

Chapter 4

Case study 1

Gamba grass in Western Australia: eradication is in reach

John-Paul Slaven, Department of Primary Industries and Regional Development, WA

Management objective: eradication

Key points

- Eradication programs require surveys to determine the full extent of the infestation.
- Eradication programs require agreement and cooperation across all land managers.
- Successful eradication programs require exhausting the existing seed bank while preventing any further addition to the seed bank.



Background

While gamba grass is well established in the Northern Territory (NT) and Queensland, it hasn't gained more than a toehold in Western Australia (WA). Released as a pasture species in the early 1990s on El Questro station, gamba grass spread unchecked until eradication efforts started in 2008.

The eradication program has evolved over time as project partners reflected on their learnings and adjusted the approach accordingly. This case study highlights how control methodologies evolved as project partners made the changes required to achieve eradication.



Isolated gamba grass plant in El Questro, WA.

Raitech

Case study 1

The problem

In the 1980s, the WA then-Department of Agriculture promoted gamba grass as a useful pasture species for pastoral leases in the region. Its production of quality green fodder at the start of the wet season, ability to spread and resilience to fire made it an ideal companion to popular fodder legumes.

While not widely adopted in the region, gamba grass was established on El Questro station in the East Kimberley through aerial broadcast over 1,770 ha in 1991. The area infested consists of low undulating shale hills supporting spinifex or grasslands with creek lines populated with paperbark and low eucalypts on Pago sands. This land is of low grazing potential and not ideal for the establishment of pasture.

Despite annual fires and heavy grazing, gamba grass successfully established on the small pockets of fertile land along creek systems in the area. Surrounding areas of high ridgelines and plateaus effectively confined gamba grass to one catchment. Its proximity to vast expanses of untouched wilderness and highly productive black-soil plains motivated stakeholders to embark on an eradication program.

The approach

Given the magnitude of the gamba grass problem in the NT, land managers and agencies in WA were concerned about its potential to spread. Following a 2007 assessment by staff of the then-Department of Agriculture and Food Western Australia (DAFWA), El Questro management decided to commence eradication. The following year, DAFWA listed gamba grass as a declared pest, requiring its eradication.

Methodology

El Questro rangers and biosecurity staff from DAFWA conducted initial control efforts between 2008 and

2012. Treatment consisted of grading access tracks and a 'burn, spray, burn' technique, where a late-dry-season hot burn was conducted, regrowth from opening rains was sprayed with glyphosate, and another burn conducted when gamba grass started to senesce.

In 2012, DAFWA and the then-Department of Parks and Wildlife (DPAW) began annual aerial surveys of the area to delimit the population and identify areas within the infestation for targeted management. DPAW sourced funds from the *Kimberley Science and Conservation Strategy* to employ Wunggurr Rangers to assist their own staff in eradication efforts.



Hand removal of gamba grass.

Raitech

Dense areas of gamba grass were treated by removing, bagging and destroying seed heads. This was followed by a burn to reduce foliage. Regrowth was then treated with a foliar application of glyphosate. Extended line surveys searched surrounding areas, with remaining plants treated again with glyphosate.

Rethinking the project

By 2016, much had been done to knock back the large populations of gamba grass, but eradication was proving more difficult to achieve than initially anticipated. New plants were still appearing, and there was inadequate data being collected to provide evidence of eradication. Greater coordination between project partners was also needed to achieve eradication.

The project partners agreed to adopt a new approach to eradication. The newly formed Gamba Grass Steering Committee (GGSC) resolved to make the following changes to the eradication program:

- Employ a contract coordinator to oversee the control program.
- Make greater use of professional licensed pest management technicians.
- Use volunteers for the first 2–3 seasons.
- Adopt a more effective methodology.
- Source funding for the new approach.

Funding was sourced from the Kimberley Rangelands Biosecurity Association and Rangelands NRM (natural resource management). The WA Department of Biodiversity, Conservation and Attractions (DBCA, formerly DPAW) and Department of Primary Industries and Regional Development (DPIRD, formerly DAFWA) continued to support the work.

In 2017, professional licensed pest management technicians were used for the first time in conjunction with staff from DBCA and DPIRD and volunteers. The following year, a contract coordinator



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Placement of tussocks in trees to dry after hand removal.

was engaged to oversee on-ground eradication efforts. This has been maintained through to 2024.

For operational and logistical reasons, chemical control was not an option at the start of the program, so the initial control focused on manual removal by chipping gamba plants out of the ground with a geologist pick and wedging them in nearby tree forks as a visual reference for successive eradication surveys. This was a viable approach due to the relatively small size of the area and low density of the infestations. This also removed the need to carry chemicals and eliminated off-target damage. It's a very effective control for this situation and has continued as the primary control method.

Line surveys were conducted over each infested area multiple times from different directions to ensure no plants were missed. All plants found were recorded. Fire was not used as a management tool, although it was still present on a regular basis, either as prescribed burns or as bushfires. This had some impacts on gamba grass control operations.

The result

From 2017 to 2024, the infestation was reduced from more than 3,000 plants to less than 50 plants (see Figure 4.1.1). Key to this success has been the continued focus on delimitation surveys and on reducing seedbank contributions by ensuring control occurs before seed set and seedheads are removed from any remaining plants.

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The volunteer component ceased in 2020, initially due to COVID-19 restrictions. However, it was not reinstated as it was no longer required. It's difficult for new personnel to become proficient at spotting and identifying gamba grass now the plants are at such low numbers.

The future

The eradication program continues, with all project partners committed to conducting surveillance in the infestation area for up to five years past the date the last plant was found.

Challenges faced by the GGSC in the future include:

- maintaining eradication efforts with high staff turnovers and a shortage of experienced personnel
- lack of contractors in the region
- the impact of fire on eradication outcomes – it can reduce effectiveness of searching and potentially spreads seed.

Additionally, it's critical to maintain funding to support the project through to eradication. Propagules will continue to arrive in WA from core infestations in the NT. Adopting hygiene protocols, conducting surveillance on major pathways from the NT, encouraging reporting of any plants, and acting quickly on those reports will be critical to keeping WA free of gamba grass.

Key learnings

- Collecting good quality data is critical. This includes individual plant locations, plant numbers, total area surveyed (including where nothing was found) and plant life stage (especially whether it has gone to seed).
- Having a coordinator is crucial. This improved communication between multiple partners, helped to bring together all the data, and

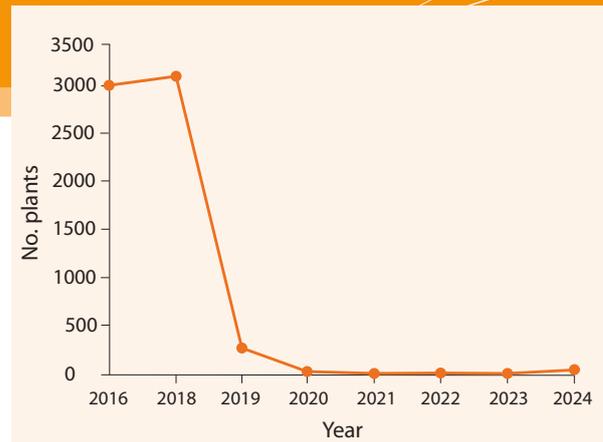


Figure 4.1.1 Reduction in gamba grass plants between 2017 and 2024.

facilitated reporting of the control program to the committee.

- As plant numbers become low, it's critical to have people in the field who can identify the plant and respond quickly. Relying on volunteer assistance becomes less viable as the program progresses.
- Ideally, exclude grazing and burning from the eradication area so the plants flourish and can be easily found and treated. Be adaptive – every season will be different (e.g. amount and timing of rainfall, timing of germination and seeding, access).



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Gamba grass found during followup surveys.

