



Global community booklet

Indigenous People and Invasive Species

Perceptions, management, challenges and uses



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Ecosystems and
Invasive Species
Thematic Group

Yellomundee Firesticks

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firesticks



Yellomundee Firesticks with Yellomundee Aboriginal Bushcare are treating African Lovegrass (*Eragrostis* spp.) and Lantana (*Lantana camara*) with cultural fire on Darug land.

'Firesticks aims to increase culturally relevant learning pathways that enable a greater diversity of fire, sustaining a healthy people and healthy country approach to Natural and Cultural Resource Management.'



Applying cultural fire assists with the heavy labour of manual removal of weeds. **Cultural fire** is a cool fire that burns the invasive weed to allow native species a chance to regenerate. Cultural fire removes biomass and allows sunlight to hit the ground where native seedlings fight to compete with exotic weeds. Cool fire also stimulates native seed bank while not burning surrounding native gum trees.

Invasive Pest Attack in North Bengal

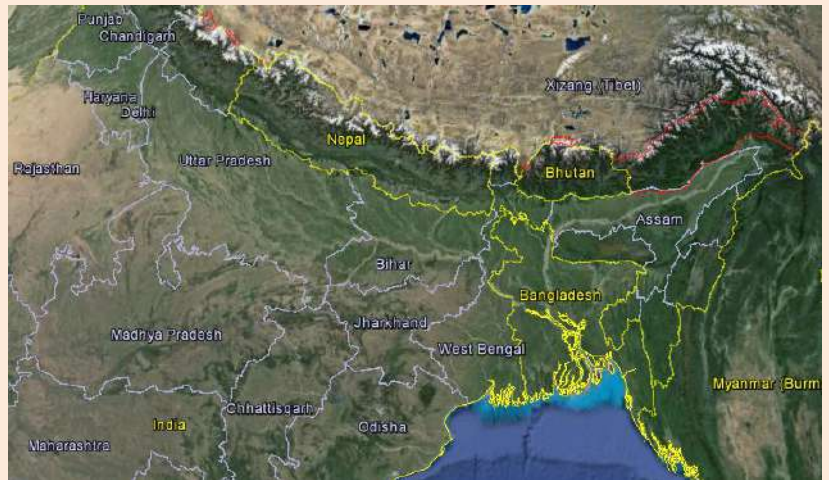
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North Bengal spans the sub-Himalayan area of the **West Bengal State of India**. It includes the Teesta-Brahmaputra and Mahananda-Ganges River basins separated by the Barindland Ridge. Parts of Nepal, Sikkim and Bhutan Himalayas and the Foothill regions are also part of this territory. There are many rural-urban areas in Sub-Himalayan North Bengal especially tea-plantations which are surrounded by sacred groves, social forestry, gardens, parks and small rivers.



Rajbanshis are Indigenous to the plain, hillock and ridge portions (not the Himalayan pockets) and live an agrarian rural lifestyle. They are associated with animal husbandry on both waterweeds of marshland areas and special grasses grown in grassland areas of upland catchment areas. They also cultivate some local rice paddy varieties, jute, summer and monsoon vegetables, chilli, spices, banana and leafy vegetables and collect yams, fruits, arum and edible ferns. They also collect fishes from local streams, wetlands, ditches and catchment areas. They use paddy-come-fish as well as fish-come-duck types of production systems. Some Rajbanshis also work in the local tea-gardens.



In the tea garden areas, attack of looper and other hairy caterpillars has increased to a high level. They are coming from shade trees and neighboring jungles and have become a matter of concern for the economy and agriculture of the region. The pesticide Alphamethrin is no longer effective and Quinalphos, Imamectin benzoate and Cypermethrin are now more common.

Caterpillars emerge from eggs in the soil and attack plants which has become a serious problem for small scale tea gardens. Lime, micro nutrients, organic manure, bioNPK, di ammonium phosphate (DAP), chemical weeding, irrigation through sprinklers, nitrogen manure are added to the tea plantations. Regular spacing, proper seed bed management, ramming, good shade trees and ring systems are also followed. Timely rain in the pre-monsoon and monsoon assists with natural control of caterpillars.



