Evidence is in on the impact of gamba grass

Gamba grass is a tall perennial African grass introduced into northern Australia as a pasture grass, but it is now established outside of pastoral systems in the Northern Territory and Queensland. TS–CRC researchers have studied gamba for the past 10 years, finding it has significant environmental impacts.

Photo: Michael Douglas

Dense stands of gamba grass in the Northern Territory. The grass now poses a serious risk to savanna vegetation as it transforms key elements of the ecosystem.

Concerns about the potential environmental impacts of gamba grass (*Andropogon gayanus*) were first raised in the early 1990s. However, the push for effective and coordinated control strategies were hampered by the lack of published scientific information about its biology and environmental impacts[1]. In response to this knowledge gap, Drs Samantha Setterfield and Michael Douglas from Charles Darwin University have led several research projects over the last decade—investigating both gamba's biology and evaluating its impact on ecosystem invasion.

Gamba can establish in intact ecosystems

Gamba grass has rapidly spread along roadsides and other disturbance corridors since its introduction. However, its ability to establish and spread in relatively undisturbed sites with intact canopies was, until recently, vigorously denied.[1]

To address this knowledge gap, Samantha and Michael ran controlled trials in late 2000 specifically investigating the effect of soil and canopy disturbance on the establishment of gamba grass. Results showed that gamba can establish and survive regardless of canopy cover or soil disturbance, although modified or disturbed land does increase the grass's chance of successfully establishing.[2]

After these trials it was now clear that gamba grass threatened a much wider part of the savannas than had previously been thought.

Gamba grass changes fire regimes

Further studies examined the effect of gamba grass invasion on fuel loads and fire intensity.

Compared with native grasses, gamba grass forms taller, denser stands, that cure later in the dry season, resulting in substantial changes to savanna fire regimes.[3] Native grass fuel loads are typically 2–4 tonnes/ha[4], whereas gamba fuel loads are typically 11–15 tonnes/ha[3] and may be as high as 30 tonnes/ha. The higher fuel loads of gamba grass support early dry season fires that are about eight times more intense that those fuelled by native grasses.[3] Later in the dry season, when the gamba grass was more fully cured, fire intensities were almost 25 times as high as these recorded in adjacent native grass savannas.[5]

Gamba grass reduces tree cover

It was suggested that this increase in fire intensity in areas where gamba had invaded, could lead to a decline in trees and shrubs, resulting in a process called the 'grass–fire cycle'.[3] To test if high-intensity gamba grass fires were leading to increased numbers of tree deaths, the CDU team combined historic and current aerial photography of areas in the Darwin rural area, together with field surveys. They found that over 12 years there was a 50% reduction in tree canopy cover.[6] This dramatic change in the structure of savanna vegetation demonstrates the serious risk that gamba grass poses to the savannas across northern Australia.

Gamba grass alters hydrology

Further collaborative research, led by Dr Lindsay Hutley (CDU), examined patterns of soil moisture dynamics in native grass and gamba grass plots. Of particular interest was soil-drying patterns in the dry season and how this varied with soil depth. Evergreen savanna trees exploit deeper and deeper soil horizons for moisture uptake as the dry season progresses. Sensors were installed in adjacent gamba and native grass plots to a depth of 1 m to track these patterns of soil moisture through three wet–dry seasonal cycles.

Lindsay found that the gamba plants used larger amounts of water than native grasses.[7] Water use also occurred for a longer period into the dry season, with the deeper rooted gamba extracting soils moisture from depth. This meant that a larger deficit in soil moisture developed under gamba grass plots at these deeper horizons (50 and 100 cm), suggesting increased competition between evergreen trees and dense gamba grass stands for soil moisture. This enhanced competition represents another stress that gamba grass invasion imposes on the savanna ecosystem, particularly the woody components.

Gamba grass alters nitrogen cycling

Natalie Rossiter has completed her PhD on the effects of gamba grass on nitrogen cycling. Natalie found that gamba grass invasion changes the amount of nitrogen stored in various components (pools) of the savanna ecosystem (e.g, vegetation, litter, and soil) and the rate of transfer of nitrogen among these components (fluxes). Compared to plots dominated by native grasses, grass-nitrogen pools in gamba

Decision tools help manage weed risks

A NEW decision support tool—a Weed Risk Management (WRM) system—is being developed in the Northern Territory to assess and respond to the risks posed by exotic plants. The system is being developed for the Northern Territory by Charles Darwin University and the NT Government.