Case study 2

Surveying and planning: keys to successful eradication of a historical gamba grass infestation at Mudginberri, Mirarr Estate, Kakadu National Park

Territory Natural Resource Management in collaboration with Djurrubu Rangers

Management objective: eradication

Key points

- The closer you get to eradication, the harder gamba grass is to find.
- A well planned and coordinated aerial survey program, integrated with a targeted control program, is an effective way to eradicate isolated infestations in remote areas.
- Other land management activities, such as burning, can hinder gamba grass detection during surveying.
- Supporting rangers through training is critical when adopting new approaches to managing gamba grass.

Background

The Mudginberri area occupies more than 30,000 ha of lowland savanna country close to the regional town of Jabiru within Kakadu National Park (Kakadu) in the Northern Territory (NT; Figure 4.2.1). Mudginberri is in the NT gamba grass Eradication Zone (page 122).

Facilitated by Territory Natural Resource Management (TNRM) and led by Gundjeihmi Aboriginal Corporation's (GAC) Djurrubu Rangers, the gamba grass eradication program at Mudginberri is informed by First Nations' knowledge of the region, previous weed management works in Kakadu, and best practice land-management principles.



The area historically supported an active station and abattoir during the 1970s and 1980s, focusing mainly on buffalo. The abattoir closed in the mid-1980s, and the station was included in the Stage 2 declaration of Parks Australia in 1987. GAC undertakes some land-management activities in Mudginberri under contract from Kakadu and holds partnerships with many other agencies, including TNRM. TNRM has supported GAC over the period 2018–23 through regional projects funded by the Australian Government's National Landcare Program.

The problem

Gamba grass was planted in the Mudginberri area around 1983 as pasture for the station's buffalo stock. Grassy weed management commenced in 1987, when the Mudginberri area was incorporated into

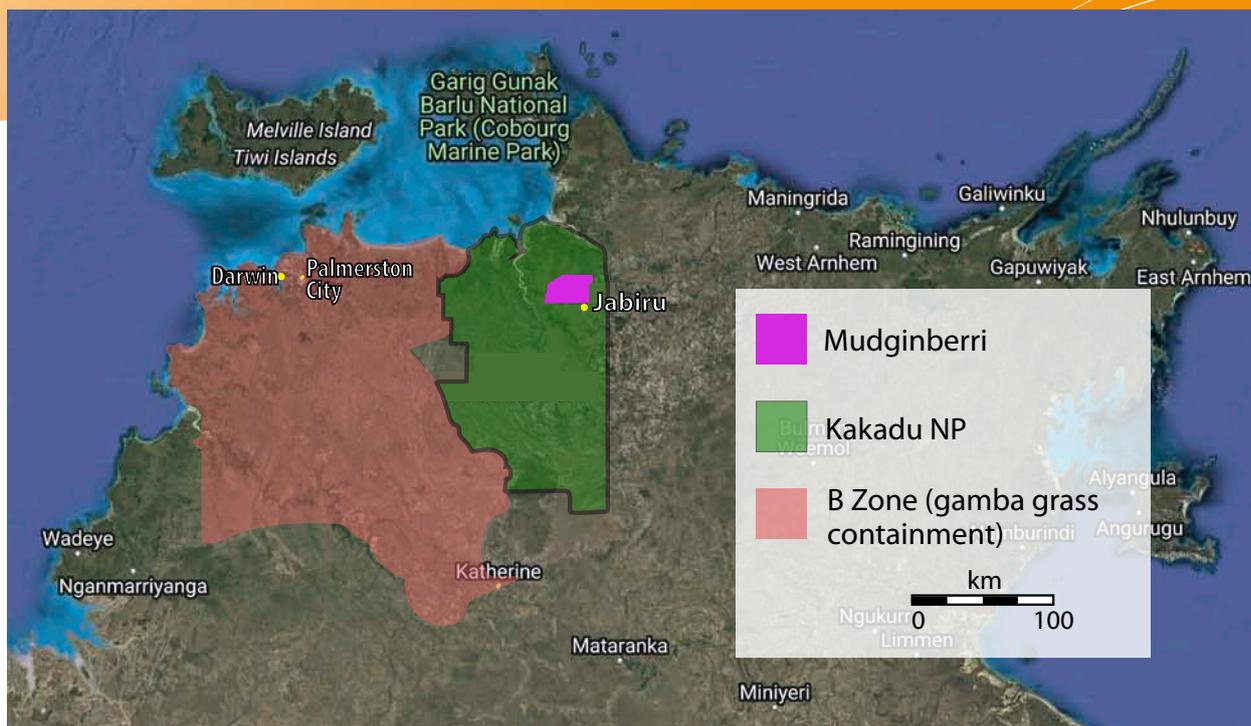


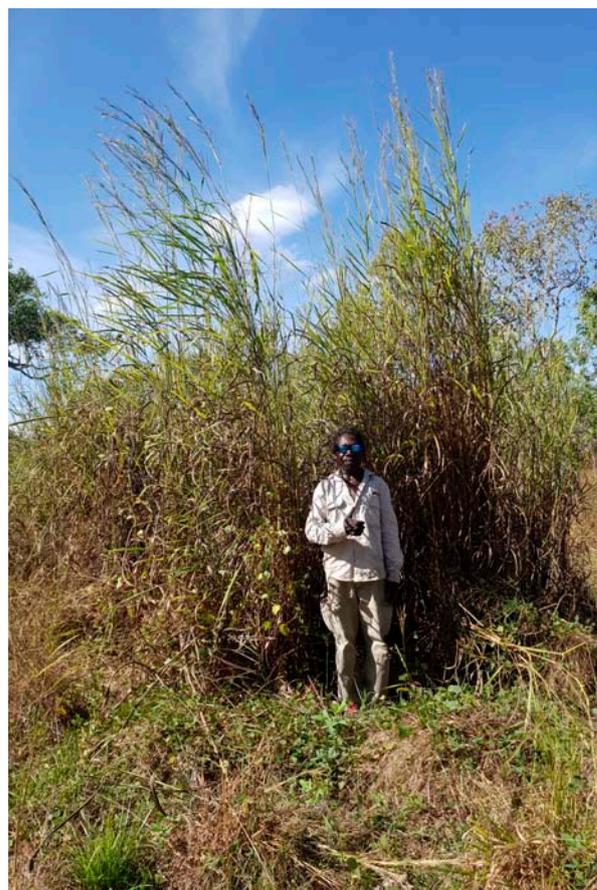
Figure 4.2.1 Aerial image showing the location of the 30,866-ha Mudginberri area within the Northern Territory.

Kakadu National Park. However, due to seasonal inaccessibility and other constraints, gamba grass has persisted in the area in discrete, scattered patches distributed over approximately 10 km².

These infestations occur in remote locations where there's no routine monitoring – meaning there's a risk they could remain undetected and continue to spread. Additionally, seasonal watercourses in the Mudginberri area prevent on-ground access until after gamba grass has started seeding in May. Fire is a constant threat for Mudginberri, and fuel-reduction burning is carried out early in the dry season. This can increase localised spread and the density of existing patches. Burning early in the dry season can also hinder detection of gamba grass for surveillance mapping, so timing of these activities is critical.

The approach

Between 2020 and 2022, staff from Djurrubu Rangers, NT Weed Management Branch, TNRM and Kakadu collaborated to plan an eradication program using best practice control methods. The plan identified seasonal access constraints and workable solutions so that rangers could identify and physically reach areas before seeding and fire.



Large gamba grass tussocks tower over Djurrubu Ranger Craig Djangjoriekk in 2022.

Diego Alvarez, TNRM

The preparation and preliminary work set the stage for Djurrubu Rangers to deliver their highly successful 2023 eradication program. This included:

- building capacity and capability in planning, surveying, weed hygiene and treatment
- developing techniques for detection in hard-to-reach places
- treatment and trialling of methods for hard-to-reach places (including the use of helicopters)
- data recording, management and interpretation
- monitoring techniques to lead to eradication.

Detection in hard-to-reach areas

In previous years, accessibility issues and a lack of reliable survey data have hindered gamba grass eradication efforts.