Local Rajbanshis from earlier days perform certain sacred bathing in winter and spring such as *Maghali sinan*, *Bauni sinan* and also worship the rivers when monsoon begins. Now, we could understand that these performances are all related to timely raining that control the pests in natural way.



Managing Weeds on Bunuba Country in the Kimberley, Western Australia



Clive Aiken, Natalie Davey, Kendrick Chungul (Bunuba Rangers); Tom Bach and Haripriya Rangan (Monash University); and Christian Kull (Monash University/ Université de Lausanne)

Caring for Bunuba Country

Bunuba Country is located in the central Kimberley region of Western Australia. The Bunuba Rangers work on behalf of the Bunuba people to look after Country in accordance with their culture and customs. The Rangers work in partnership with the Western Australia Department of Parks and Wildlife and research organisations such as Monash University to share knowledge about how best to care for their country.



A significant part of sharing knowledge and caring for country involves managing weeds at significant sites around the Fitzroy River, which flows through Bunuba Country.



Main approach: Place-based weed management

Place-based weed management focuses on particular places within a broader landscape, identifies the values attached to them and then strategically manages the vegetation at these sites. This contrasts with the dominant species-led management approach, which organises and prioritises management solely according to declared weed species.

The Bunuba Rangers adopt a place-based approach to their weed work allowing them to:

- foreground cultural values for places and connect weed management to its cultural significance
- develop a specific weed management plan for each culturally valued site or location
- integrate weed management with other Ranger activities so that it is part of a holistic approach to maintaining healthy country.

The Fitzroy River: The focus of place-based weed management

The Fitzroy River is significant to Bunuba people. It has many culturally significant sites such as the Men's and Women's Law grounds, Dreaming sites, as well as numerous fishing, hunting and camping grounds. It is therefore a focus of the Bunuba Rangers' place-based weed management strategy. As a major corridor in the central Kimberley, the river transports a number of weeds including: *Parkinsonia* (*Parkinsonia aculeata*), *Calotropis* (*Calotropis procera*), Passionfruit vine (*Passiflora gossypifolia*) and many more.



Calotropis



Passionfruit Vine



Parkinsonia

Noogoora Burr

Through place-based management, Noogoora Burr was identified as a significant threat to Bunuba cultural activities such as camping, fishing, hunting and walking on Country. All of these practices are important for teaching young people about Bunuba Country and culture. If these practices are affected, so is the ability to transfer this culture. Noogoora Burr has been spotted at important sites along the Fitzroy River. As such, it is being strategically targeted and controlled by the Rangers at these important places.



About the Kimberley Project: *Working together*

The Bunuba Rangers and Monash University researchers are interested in sharing cultural understandings of landscapes and exploring how this can improve weed management. We compare and share this knowledge around the Indian Ocean with our partners in India, Madagascar, South Africa.



MONASH University

Non-native mangrove *Nypa fruticans* invasion in the Gulf of Guinea



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Nypa palm (*Nypa fruticans* Van Wurmb. (Arecaceae) is native to Southeast Asia in the Indo-pacific mangrove block (including Bangladesh, India, Indonesia, Malaysia, and Philippines). It is invading the Niger Delta in the Nigerian mangrove ecosystem. The entire Gulf of Guinea is threatened by the *Nypa* palm. It is uncertain where or when this plant was introduced in this region. The year of introduction has been suggested at 1902 by Ajonina (2008) or 1906 by the Food and Agriculture Organisation (FAO, 1994). However its not clear if these dates were when the species was introduced to Nigeria or the Nigerian mangrove ecosystem itself.



Nypa spread in Yassa, Cameroon Estuary



Nypa stand, Yoyo, Cameroon Estuary

The actual reason why *Nypa* palm was introduced to Nigeria is a dilemma. Nevertheless, it was intentionally introduced without a risk assessment. Some say that *Nypa* palm was introduced to Nigeria by a European on an exchange field visit who planted it possibly to “beautify” the coastal area or for the large fruit body that provides sweet juice. We suggest that hydrochloric power and intensity facilitated seed dispersal and intrusion into the mangrove ecosystem most probably since 1890. It is likely that it then became visible in the Delta by 1900-06 and subsequently spread to make other nursery mass-patches. Since this time, *Nypa* palm has rapidly spread in the eastern Niger Delta and replaced Nigerian native mangrove forests species (FEPA et al, 1998).

