		2
	Property management extension programs to include a focus on weed management.	NSW Ag, QDNR	2
2.5.2 Manage implementation of this Strategy	Form a Lantana Management Group to implement and monitor this Strategy	Workshop Steering Committee	1
2.5.3 Maximise the availability and use of resources	Obtain adequate resources to implement this Strategy Identify new/additional sources of funding/labour Lobby for additional funding toward lantana management	Lantana Management Group, NWSEC, State agencies, local government	1

3 MONITORING AND EVALUATION

This Strategy is subject to a 5-year review. The Lantana Management Group will monitor the implementation of the plan as a component of its quarterly meetings. Annual reports will be forwarded to the National Weeds Strategy Executive Committee and made available to interest groups in the most cost effective way. Monitoring will include a review of actions outlined and undertaken in:

- State weed management strategies,
- Catchment management plans,
- Local government pest management plans,
- Project plans developed from this strategy and
- State of the Environment reporting processes.

A set of key performance milestones include the:

- Establishment of the Lantana Management Group,
- Provision of adequate resources to implement the Strategy,
- Establishment of a reporting process,
- Identification and documentation of best practice,
- Identification and action taken on high priority management areas,
- Completion of the study of the economic impacts of lantana,
- Introduction of national legislation restricting the trade and distribution of lantana,
- Identification and promotion of appropriate alternative species,
- Removal of lantana plantings from public gardens and spaces,
- Establishment of the Communication Committee,
- Implementation of a national promotion campaign,
- Completion of mapping and
- Recognition of lantana impacts and management in planning initiatives at all land management levels.

4 STAKEHOLDER ROLES AND RESPONSIBILITIES

Agencies and individuals share responsibilities for the strategies and actions listed in Section 3 and rely on the development and maintenance of partnerships between community, industry and government.

Industry (including wholesale and retail nursery associations, gardening clubs, television, print media, landscape architects and designers)

- Promote best practice management of lantana,
- Contribute to extension and education on impacts of lantana,
- Stop promoting and planting lantana in new areas,
- Self-regulate sale of all fertile species used in industry and
- Promote alternative species to the community.

State agencies (Agricultural and horticultural sections of Departments of Agriculture, Forests, Environment, Natural Resources and Water Conservation)

- Introduce and enforce legislation covering sale and distribution of lantana,
- Investigate the biology and ecology of lantana phenotypes,
- Continue to investigate/implement biocontrol,
- Investigate alternative control methods and integrated management systems,
- Document and promote best practice,
- Develop long term extension and education program for specific regions and audiences highlighting the impacts of lantana,
- Contribute to management plans, and ensure lantana management is incorporated into all appropriate plans,
- Identify strategic management areas,
- Map and monitor distribution of lantana phenotypes and
- Liaise with other departments to remove existing plantings on State lands/buildings/roads.

Local governments (including County Council Weed Committees, Land Councils)

- Replace lantana and ensure it is not used or removed from public plantings,
- Enforce legislation,
- Develop and use long term extension and education strategies to highlight impacts,
- Ensure lantana strategy goals are recognised in all appropriate management plans covering the area,
- Identify priority management areas,
- Promote and use best practice and
- Monitor and evaluate Strategy implementation.

Federal government

- To ensure uptake by Departmental staff to restrict movement of weeds (agencies that manage land and travel on non-government land),
- To ensure lantana control is undertaken on all Federally managed lands (Defence, EA and other Commonwealth departments / corporations that manage land),
- Oversee and manage federal funds including NHT and NWP (EA, Agriculture, Forestry and Fisheries – Australia) and
- AQIS to prevent further imports.

National Weed Strategy Executive Committee

- Identify a national weed mapping system and,
- Promote goals and objectives of National Weed Strategy to industry professional bodies, local governments (users of lantana).

Lantana Strategy Management Group

- Implement and monitor the Strategy,
- Access and coordinate resources and
- Develop the Communication Committee.

Community groups (including Landcare, ICMC, Greening Australia)

- Identify and manage priority areas,
- Assist develop and promote best practice,
- Canvas support for National Weed Strategy goals,
- Identify and use alternative species and
- Map and monitor the distribution of phenotypes.

Individual managers

- Identify and manage priority infested areas,
- Include lantana in property management plans,
- Use alternative species.

5 ADDITIONAL READING

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7 GLOSSARY

AQIS	Australian Quarantine and Inspection Service
CLIMEX	Simulation modelling system developed by CSIRO
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DLWC	Department of Land and Water Conservation (NSW)
DNR	Department of Natural Resources (Qld)
DNRE	Department of Natural Resources and Environment (Vic)
DUAP	Dept of Urban Affairs and Planning
EPA	Environmental Protection Agency
ICMC	Integrated Catchment Management Committee
LG	Local Government
NIAA	Nursery Industry Association of Australia
NRA	National Registration Authority
NRM	Natural Resource Management
NTDPIF	Department of Primary Industry and Fisheries (NT)
NPWS	National Parks and Wildlife Service (NSW)
NWS	National Weed Strategy
NWSEC	National Weed Strategy Executive Committee
Pestinfo	GIS based information system
PIJAC	Pet Industry Joint Advisory Committee Planning (NSW)
PWCNT	Parks and Wildlife Commission of the Northern Territory
QDNR	Queensland Department of Natural Resources
QDPI	Queensland Department of Primary Industries
QEPA	Environmental Protection Agency (Qld)
QPWS	Queensland Parks and Wildlife Service
Ramsar site	Internationally recognised wetland
SCARM	Standing Committee on Agriculture and Resource Management
WONS	Weeds of National Significance.