A key action to support the eradication outcome of this project was to develop a survey **methodology** that would detect and accurately record **all** individual gamba grass plants in the landscape with sufficient time to return and treat them before burning or seed set.



Matt Sheehan

Preparing for remote gamba grass control.



Sean Spicer, Djurrubu Rangers

Gamba grass infestation along a seasonal waterway recorded during the 2023 aerial survey. Dense canopy cover and presence of native grasses can hamper the detection of gamba grass.

The following factors had to be considered when developing the methodology:

- The area is frequently burnt by bushfire, usually early in the dry season before or during gamba grass flowering and seeding. It isn't best practice to survey immediately after fire, as it is likely plants will be missed.
- The dense tree canopy cover of the area's significant riparian environments can reduce gamba grass detection when surveying aerially. There are also several native grass species which may be mistaken for gamba grass.
- The area is difficult to access, requiring off-road vehicles. There are also seasonal constraints, such as water courses during the wet season, that may prevent access until after gamba grass seeds.
- Infestations tend to be in discrete patches, usually less than 100 m diameter. This means infestations may be missed.

Survey methodology

In early 2023, project partners agreed on a 30,866-ha area to be aerially surveyed for gamba grass. The search area was based on historical data, data-deficient locations, pathway analysis, and the potential for gamba grass spread within the landscape.

Surveying took place between February and early March 2023, with treatment occurring in March and

Case study 2

New technique for detecting gamba grass earlier in the year

At Mudginberri, the best time to detect gamba grass is around mid-April, when most native grasses have turned brown but gamba grass is still green. Without this contrast in colour, surveys are much more likely to miss gamba grass plants, particularly when relying on aerial surveys.

Prior to this project, aerial gamba grass surveys were typically conducted from April onwards to exploit this colour difference. However, for an eradication program, all control works should be performed prior to seeding, which starts around May, to disrupt seed bank recruitment.

A new method was needed to accurately detect gamba grass from the air with high confidence earlier in the year. This would allow Djurrubu Rangers to:

- undertake treatment and follow-up work prior to seed set and
- avoid the risk of wildfires undermining survey and control activities.

TNRM and Djurrubu Rangers trialled surveying at different times of the day. They discovered



Diego Alvarez, TNRM

Gamba grass patch (centre bottom) standing out among native spear grass in the early morning at Mudginberri.

that gamba grass could be distinguished from other grasses before 9:30 am, when the sun was low in the sky. In the early morning, the hairs on the leaves of gamba grass hold drops of moisture (dew). This gives the tussocks a droopy appearance, and the leaves look silver-blue. These characteristics allow gamba grass to be easily distinguished from surrounding native grasses.

Now, surveying is conducted early morning from February to March, meaning control can be completed prior to seed set.

April. The site was divided into 12 blocks, ranging from 1,702 to 2,448 ha. It took between 100 and 150 km (roughly 1.5 hours) of flying to survey each block – totalling 18 hours' survey time for the entire area. Follow-up visits to sites that had gamba grass took an additional four hours (on average) per block. These visits were to confirm gamba grass identification and treat it with herbicide. The combined helicopter hours for survey and treatment for the 12 blocks totalled 66 hours.

Each block was surveyed by flying transects of 200 m, a distance chosen to:

- ensure no small patches or individual plants were missed
- reduce or eliminate data gaps or doubling-up on waypoints
- make flying over the target area easier for the pilot and surveyors to positively detect and record accurate waypoints.

Transects were flown at low speed (40 kt) and altitude (~100 ft). Testing found that this optimised the detection of small infestations or individual plants within Mudginberri, even with denser tree-canopy cover. The survey team consisted of two observers and one coordinator. All three team members searched, and the coordinator recorded the waypoint, patch size and density. If required, the pilot deviated from the transect line for verification or waypoint recording, and the helicopter track logs also recorded flight paths to assist with presence/absence data. These surveys found a total of 150 gamba grass patches within the Mudginberri area (Figure 4.2.2).

Data management

Following each daily survey and treatment works, a designated data manager retrieved data from the recording devices (Djurrubu Rangers used their operations application, Fulcrum, to ensure ease of point-data recording and follow-up treatment), created maps of surveyed areas and any treated patches, and provided the navigation tracks for the next day's transect survey to the helicopter pilot. Data management required a computer with internet access and geographic information system (GIS) software, such as QGIS or ArcGIS, to assist with data curation.

On-ground treatment work

Any gamba grass patches that were identified and recorded during the early-morning surveys were treated later that day. In remote areas, rangers were dropped in by helicopter to treat gamba grass using backpack spray units. Other sites were accessed using quad bikes with spray tanks installed. Additional materials for chemical mixing and refilling were taken to site, including herbicide, measuring jug, a pump or bucket for water access and appropriate personal protective equipment. Rangers' tracks and gamba occurrences were recorded while spraying to inform future surveys and to track progress.

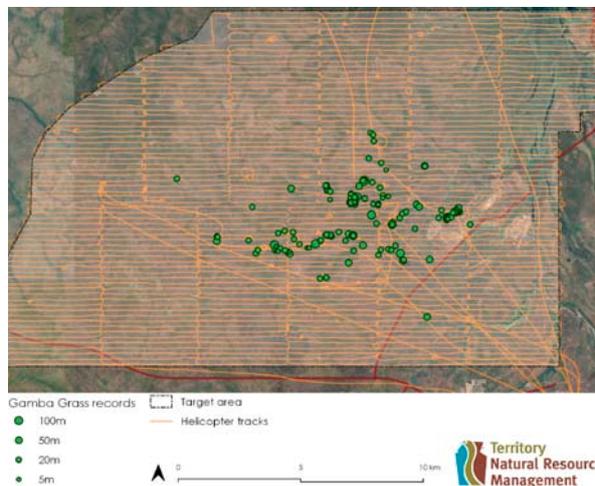


Figure 4.2.2 Results of the helicopter surveys, with gamba grass distribution shown in green and helicopter transects and flight paths in orange.

Roles and responsibilities for each person (coordinator, surveyors, data curator, treatment persons, supporting staff) were clearly noted during the project planning (Figure 4.2.3).

Supporting land managers

This approach to managing gamba grass was significantly different from previous management approaches. A critical factor in the success of this approach was the support offered to rangers and other land managers. This included training in the methodology, involving rangers in the planning phase, and communicating the benefits of taking a strategic, adaptable approach.

The result

Methodologies for aerial detection surveys and data collection have been developed, tested and refined over the project lifetime. Eradication efforts in 2023 used 60 days of Djurrubu Ranger time to collect fine-scale baseline data over 26,237 ha of landscape. This data then underpinned treatment of the identified

Mudginberri Gamba Grass Eradication Program 2023 – daily workplan to detect and treat – Activity Schedule (tackling 1 block per day)			
Time	Activity	Who	Equipment
7 am – 8.30 am (as early as possible)	Aerial survey of the block at 200 m transect spacing: <ul style="list-style-type: none"> Collecting flight tracks of survey Marking waypoints of gamba grass seen Recording patch size 	1 × program coordinator 2 × team leaders 1 × pilot	<ul style="list-style-type: none"> Tablet/device to record waypoints and tracks Helicopter Helicopter navigation system pre-loaded with survey transect lines for pilot to follow
8.30 am – 12.30 pm (until all detected patches are treated, or get rained out)	On-ground treatment of patches detected during block survey: <ul style="list-style-type: none"> Mixing herbicide (if doing this on site) Spraying gamba grass (including use of quads/backpacks) Collecting treatment data (points and tracks) on tablets/devices if this is not being done by coordinator Tidy up and preparing for the next day's work 	2 teams each with: 1 × team leader 1 × assistant	<ul style="list-style-type: none"> Tablet/device to record waypoints and tracks Communications devices Quad bikes (if using) If mixing on site: quad spray tank, empty backpacks, pump or bucket for creek, herbicide, measuring jug, PPE for mixing and spraying, If using premixed: backpacks of premixed herbicide, PPE for spraying
As above	Coordination of on-ground treatment and mixing/refilling: <ul style="list-style-type: none"> Liaising with teams on ground and moving them to new spots when required Refilling backpacks and tanks as required Collecting data on treatment, incl. herbicide record sheet, Transferring data from tablets/devices at conclusion of the day's work – sending data to data manager Tidy up and preparing for the next day's work 	1 × program coordinator	<ul style="list-style-type: none"> Tablet/device to record waypoints and tracks PPE for mixing Communications devices Internet access at conclusion of day – to transfer data from devices
As above	Ferrying treatment teams and equipment to/between patches	1 × pilot	<ul style="list-style-type: none"> Helicopter
12.30 pm – 3.30 pm	Data management: <ul style="list-style-type: none"> Retrieving data from devices Making maps of surveyed area and treated patches Providing tracks for next survey to the chopper pilot 	1 × data manager (could be program coordinator if they have the skills)	<ul style="list-style-type: none"> Computer GIS software Internet access