The uses of this palm are many and diverse (FAO, 1994). *Nypa* fronds are used as thatches, cigarette wrappers and as fuelwood for cooking and fish smoking (FAO, 1994; ITTO et al. 2010). In some case its fronds are used to kick start burning in the Douala Edea future park. Therefore, although *Nypa* invades the Nigerian Delta it provides services and goods that benefit poor local mangrove communities.

To date, this species has escaped and become invasive in other Gulf of Guinea countries like Tanzania, where little is known. *Nypa* has further spread out of the Nigerian Delta, especially into Cameroon for two reasons. The first is due to the hydrochory of the many seeds that float in water and form self-induced nurseries along the coast. The movement of ships and subsequent sea water current dynamics plays an equally significant role in the dispersal of *Nypa* palm. When the tide goes out on average 27 *Nypa* palm seeds per second leave from the beach/landside. The fate of seeds are diverse, but frequently they lead to the formation of a self-induced nursery or are collected as duty on some beaches.



The second dispersal vector is humans. When local poor coastal communities move they transport the *Nypa* seeds for subsequent use. As local people move further down south towards the equator, *Nypa* palm follows to support house construction. The reason is that woody or hard material will take more time and is costly to buy and transport, hence, they resorted to using *Nypa* palm leaflets to thatch roofs and walls for shelter. These houses tend to be fragile with no room partitions and they are suspended to try and accommodate the tides. Local people (especially Nigerians, Ghanaians, etc.) are strongly tied to the availability of natural resources and therefore need to be near rich coastal resources to improve their livelihoods. Men practice fishing, women smoke the fish and both harvest wood. This is why there are plenty of the spontaneous fishing camps or hamlets found in mangrove areas with *Nypa* palm along Cameroon's mangrove coastal and marine areas.

We are working to collect baseline data on *Nypa* distribution and spread to provide feedback and monitoring for NNS legislative requirements. There are little or no strategies to understand or curb such invasions and there is very little accessible data on this species in the Gulf of Guinea.

Top to bottom: *Nypa* leaves in Jabane Komo Itindi; *Nypa* nursery, Jabane Kombo Itindi, Rio Del Rey; Georeferencing *Nypa*, Limbe, Cameroon; Fishing camp in Rio Del Rey Estuary, Cameroon

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Feral Herbivores in Central Australia

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The **Alinytjara Wilurara Natural Resource Management Board** is an all Aboriginal board operating within the South Australian Government which focusses on integrated natural resource management.

The region covers an area more than twice that of England and has a population of around 2000 people. It is freehold native title land, in favour of the traditional owners and inhabitants of the region, who refer to themselves as **Anangu**.

The operational side of our work is under-taken around three key themes: people, country and water which are seen as inseparably integrated.



Camels, horses and donkeys were introduced into central Australia during European colonisation. From the mid-1800s they have progressively been either released or escaped and, in the absence of predators or significant diseases, their population numbers have grown unchecked. These large feral herbivores impact on the fragile natural environment causing erosion, polluting surface waters and competing with native animals for the limited water and food supplies. They present a hazard on roads and within communities and negatively impact on sacred sites.

Since 2012, our operational arm, Natural Resources Alinytjara Wilurara has engaged in an ongoing consultative program to understand community concerns about feral animal impacts on places of significant cultural and biodiversity values in the **Anangu Pitjantjatjara Yankunytjatjara (APY) Lands**. The APY Lands cover more than 103,000 square kilometres of arid land in the far northwest of South Australia.



A key focus of the consultation process was to define local concerns regarding the impact of the feral animals on people, water and country, and then to come to an understanding of each communities' preferred management techniques. To provide consistency of process between communities, a large flow chart was used to introduce Anangu to the process, and to record Anangu ideas on how to manage local problems.



Consistently across the region, local communities identified that:

- mustering, trapping and removal of animals was preferred to culling programs
- removal programs may provide training and skills development opportunities in stock handling, vehicle use and possible business opportunities
- training could be developed in terms of use of animals as a local food source, and humane management of sick or injured large feral herbivores
- water and trap yards should be developed away from towns and communities to lure large feral herbivores away and reduce risks of town invasions by thirsty animals.