CDU researcher Dr Samantha Setterfield said the development of the system was being guided by the National Post-Border Weed Risk Management Protocol as well as through working with weed experts from around the country.

"Weeds are recognised as a key threat to biodiversity conservation, industry and in some instances human health," she said. "However, recognising the problem is only the first step, we then need to establish which weeds are priorities and then how to respond to the threat."

The system will assess the relative risk posed by exotic plants and how best to respond to these risks. It takes into account the characteristics of the plant, its current and potential impacts, and how feasible it is to control.

"The WRM process will provide a standard, transparent, and scientifically based assessment of both potential and current weed species," said Samantha. "We are currently customising the system to suit the NT and some of the unique problems we face, such as weeds changing fire regimes."

The development of the WRM system was overseen by a Technical Committee, which comprises scientists from CDU and a range of government departments (Natural Resources Environment and the Arts, Primary Industry, Fisheries and Mines, and the Australian Quarantine and Inspection Service).

However stakeholder involvement was recognised as a key element in developing the system.

Dr Keith Ferdinands, Weed Risk Manager for NT NRETA, said that to ensure input from key stakeholders a Weed Risk Management Reference Group was formed.

The group has government and non-government industry representatives—which include the NT Cattleman's association, NT Garden and Nursery Association, World Wildlife Fund Australia and the Central Land Council. Workshops also ensured that stakeholders in the Northern Territory were involved in planning and implementing the strategy.

Photo: Samantha Setterfield

Some exotic plants, such as gamba, cause devastating changes to fire regimes

"To ensure transparency and accountability, a detailed species assessment document is prepared for each WRM candidate," explained Keith. "When the WRM development is completed and the Technical Committee recommends a weed risk and feasibility of control score, the species assessment documents will be available for all interested parties to scrutinise for support or appeal, and to provide additional information."

To date, 80 WRM candidate species have been assessed, and a preliminary weed risk and feasibility of control score has determined for each species. A report on these candidate species and suggested management recommendations will be presented to the NT Government by the end of 2007.

Information on weed risk management:
NRETA: <www.nt.gov.au/nreta/natres/weeds/risk/system.html>
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grass plots were seven times higher, soil nitrate availability was three times lower and soil ammonium availability three times higher.[8]

The large changes in soil nitrogen availability may be due to gamba grass inhibiting the process of nitrification in the soil, as it does in its native range in Africa. Ammonium is its preferred nitrogen source[8], so by preventing nitrification and accumulating ammonium, gamba can increase its own competitive superiority over native grasses. This phenomenon may help explain the apparent paradox of a highly productive grass thriving in a low-nitrogen ecosystem. Natalie also found that the larger above-ground nitrogen pool, and the higher fire intensity in gamba grass plots, doubled the fire-mediated nitrogen losses (via the process of volatilisation) [5]. In the long term, large, frequent, fire-mediated nitrogen losses in savannas invaded by gamba grass are likely to reduce levels of soil nitrogen.

Ongoing research

Despite the widespread community concern over gamba and its continued spread in northern Australia[1], the grass is still not a declared weed in either the Northern Territory or Queensland, and there are no restrictions on its sale or use. However, researchers are now providing the scientific data to demonstrate the risks associated with this invasive grass, and consequently the urgent need for a strong and coordinated management response.

The TS–CRC project has led to an ongoing research program aimed at improving management of tropical invasive grasses. The CDU team (Samantha Setterfield, Michael Douglas, Adam Drucker, Natalie Rossiter and Kristine Brooks) are working in collaboration with NRETA's Dr Keith Ferdinands and Piers Barrow, and staff from the WA Department of Food and Agriculture, Queensland EPA and Biosecurity QLD to develop a set of best practice guidelines for invasive grass management including control techniques and mapping and monitoring guidelines.

The team is also working with Dr Lisa Wainger (University of Maryland) to develop economic-based tools to prioritise management actions. The suite of projects is funded by the Natural Heritage Trust Joint Steering Committee and the Department of Environment and Heritage through the CERF and Defeating the Weeds Menace programs.

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