Figure 4.2.3 Daily plans for gamba eradication works, with aerial surveys conducted each morning, followed by treatment and more data collection, and data management duties at the end of the day.

150 gamba grass sites and will be used to track progress and inform follow-up treatment works.

All data collected has been provided to NT Weed Management Branch for inclusion in their gamba grass eradication tracking system. This baseline data will inform treatment and enable the measurement of progress towards the goal of eradicating gamba grass from the Mudginberri area.

The future

Aerial surveys are an effective and efficient way to detect gamba grass and prioritise treatment in remote locations. They will continue to inform the ongoing eradication program in the Mudginberri area. Surveys will be repeated in the future to monitor progress towards the eradication goal and inform necessary management adaptations.

Key learnings

- To eradicate gamba grass from an area, detect and treat each plant prior to seeding or burning. Otherwise, patches will persist over the long term.
- Where annual fire regimes are in place, survey sites before fires occur and with sufficient time for treatment prior to seeding. It's not possible to accurately detect gamba grass plants directly after a burn.
- Accurate records are critical. Record locations of infestation to enable follow-up treatment and monitoring until it's confirmed that no gamba grass remains.
- For this eradication program, systematic aerial transect surveys are most useful when undertaken at a scale that matches how far an observer can see (line of sight) in that terrain type.
- Wet-season detection surveys for gamba grass are most effective when done early in the day when plants are covered in dew and take on colouration that differentiates them from other grasses.
- Supporting rangers through training is critical when adopting new approaches to managing gamba grass.

Case study 3

Helping our neighbours: managing gamba grass across catchments, agencies and tenures

Darryn Higgins, Cook Shire Council, Queensland

Management objective:
containment/asset protection

Key points

- Gamba grass is spreading throughout Cape York.
- Pooling equipment, labour and expertise from surrounding regions for short, intense periods is an effective way to both map and treat gamba grass in remote areas with limited management capacity.
- The project has resulted in improved gamba grass mapping data across multiple land tenures.

Background

The Annan–Endeavour rivers catchment is a minor catchment in Cook Shire, covering 218,243 ha on Cape York Peninsula (the Cape) and including the town of Cooktown. Gamba grass has been recorded at various locations throughout the catchment over several years. However, the extent of its distribution isn't fully known. It's a big task for one management authority – the Cook Shire Council – to map and control gamba grass over such a large geographic scale. Since 2021, various agencies across Far North Queensland have been helping survey and treat gamba grass in the catchment and raise public awareness about the threats posed by this species.



The problem

Gamba grass has been present in the Annan–Endeavour catchment, and more broadly on the Cape, for several decades. Its establishment has been slow and its spread has not been well documented due to the scale and remoteness of the area. Unfortunately, historical data is largely comprised of surveys and works undertaken on roadsides, with little data available on gamba grass distribution on private landholdings.

There are mixed feelings about gamba grass in the region. Some land managers still see it as a valuable pasture species and not their responsibility to manage, while others have watched its expansion in the neighbouring Northern Territory (NT) and fear what might happen if it's left unchecked on the Cape. Modelling suggests that the Cape is highly suitable for gamba grass and it's likely to result in densities and impacts similar to that seen in parts of the NT. Gamba grass is still considered in the early stages of invasion on the Cape – therefore, the time to act is now.

Case study 3

Adopting a strategic management approach is difficult with only one control authority for a very large region, incomplete distribution data, and low participation from land managers. In 2021, Cape York Natural Resource Management (NRM) gathered together local stakeholders from within the Annan–Endeavour catchment to assess the potential of managing gamba grass across the region. A basic map was produced by collating data provided by several agencies. To address the bias towards roadside mapping, Cook Shire Council also undertook a survey of private landholdings adjacent to historical gamba grass locations. This survey identified 39 individual allotments with gamba grass.

Results of combined mapping confirmed that gamba grass distribution was more widespread than initially thought, and effective treatment was considered beyond the capacity of many landholders. The stakeholder group discussed various strategies to manage the species within the catchment and decided upon a taskforce approach using funding provided by Cape York NRM.

The approach

The regional taskforce concept was developed and fostered by the Far North Queensland Regional Organisation of Councils (FNQROC). Under a memorandum of understanding, member councils agreed to support their partners in nominated projects to manage invasive plants and animals.

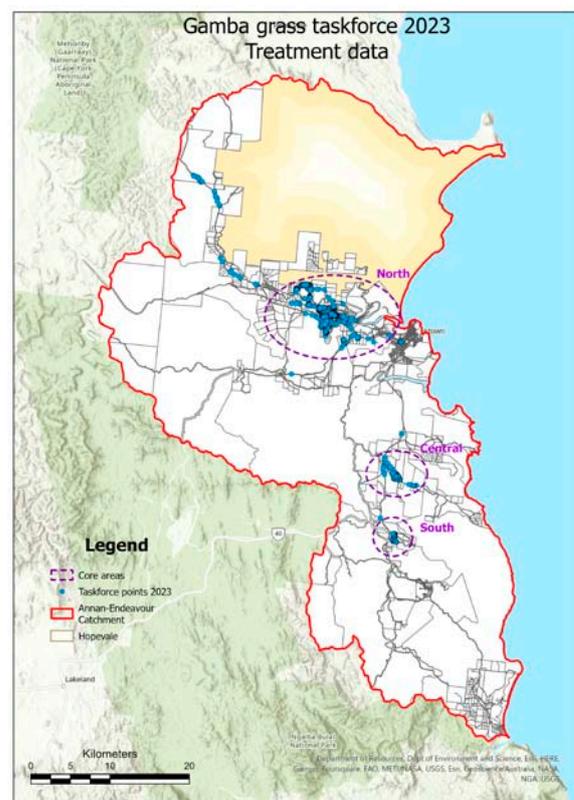
A request for assistance was extended to FNQROC members and other stakeholders in 2021 to map and control gamba grass. Various agencies accepted the request and have been participating in the catchment-scale project since 2022. Participating member councils and organisations include Douglas Shire Council, Hinchinbrook Shire Council, Tablelands Regional Council, Mareeba Shire Council, Cairns Regional Council, South Cape York Catchments, Balngarrawarra Rangers, Jabalbina Rangers, Department of Natural Resources and

Mines, Manufacturing and Regional and Rural Development, Queensland Parks and Wildlife Service, and Biosecurity Queensland.

In the 2023 season, the taskforce consisted of 10 field teams from eight agencies. In addition, Biosecurity Queensland provided technical support, and Cape York NRM provided logistical support and funding. Gamba grass was treated across 59 private landholdings and adjacent roads across a three-day period during April 2023.