Following the consultation process, NR AW developed an operational partnership with the Australian Government and appointed a local services and training provider who assisted in the development of a training program in large feral herbivore trap yard planning and construction. With funding assistance from the Australian Government's National Landcare Program an ongoing program to develop permanent and mobile trap yards is underway.



To prevent ongoing economic dependence on feral stock, which would perpetuate the negative impacts they have for people, country and water, NR AW is working with the APY Livestock business to develop a managed herd of feral animals behind wire. In this way, animals that don't have a current market value are to be kept in captivity and grown out as part of a managed domestic herd. This controlled grow out will be in large, purpose built pastoral grazing paddocks where the domesticated herbivores don't have the same negative consequences as they would have in the wild.



As the program develops, local community capability and capacity improves through the training programs, Anangu desires for sustainable economic development will be recognised, culturally important places are protected and local employment opportunities will increase.

CoastBusters

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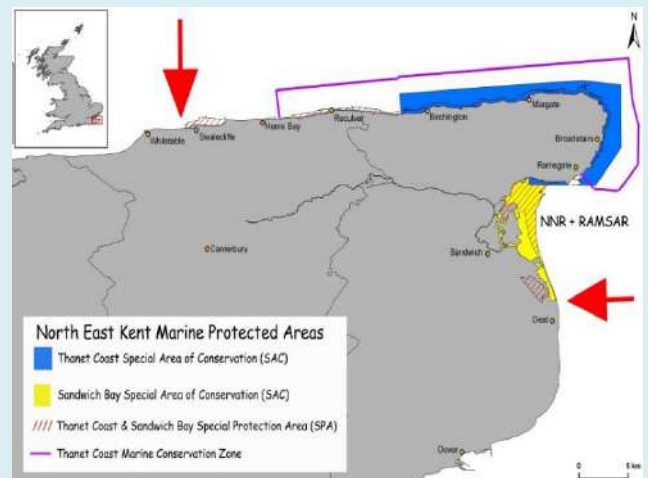


Since 2007 Willie McKnight has been running a project for Natural England which looks at the distribution and impact of wild Pacific oysters within the North East Kent Marine Protected Areas (NEKMPA). Natural England is the UK government's adviser on the natural environment.

The North East Kent Marine Protected Areas are located in south east England and are designated for their unique coastal chalk features, habitats and species. The figures below show their location and typical coastal chalk features.



Typical coastal chalk features



North East Kent Marine Protected Areas



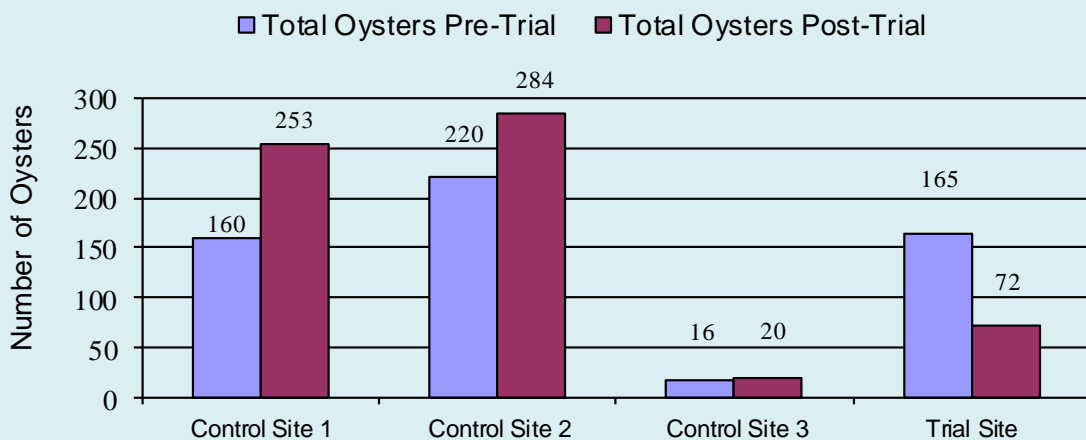
The Pacific oyster is native to Japan and south east Asia. It has been trans-located around the world to support shellfish industries where native species have declined. In 1965 they were introduced to the UK by the government and after successful local trials were approved for commercial use. Sea temperatures at UK latitude were considered to be too low to enable reproduction but from 1990 wild settlement was recorded outside of licensed areas in Devon, Essex and Kent.