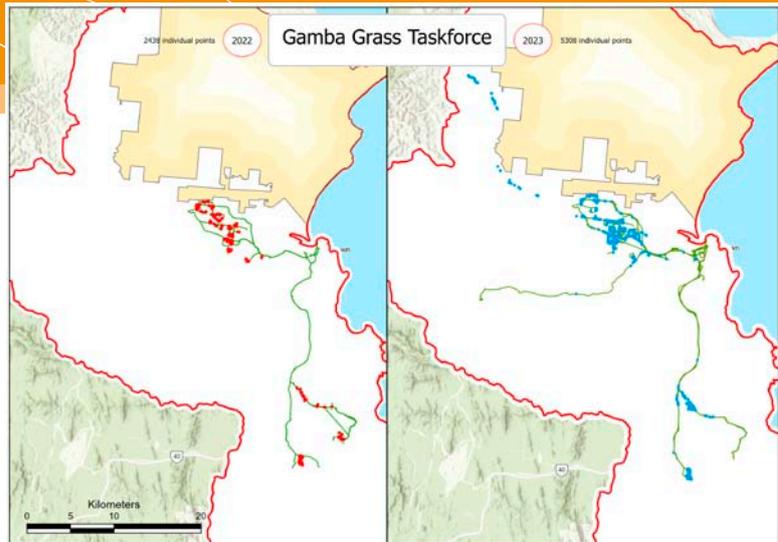
The result

In 2023, the three-day blitz was equivalent to 60 days of labour. This temporary boost in highly experienced professional personnel meant that gamba grass could be mapped and treated within the catchment to a level that couldn't be achieved by a sole agency.



Gamba grass taskforce treatment areas within the Annan–Endeavour catchment.

The 10 teams collected 2,438 waypoints in 2022 and 5,308 waypoints in 2023. Collation of this data showed there are three distinct infestations within the Annan–Endeavour catchment – one each in the north, central and south of the catchment. Management strategies for each of these infestations are based on distribution, density and the overall willingness of landholders to participate in the program.



Gamba grass distribution records from 2022 and 2023.

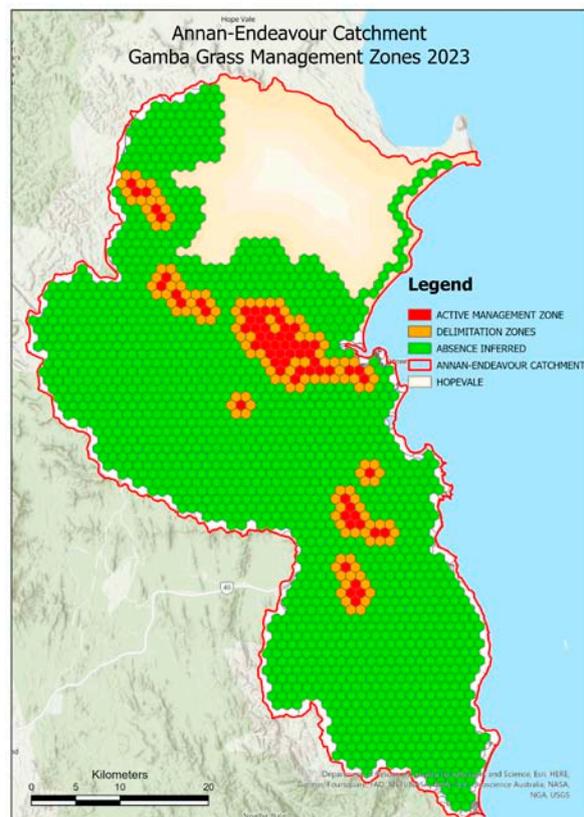
“Our management objective for the northern and central infestations is currently containment. The intention of continued taskforce involvement in these areas is to reduce gamba grass density to a level that’s manageable by landholders using affordable or loaned equipment. It’s anticipated that these infestations will reduce in area over time.”
Darryn Higgins.

During the taskforce program, waypoints were recorded every time an isolated plant was treated or every 10 m where gamba grass was continuous. There was a wider distribution and a far greater density of points in 2023 compared to 2022. This has been attributed to improved detection skills and increased participation since the 2022 survey, rather than significant spread of gamba grass over that period.

Taskforce members attended, surveyed and treated all identified allotments during the 2023 season, so they were confident that the infestation was accurately defined.

A broad snapshot of the catchment in 2023

One method of visualising the distribution of gamba grass within the catchment is by using 1-km² grids. Using data collected during the taskforce program, each of these grids was assigned one of three categories. The red hex grids contain gamba grass, the orange are likely to contain gamba grass based on proximity to the core infestations, and green infer the absence of gamba grass.



Gamba grass presence/absence mapping of the Annan–Endeavor catchment.

“Using grids provides us with one method of examining the catchment without becoming overwhelmed by an area in excess of 200,000 hectares. It also provides a coarse ‘snapshot’ to compare against in future years and assess whether distribution of the species has expanded, decreased or remained static.” Darryn Higgins.

Case study 3

Control was focused on identifying and managing gamba grass within the red grids and attempting to confirm presence/absence in the orange and green grids.

Eradication in the south?

Based on waypoint data, it was calculated that the infestation in the south was limited to an area of 22 ha – relatively small in comparison with the central and northern infestations. In addition, all landholders within this area are willing to participate in the program. Given these factors, the management objective for the southern infestation is eradication.

The immediate post-taskforce objective following the 2023 season was to survey the area surrounding the recorded waypoints. Consequently, a finer-scale map was produced. The area surrounding the

known infestation was divided using 50-m contours. Each of these contours are being walked by Cook Shire Council biosecurity staff to either confirm the absence of gamba grass or expand the core infestation should additional plants be identified.

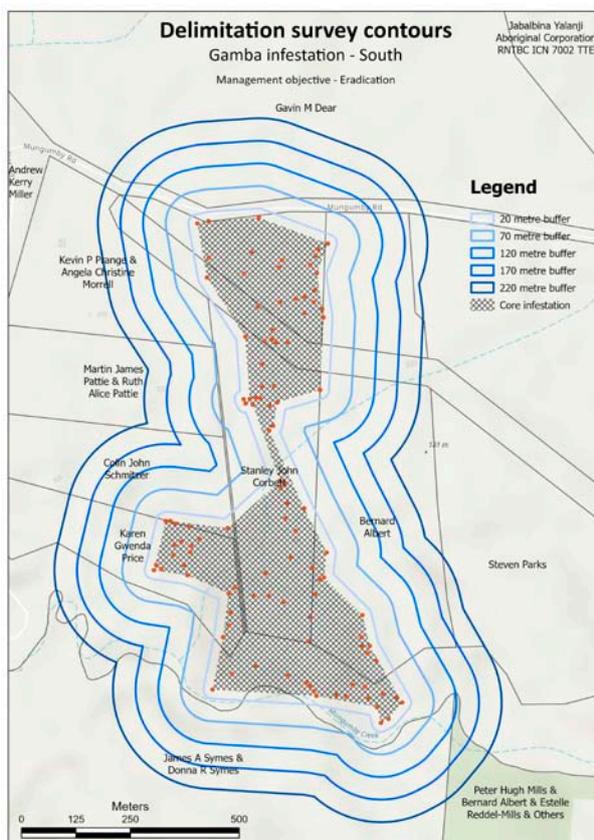
Additionally, four trial sites were established within the southern infestation to monitor i) the efficacy of wick wipers in controlling gamba grass, ii) the landscape response to indiscriminate use of glyphosate, and iii) pasture renovation using pasture species.

These trials are a component of the Strategic Invasive Grass Project, administered by Biosecurity Queensland and funded by the Australian Government, that joined the taskforce as a partner in 2023.

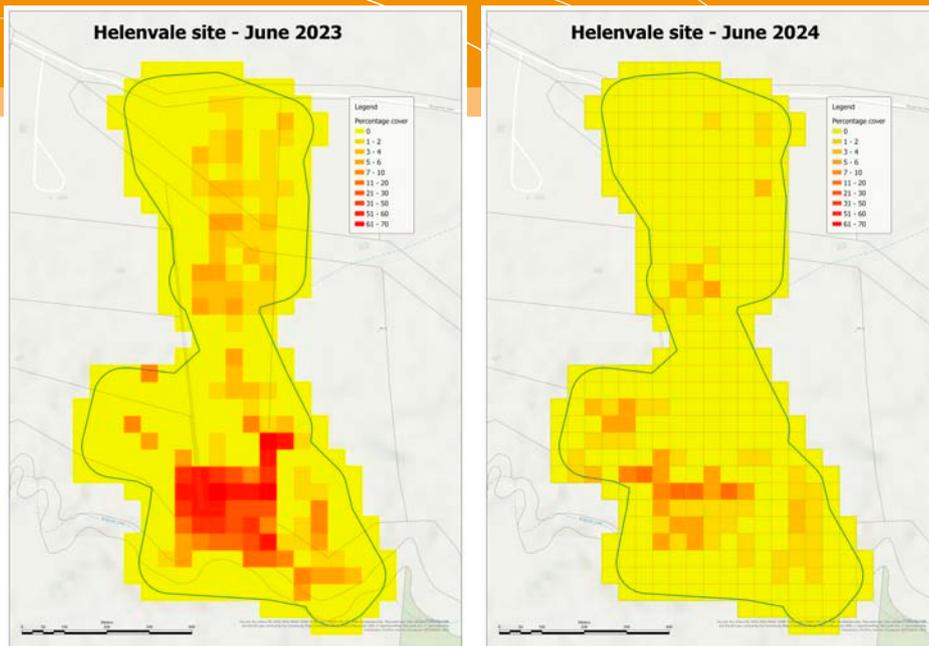
2024

The taskforce returned in 2024, treating gamba grass across 40+ landholdings over three days with nine teams (seven from local governments and two from the Queensland Government). There was no evidence of spread due to floods associated with Cyclone Jasper in mid-December 2023, and there was a measurable reduction in the density of gamba grass in the target areas. Some properties have transitioned to private management of gamba grass using equipment either loaned under the auspices of the taskforce or privately acquired. Cook Shire Council continues to supply limited quantities of glyphosate for free to participating properties that have moved to private management. The challenge will be fostering this transition across the remaining properties.

Progress toward the goal of eradication at the southern site is evident in the images below. To assess the site on an annual basis, it was divided into 322 1,600 m² grids. Biosecurity staff estimated the percentage cover of gamba grass in each grid in 2023 and 2024. There was a marked reduction in the density of gamba grass between the two years.



Map showing the delimitation surveys approach that is conducted around core infestations.



Comparison of gamba mapping data from June 2023 and June 2024, showing no expansion of the infestation and considerable reduction in density.

The future

While dependent on funding, participating agencies intend to expand on and repeat the taskforce's activities yearly into the future. In the meantime, Cook Shire Council's Biosecurity Services team will monitor and treat gamba grass within the catchment while communicating a transition plan to residents, so that residents are prepared to continue management when the program concludes.

Trial plots where treated areas were planted with a combination of humicicola and signal grass are now gamba grass free. Given its success, this strategy is now being applied across the entire southern infestation. A post-taskforce survey was undertaken in July 2024 to measure the success of the taskforce approach. The results of the survey are expected to be available in early 2025.

Utilising this cross-tenure, multi-agency, regional approach has been very successful. The gamba grass problem in the Annan–Endeavour catchment has been quantified, and it's anticipated that the spread of gamba grass has been slowed, with localised eradication considered attainable in at least one area. The longer-term success of this initiative will largely depend upon the local community taking increased responsibility for management.

Key learnings

- Follow-up treatments in the same season are critical – plants will be missed in the first sweep. Landholders should be encouraged to undertake these.
- Establishing memoranda of understanding is an effective way to administer such arrangements.
- It's critical to work to a long-term strategic plan and have a transition plan post-taskforce.
- A collaborative effort is effective in raising local awareness and providing professionals with first-hand experience of a species uncommon in their region. Everyone in the area now knows what gamba grass is and what its impacts are. This was not the case in 2021.
- GIS maps inform control and management and are a valuable communication tool for a broad audience.
- Broad-scale application of glyphosate to control gamba grass requires a strategy to rehabilitate the treated site.

Case study 4

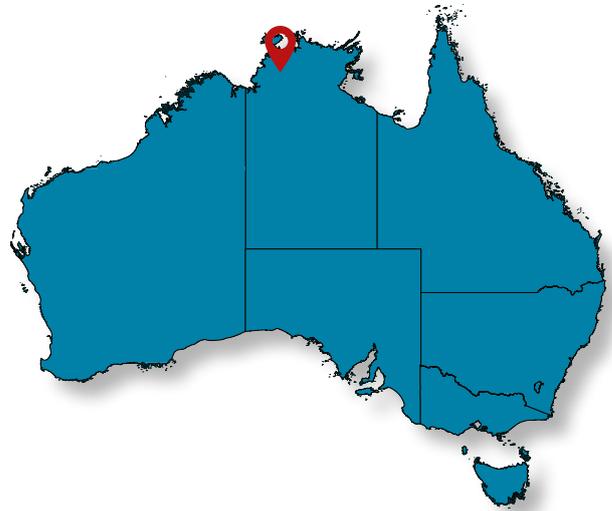
Managing gamba grass using rotational grazing in the Douglas Daly, NT

Tim Schatz, Northern Territory Department of Industry, Tourism and Trade, with assistance from Cameron Heeb and Jamie Marschall, Douglas Daly Research Farm

Management objective: asset protection

Key points

- Gamba grass is a declared weed and must be controlled.
- When tall and rank, gamba grass has little grazing value and is a fire hazard.
- Rotational grazing can keep gamba grass short and palatable, reduce seed production and spread, and result in good weight gains in cattle.



Background

The Douglas Daly Research Farm (DDRF) is a 3,100-ha research facility managed by the Northern Territory Government. It's located at the junction of the Daly and Douglas rivers, 230 km south of Darwin. The rainfall (1,200 mm annually) and soil of the Douglas Daly region are suitable for a range of production enterprises including cattle grazing, cropping and hay production. DDRF was established in the 1960s, and its purpose is to host research, development and extension of agriculture in the Top End of the Northern Territory (NT). The focus of agriculture within the Douglas Daly region has changed over the years, from cropping in the 1980s and intensive livestock production in the 1990s, to a diverse mix of agricultural industries in later years. Research at the farm has reflected and, in some cases, driven these changes.

The problem

Gamba grass is valued as a pasture species by many graziers in northern Australia, and it continues to be intentionally grazed. However, land managers in the NT are legally required to manage gamba grass on their properties, even on properties outside the eradication zone. This can be achieved by minimising seed production and preventing spread. However, gamba grass grows rapidly when grazed with traditional methods (e.g. set stocking, where the grazing paddocks are rarely rested), leading to the production and spread of seed, increased fire hazards and impacts on other values such as the environment. Tall gamba grass is also less palatable for stock and results in poor growth rates in cattle.



Tim Schatz



Tim Schatz

Tall gamba grass (a) in seed and (b) browned off, both stages that offer little little nutritional value to stock and present significant seed spread and fire risk.

Anecdotal reports from some commercial cattle producers suggest that intensive rotational grazing – where groups of stock are frequently moved through a series of paddocks and the pasture is given time to re-grow before being grazed again – keeps gamba grass short and palatable. This results in better livestock productivity, regulated plant growth, less production and spread of seed and reduced fire hazards. Rotational grazing is potentially a win-win control option for graziers and the environment. However, limited robust, objective data exists on the results of rotational grazing and it has only been adopted at small scales. To address this, a rotational grazing trial was established at DDRF in 2018 at a paddock infested with gamba grass. The objective was to investigate if rotational grazing improves cattle production while reducing the negative impacts of gamba grass and, if so, to advise graziers outside the eradication zone on how they can adjust their farm management practices to improve both productivity and environmental outcomes. This case study documents this trial.