In 2007 Natural England commissioned a project to record the distribution and impact of Pacific oysters within the NEKMPA. The baseline survey showed that they were present across the 46km site. Abundance was generally at a low level suggesting that the invasion was at an early stage. However at some locations density exceeded 200 oysters per square meter and oyster reef formation was at an advanced state resulting in the displacement of native mussels *Mytilus edulis*.



Based on the results of the baseline survey and subsequent monitoring programme, it was decided that a one-year trial should take place to assess the feasibility of controlling wild Pacific oysters within the inter-tidal zone of the NEKMPA using volunteer labour. An appeal was made within the local community for volunteers who had a passion for the Kent coast and its wildlife. Note that in this region, local people are Indigenous people who are largely descendants of the Normans (French) who colonised this area from AD 1066. Fifteen volunteers were recruited, trained and equipped to remove Pacific oysters under the supervision of Natural England. In 2012 the team was launched as “CoastBusters”.

The trial took place within the inter-tidal zone of a one-kilometre section of coast. To test effectiveness, three control transects were set up adjacent to the trial site and a fourth set up within. Oyster numbers were counted before and after the trial. Results were very pleasing and suggested that in the short term it is possible to control wild Pacific oysters at selected locations. Work is now in progress to assess long term feasibility.



The total number of Pacific oysters removed by the volunteer team now stands at 104,637 and a total of 654 volunteer hours have been spent on-site. Work continues section by section as a targeted response to priorities identified from the monitoring programme. The challenge now is to maintain momentum by expanding the pool of volunteers thereby ensuring long term commitment to the project.

Allowing tradition, not weeds, to flourish in Kakadu National Park

Northern Territory, Australia



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Kakadu National Park is a living cultural landscape. It has been home to Aboriginal people for more than 50,000 years and is one of few World Heritage areas listed for both its natural and cultural significance.

The Park's plentiful floodplains are especially important to its Traditional Owners. These freshwater environments are highly valued areas for hunting, fishing and gathering, having sustained Aboriginal communities for many thousands of years. Today they continue to provide an abundance of food, traditional medicines and other natural products that support traditional livelihoods. However, the cultural and environmental assets of these floodplains are under immediate threat from two aquatic invasive grasses. Para grass and Olive Hymenachne were first planted in or near Kakadu to feed livestock in the 1940s and 1980s respectively. They spread very quickly and choke out native grasses. They also increase the fuel load and fire intensity, threatening turtles that hibernate in the floodplain soil during the dry season.



Photo: Photo right: Kakadu land manager, Peter Christophersen collecting food resources with his family from the floodplains of the South Alligator river region in Kakadu National Park.

Bottom right: Kakadu floodplains during the wet season.



Aboriginal people living in the Park are all too aware of the impact these rampant weeds are having on their floodplains. To help contain their spread, Traditional Owners have been working with Park staff and a team of researchers from the National Environment Research Program's Northern Australia Hub. To improve management of these weeds, the researchers first wanted to understand which floodplains areas were most important to Aboriginal people and why.

Thirty seven Traditional Owners were asked to describe and map floodplain areas that provide important economic and cultural resources, and also how the floodplains are changing. The participants said almost a quarter of the floodplains were being used for hunting and gathering. However, there are also some floodplains that Aboriginal people living in the park no longer visit. This is for two main reasons – salt water coming into low lying areas and weed infestation. For example, para grass is now making it hard to access the Magela floodplain in the east of the Park and is also impacting on magpie geese, which depend on native plants for food.



Cooking turtles © CSIRO



© Michael Douglas

Jessie Aldersen talking about important cultural areas on the floodplains

One Traditional Owner told researchers that para grass is beginning to wreck a highly valued river system.

“I go to Four Mile Hole – beautiful turtle place, nearly every year and to Boggy Plains. Para grass changes it. It’s like a spring, a mat. Turtle sits underneath, harder to get them out. Donkeys, pigs spread it,” she said. “One day it’s going to be over-run. There were never any weeds here until they started to bring feed in for the cattle.”

Another Traditional Owner told the researchers that while magpie geese could still nest in para grass, its now so dense it’s too hard to get the eggs out to eat.

The researchers mapped the location of the weed grasses, which were found over more than 4000 hectares of floodplains. Some of the patches are incredibly large and dense while in other areas there are still scattered smaller patches. The researchers also looked at which areas of Kakadu’s floodplains are currently weed free, but are at risk from these weeds. Finally, the team looked at management options available to respond to these invasive weeds, including their associated costs and benefits. They found that while a strategy that both contains the spread of weeds and protects places of importance to Aboriginal people was more costly, it delivered additional cultural (recovery of bush-tucker sites) and biodiversity (reducing weed spread) benefits. This research will help Park managers, including Traditional Owners, to plan strategies to protect key values within Kakadu floodplains. A management strategy that considers multiple objectives (environmental and cultural values) is an effective way forward to preserve these significant sites for decades to come.

For more information, visit: <http://www.nerp.northern.edu.au/research/projects/32>

The research team would like to thank Traditional Owners, other Bininj (local Indigenous people) and Kakadu National Park staff for their support and assistance in undertaking this research.

Wular Lake management and Alligator weed: perspectives of local people

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Ather Masoodi works in the Kashmir Himalaya, which is a distinct biospheric unit in the northwestern Himalayas. The valley of Kashmir has numerous natural lakes and wetlands, rich in biodiversity



and a key part of Kashmir's natural heritage, culture and economy. The Kashmir valley is traversed by the river Jhelum and its tributaries which feed many world famous freshwater lakes, such as the Dal and Wular Lakes. Wular Lake is the largest freshwater lake in India (11,277 hectares) and is a Ramsar site (international importance).



Invasive aquatic macrophytes (large water plants) are a major problem in Kashmir like many other parts of the world. Shrinking of the Kashmir lakes was mostly attributed to the profusion of aquatic plant growth.

In this report Ather highlights his research and action on Alligator weed in Wular Lake.



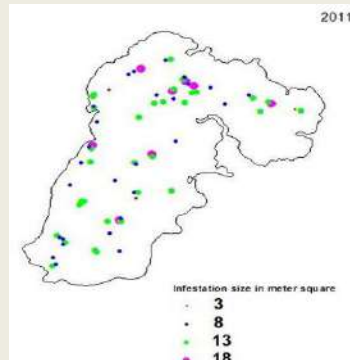
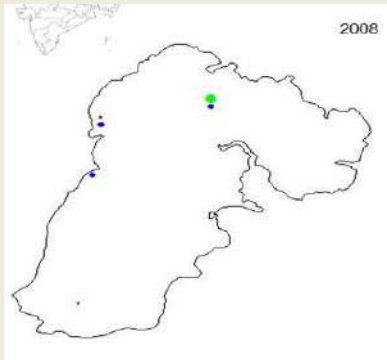
Alligator weed (*Alternanthera philoxeroides*) is a perennial herb native to South America capable of aquatic and terrestrial growth. Alligator weed was introduced in India around the 1940's and has now spread throughout the country. It has very recently invaded the Kashmir valley and was first reported from Wular Lake (Masoodi and Khan 2012a). Alligator weed forms large floating islands in the Lake and reproduces vegetatively.



Floating mats of Alligator weed can cover waterbodies, restricting human use and interfering with the ecology. Prolific growth restricts flow, increases sedimentation and aggravates flooding by acting as a barrier and collecting debris. It also provides habitat for mosquitoes. Floating mats of Alligator weed crowd and out-compete native aquatic species, restrict light penetration and ultimately cause anoxic or anaerobic conditions. It can affect hydroelectric power production, impede fishing, and can degrade wetland aesthetics.



There were only six patches of Alligator weed in Wular Lake in 2008 (41.3m²), by 2011 there were 82 patches (831m²) (Masoodi et al. 2013). The rapid increase in the number of patches was the result of fragmentation due to disturbance by local harvesting of fish, *Trapa natans* nutlets (food; photo at right) and *Nymphoides peltata* (fodder).



Predictive modelling suggested that this weed could cover the entire lake in 13-19 years, from 2008 (Masoodi et al. 2013). There are 2499 fishermen operating in the lake and most of them consider alligator weed to be an emerging threat. Control of this weed is feasible if conducted rapidly, otherwise it would reduce the size of the fishery and other benefits and be a disaster for the people of the region. It is highly warranted to monitor the growth and spread and manage alligator weed in the region.