The approach

Establishing the rotational grazing trial

The trial site on DDRF is 180 ha. It was historically one of the worst performing parts of the property in terms of cattle production due to the tall, dense, rank tussocks of gamba grass that dominated the paddock for many years. These tall tussocks aren't palatable to cattle and other grazing animals (e.g. wallabies). These animals avoided the tall gamba grass and overgrazed other grasses, leaving just the gamba grass tussocks with bare ground between them.



Cattle grazing the trial area at Douglas Daly Research Farm in December 2020.

Case study 4

In 2018, the paddock was subdivided into five smaller paddocks (20–38 ha) for rotational grazing. A mob of 360 cattle rotationally grazed the five paddocks, with the aim of keeping the grass short and palatable, preventing it from seeding, and giving it time to recover before being grazed again. Some of the paddocks were burnt in November 2018 to remove the old rank tussocks of gamba grass before grazing commenced about six weeks later, after the first rains of the season.

Paddock	Area (ha)	Stock density (head/ha)
Hazels	38.0	9.5
Shottons	25.0	14.4
Hauslers	36.0	10.0
Front of Hay	19.5	18.5
Parkers	34.0	10.6
Gamba	27.0	13.3
Total	179.5	2.0

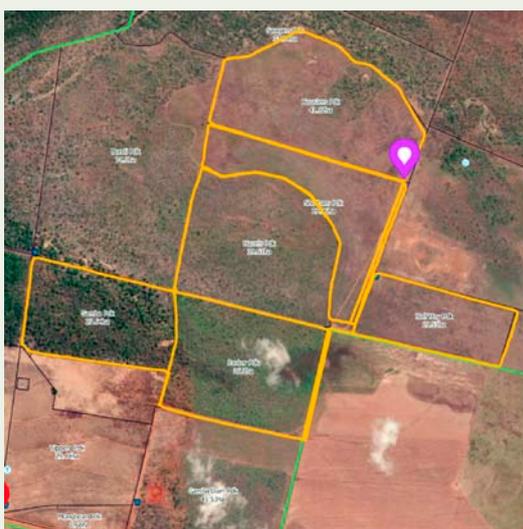


Figure 4.4.1 The paddocks, sizes and stocking densities of the 360 head of cattle in the gamba grass grazing trial.

The overall stocking rate over the 180-ha trial area was 2 head/ha. However, when the mob of cattle was in one of the small paddocks, the grazing density ranged from 9.5 to 18.5 head/ha, depending on the size of the paddock (see Figure 4.4.1). The cattle stayed in a paddock for 2–6 days, depending on how the pasture was holding up to the grazing pressure.

Cattle were removed from the trial area from May until after it had rained (usually in November), as gamba grass has limited grazing value during the dry season.

Trial extension

Communicating the trial results to pastoralists was just as important as the trials themselves.

Field days were held at DDRF in 2019 and 2021, so that local cattle producers could see the trial area and hear about the results. This was an opportunity to communicate land management responsibilities in relation to gamba grass and how a change to pasture management could help to meet land management responsibilities while improving productivity. The field days were well attended and people were very interested in the grazing strategy. It's likely that more cattle producers will adopt this grazing strategy to manage gamba grass in the future.



Field day in April 2019. This paddock was burnt in November 2018 to remove rank material and then rotationally grazed over the wet season.

NT DIT

The result

The trial – which is ongoing – is demonstrating that rotational grazing is very effective at controlling gamba grass by limiting its growth and spread. It also increases the growth rates of cattle grazing on country already infested with gamba grass.

Each year since the start of the trial, gamba grass has been kept short by grazing, hasn't produced any seeds, and hasn't spread off site.

The average daily gains of cattle grazing in the trial area are shown in Table 4.4.1. In most years, the growth was recorded from mid-December to early April. Note that data was not collected in 2019–20.

Table 4.4.1 The average daily gain (ADG) of cattle in the gamba grass grazing trial.

Wet season	Yearling bulls ADG (kg/day)	Two-year-old steers ADG (kg/day)
2018–19	0.58	0.71
2019–20	NA	NA
2020–21	0.53	0.52
2021–22*	0.86	0.74
2022–23	0.56	0.43
Average	0.63	0.60

* Final weight recorded in late February instead of April.

The cattle weight gains recorded in the DDRF gamba grass grazing trial are considerably better than what was previously achieved in these paddocks under lower stocking rates (e.g. 0.2 kg/day) but slightly lower than what has been recorded on other improved pastures at DDRF (e.g. 0.9 kg/day on buffel grass).

The future

This grazing trial will continue, monitoring seeding, spread and live weight gain (LWG) long-term. Of particular interest is whether the nutrition from gamba grass declines over time as soil nutrients decline, and if this leads to reduced cattle LWG.

The trial's outcomes will hopefully result in more land managers adopting rotational grazing. However, this will be difficult to measure, as changes to management practices are seldom reported.

Key learnings

- Conservative set stocking of gamba grass is not a good grazing management strategy, as the gamba grass grows into tall tussocks which aren't palatable for livestock and produce many seeds. As a result, cattle weight gain is low, and the gamba grass spreads and becomes a fire hazard.
- Rotational grazing is a much better management strategy for gamba grass. It keeps the grass short and palatable and prevents seeding while increasing cattle weight gains.
- It's best to burn old stands of gamba grass to remove large tussocks, then give the grass about six weeks to grow after rain before commencing rotational grazing.
- Split the area to be rotationally grazed into a number of paddocks so that each paddock is spelled for about 24–30 days between grazes. The stocking rate over the entire area should be about 2 head/ha, but it will be much higher (e.g. 10–20 head/ha) when the mob of cattle are in any of the individual paddocks.

Case study 5

New ways to manage gamba grass and fire in the NT's Mary River National Park

Natalie Rossiter-Rachor and Samantha Setterfield, National Environmental Science Program (NESP) Resilient Landscapes Hub, The University of Western Australia

Steve Dwyer and Roderick Edmonds, Department of Tourism and Hospitality, NT

Management objective: asset protection

Key points

- Mary River National Park rangers manage gamba grass strategically, by fine-scale herbicide application and, where possible, excluding fire.
- Maintaining tree structure and diversity and improving tree health have been a key focus of the park's weed and fire management.
- Excluding fire has substantially decreased fire frequency, with large areas of the park now burnt very infrequently.
- These changes are helping the native savanna woodlands regenerate in areas formerly infested with gamba grass.
- Research has played a key role helping rangers at the park turn this invasion around by guiding and providing evidence of the effectiveness of management changes.



separated by other land tenures. This case study focuses on the Wildman block, an extensive wetland and savanna complex on the Mary River. The park is recognised by the Northern Territory Government as a Class 1 (most important) biodiversity National Park. The main purpose of the park is to protect and conserve the outstanding natural, cultural, historical and visitor values.

Gamba grass was planted on the station adjoining the park to the north in 1985, and trial plantings occurred to the south-east in the 1970s (Flores et al. 2005). Extensive interviews with researchers and land managers about planting activity in the 1970s to 1990s showed no evidence of gamba grass being planted in the Wildman block, suggesting that gamba grass arrived there from these adjacent sites. Gamba grass established on the Wildman block and, by 1998, became a monoculture over large areas of the park. This created a significant management

Background

Mary River National Park is approximately 100 km east of Darwin in the Northern Territory. The park comprises approximately 121,525 ha of wetlands and savanna, with an average annual rainfall of 1,524 mm. It is made up of several land parcels

issue, particularly for fire management. Gamba grass is a serious threat to the savannas and wetlands of the park, particularly on the northern Wildman block.

The problem

Gamba grass has invaded a significant area of the park over the last 30 years and has resulted in substantial increases to both fuel loads and fire intensity. Managing gamba grass in the park is a significant challenge for park managers.



Matt Sheehan

Damage to canopy trees by gamba fires.

Historically, gamba grass was managed in the park by burning early in the fire season to reduce fire risk. Often, 4-m tall gamba grass was set alight to safeguard the properties to the north from a more damaging late-season fire.