Left: Alligator weed awareness campaign poster launch world wetlands day 2015

References: Masoodi and Khan (2012). National Academy Science Letters 35: 493-5; Masoodi et al. (2013) Ecological Modelling 263: 119-25;

Weeds, feral animals, fire and research at Wattleridge and Tarriwa Kurrukun Indigenous Protected Areas, Australia



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firesticks

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The Banbai Aboriginal nation own and manage two Indigenous Protected Areas (IPAs) in northern New South Wales, Australia. Wattleridge was the first IPA declared in the state (2001) and covers 648 hectares of native bushland. Tarriwa Kurrukun (which means 'strong one') (est. 2009) covers 930 hectares of wetlands and stringy bark forest. Both IPAs have a high diversity of plant and animal species, including threatened species, and have high cultural values for the Traditional Owners.



The Banbai Rangers are tackling weeds and feral animals on both properties. At Wattleridge, the priority weeds include Blackberry (*Rubus fruticosus*), Broom (*Cytisus scoparius*), Tree of heaven (*Ailanthus altissima*), African lovegrass (*Eragrostis curvula*) and St John's wort (*Hypericum perforatum*) (pictured to left). At Tarriwa Kurrukun, priority weeds are Willows (*Salix* spp.), African boxthorn (*Lycium ferocissimum*), Hawthorn (*Crataegus monogyna*), Sweet briar (*Rosa rubiginosa*), Tree of Heaven and Blackberry.



Both IPAs need to manage the feral animals: Pig (*Sus scrofa*), Goat (*Capra hircus*), Fox (*Vulpes vulpes*), Wild dog (*Canis familiaris*), Cat (*Felis catus*), Fallow (*Dama dama*) and Chital deer (*Axis axis*) (photo to left), Rabbit (*Oryctolagus cuniculus*). At Tarriwa Kurrukun, Mosquito fish (*Gambusia holbrooki*) and Redfin (*Perca fluviatilis*) are also a problem.

Some of the biggest challenges for managing weeds on the IPAs are the weather (which can help or hinder management), difficulty in accessing weeds and trying to ensure all weeds are being managed at once. Cattle have also brought new weeds into the IPAs, such as St John's Wort. Recently the rangers had success in getting a 95% kill rate on weeds which is highly effective considering that sometimes the kill rate can be as low as 20%.

Weeds are usually managed by spraying or stem injecting herbicide, or chipping small plants. The photo to the right shows Ranger Travis Patterson tipping herbicide into a hole drilled into a Willow tree. This method ('stem injection') kills large trees and prevents chemical from running-off into sensitive riparian areas. Most species of Willow are Weeds of National Significance in Australia. They are among the worst weeds because of their invasiveness, potential for spread and economic and environmental impacts.



Feral animals are managed through shooting, trapping and netting or line-catching fish. The photo to the right shows the rangers setting up a cage trap for pigs. The Banbai community have put a lot of effort into trying to control Mosquito fish. By competing with- and preying on- native fish, Mosquito fish have been associated with the decline of 35 fish species worldwide, including at least 9 Australian species. Mosquito fish don't like cool water, so the Banbai Rangers have planted 300 Matt-Rush (*Lomandra* spp.) plants in riparian areas and erected shade cloth across the river to lower water temperature. These sites are monitored once a week by measuring water pH, turbidity, conductivity and temperature.



The Banbai community are also interested to see how fire affects weeds and feral animals. "I think it would be interesting to find out what comes back, native or introduced, with the 'right way' burn as opposed to the 'wrong way' burn where we had to use a lot of chemical to control the weeds afterwards" says Tanya Elone, manager of Banbai Business Enterprises. Banbai rangers and Michelle McKemey, a PhD student at the University of New England, are developing a two-way monitoring system using Indigenous and scientific knowledge to consider the effects that fire has on the environment.