"The regime was to burn it early, then once it was all laid down, burn it again and again and again. That was the mentality we all had 15 years ago, and no one realised that we were giving it exactly what it needed to thrive." – Roderick Edmonds, Mary River Senior District Ranger.

This pattern of management started to concern the Senior District Ranger at the time, Steve Dwyer.

"Over time, I could really notice the difference that the fires were having, killing the trees. I began to think we could possibly do something differently."



Michael Douglas

Gamba grass in Mary River National Park in the early 2000s.

The approach

To develop a more strategic approach to gamba management based on the ecology and biology of the plant, a partnership was formed between the Mary River National Park rangers, and NESP researchers, Dr Natalie Rossiter-Rachor and Professor Samantha Setterfield. The aim was to foster the recovery of healthy native savannas.

"We knew from our research that frequent, high-intensity gamba grass fires were threatening the values of the park and that, anecdotally, these intense gamba fires were thinning the tree canopy. Our research had also shown that gamba seeds are short lived in the soil seedbank, with the majority of seeds lasting less than one year. This increases the likelihood of management success by the rangers." – Samantha Setterfield.

Steve agrees with this and adds:

"Knowing that seeds are short lived and require light and low competition to germinate, it made perfect sense to develop a management approach that excludes the two things gamba grass loves – fire and light – and so reduces the threat to the parks natural values."

The park managers implemented a strategic approach to gamba grass management which consisted of the following components.

Case study 5

Reducing the frequency of gamba grass fires and using ground-based chemical spraying

The first management change was to stop burning gamba grass annually on the Wildman block. To manage the potential risks, additional fire breaks were established and maintained to allow for rapid response to any wildfires that either originated in the park or in surrounding areas.

Initially, the focus was on establishing gamba-free buffers around trees to protect their canopies. Management then shifted to large-scale strategic control of gamba grass by cutting in parallel management tracks through the dense areas of gamba grass. This allowed access to these areas and they were treated in 20-m strips each side of the management tracks, using vehicle-based quick-spray units. Over time, crews could penetrate further in to the gamba areas and break them up. Sites were revisited several times in the same season to spray any plants that were missed or only partially sprayed. The grass was left to die, and the dead gamba grass shaded the soil and helped to inhibit germination of gamba grass seed. The canopy of recovering vegetation also provided shade and reduced germination of gamba grass seed.



NESP Northern Australia Hub

A gamba grass infestation in Mary River National Park in the early stages of management. Note the live gamba grass (green) and the sprayed, dead gamba grass (brown). Care was taken to spray around milkwood trees.

"We spray it chemically, we exclude fire, and we try to get shade back over because gamba hates competition." – Steve Dwyer.

Fine-scale aerial spraying of gamba grass

Rangers also used strategic aerial spraying to control gamba grass and protect important trees such as milkwoods (*Alstonia actinophylla*) from intense gamba grass fires. Careful aerial spraying was carried out in open areas with 100% cover of gamba grass and no canopy, integrated with on-ground spraying of the remaining gamba grass underneath important trees.



NESP Northern Australia Hub

Professor Samantha Setterfield taking measurements in the park to determine the health of the savanna.

Establishing long-term monitoring of the management approach

Any weed-control program should include a monitoring program to measure the effectiveness of the management approach. This was especially important in this case, where there was such a drastic shift in the management strategy. Aerial mapping and vegetation surveys were undertaken, with the intention of them being repeated every five years to capture changes in gamba grass distribution and density and savanna health.

The results

Gamba grass management in the park has changed considerably over the last 15 years, and NESP research on the ecology and impacts of gamba grass has supported and guided these management changes. Freed from the dense cover of gamba grass and repeated fires, milkwood seedlings are thriving around the mature trees.

"Because of the weed and fire management that Steve, Rod and their team have implemented, the gamba grass has decreased, fires are less frequent and we've got a healthy native savanna." – Dr Natalie Rossiter-Rachor, Charles Darwin University.

Roderick says that having scientific data that quantifies the ecological changes helps to refine and further develop the park rangers' annual weed

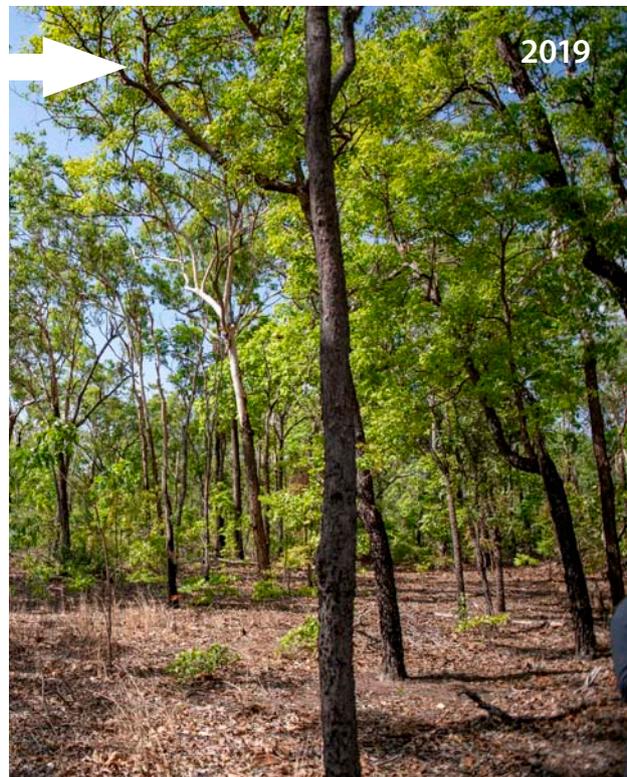
and fire management activities and has informed the integrated conservation strategy for the national park.

The data has also been an important part of the conversation with land managers about possible alternative approaches to gamba management, in locations where similar weed and fire management activities are appropriate.

"It's a real mind shift in management. To us now, it's a no-brainer that you would consider the biology and ecology of gamba grass and manage it by exploiting its weaknesses. I can sit in as many meetings as I want and talk to people about it, but the data and the photos that show the changes over time speak for themselves, and hopefully will persuade managers in other comparable environments with similar values to consider an approach like this." – Steve Dwyer.



Michael Douglas



Natalie Rossiter-Rachor

A gamba grass-infested area at Mary River National Park has been restored to native savanna woodland through diligent management of gamba grass and fire.

Case study 5

The future

"Gamba is always going to be in the landscape, but we're not dealing with a wall of gamba anymore. It's at a low-enough density now to allow recruitment of milkwoods, jacksonia, acacia and other natives, so from a biodiversity perspective, we've been very successful. If fire was to come through now, the intensity would be lower and have less impact on native ecosystems." – Roderick Edmonds.



Matt Sheehan

Recovering ground layer and canopy in the absence of gamba grass.

While the current management approach needs to continue, Rod explains that there'll need to be some tweaks to management as the park continues to recover.

"As gamba grass densities decrease and native vegetation recovers, we'll need to get lots of people on the ground – volunteers and crews from other areas – to search for individual isolated plants and spray them. This can be integrated with ongoing aerial spraying in areas that remain dense."



Natalie Rossiter-Rachor

Steve Dwyer amongst a new generation of milkwoods with their parents in the background. These have established since the removal of gamba grass and the exclusion of fire.

Continued monitoring will be critical

Park rangers and NESP researchers have used aerial surveys to monitor changes to the distribution of gamba grass on the Wildman block since the implementation of the intensive management program. These landscape-scale surveys have provided evidence of the effectiveness of the management program. It'll be important to continue the monitoring program to quantify the recovery, inform future management, and justify future investment.

Key learnings

- Reducing frequency of gamba grass fires has been key to the management success at Mary River National Park.
- Fine-scale aerial spraying of gamba grass has been successful for large, dense infestations.
- Monitoring and research have provided evidence of positive management outcomes, which have been widely communicated.
- Intensive chemical-control programs require significant investment in equipment, maintenance and repair.