Owning and managing Wattleridge and Tarriva Kurrukun IPAs gives the Banbai community an opportunity to look after their country and culture, and to pass it onto the next generations. Elder and Ranger Lesley Patterson (pictured right with grandson Tarick), believes 'Our children need to know their culture and their country so that they can keep themselves and their land healthy for generations to come'



Indigenous invasive plant management in northern Australia

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Professor Lesley Head and Dr Jennifer Atchison are geographers at the University of Wollongong. Their current research focuses on invasive species management - the ways in which people are coming to terms with invasive species, how people live with them, and what it takes to manage them. Together, they have been documenting invasive plant management across northern Australia in a project called 'The social life of invasive plants'



The socio-ecologies of Northern Australia are changing rapidly. Some indigenous lands have been identified as amongst the least weedy and are noted for the relatively 'unmodified' state. Other areas have been identified as some of the Australia's most vulnerable to significant tipping points due to the risks posed by invasive species. Gamba grass for example (photo above) promotes hotter more intense fires, which have the potential to transform the vegetation of the savanna and its biodiversity.

As a result of land rights and native title legislation over the last several decades, Indigenous people in northern Australia have formal title to extensive areas of land. This brings both traditional and legislated responsibility for management of complex issues including biodiversity conservation, fire, carbon credits, invasive species management and spiritual custodianship.

For example, on the Daly River of the Northern Territory, Ranger coordinator Rob Lindsay helps to manage the Malak Malak Aboriginal Land Trust. Rob listed six Weeds of National Significance including Mimosa, Salvinia, Hymenachne, Parkinsonia, Gamba grass and Para grass, as well as many other weeds in this area (photo next page).

As Rob described, weed work is important work. It contributes to 'caring for country', and provides some employment and training opportunities for local people (photo right). But managing weeds also takes up a lot of time and resources, and this presents something of a dilemma. There are so many weeds, that weed management is also 'eating' into other responsibilities, such as feral animal control, fire work and cultural obligations. Time taken up in these other activities means rangers cannot always work on weeds when they would like to.



Future Research In northern Australia invasive plant management is overwhelmingly carried out by men, working on short term contracts, with variable levels of skill, knowledge and training. Because of the scale of the problem, chemical spraying is the default management tool for many of the weed species, but Aboriginal people are also involved in other management techniques such as biocontrol such as for *Salvinia* (photo above). The sustainability of this weed work will depend on gender, generational and funding issues being systematically addressed. Important questions that are emerging include 'Who pays?' 'Who is at risk?' and 'Who benefits'?

While the work of weed management offers opportunities, such as skills development and work placement experience, Indigenous people are also operating from a position of disadvantage. Maximising the potential of these opportunities will require ongoing research to ensure that weed work is not just another form of dispossession.

This excerpt is based on a paper entitled 'Entangled invasive lives: Indigenous Invasive Plant Management in Northern Australia' by L. Head and J. Atchison. This research was funded through an Australian Research Council Laureate Fellowship to Lesley Head (FL0992397). We wish to thank our research participants who generously gave us their time to discuss weed management.

Weeds and Native Title in the Kimberley

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This research considered the governance context of weeds management by Aboriginal ranger groups in the Kimberley, northwest Australia. The Kimberley is a vast 423,000 km² region with deserts, monsoonal savanna and coastline. It is the traditional homelands of diverse Aboriginal peoples from about 27 different language groups. This research focuses on the changing context of native title, a recent legal process that recognises Aboriginal peoples' ongoing land and water rights and interests. About 70% of the Kimberley is recognised native title land, with the majority of the weeds work undertaken by ranger groups formed by the native title community.



Kimberley Ranger Network group photo – September 2014 Credit: Kimberley Land Council

Weed management involves more than addressing the 'weeds threat'. It often raises complex issues about how weeds are viewed and valued by different stakeholders and what processes are used. There are many people in the Kimberley working on weeds management including Aboriginal people and their organisations, governments, non-government organisations and research institutions. Each group often has different priorities, processes and assumptions.

Researchers from the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), in partnership with the Nulungu Centre for Indigenous Studies, and with support from the Kimberley Land Council (KLC), brought together these diverse groups to discuss the challenges of weeds projects on native title lands. Indigenous ranger groups identified many issues including:

- how a weeds project is planned
- which weeds are prioritised
- which areas are prioritised
- who does the weeds work
- the influence of weed funding schemes

Bardi Jawi Ranger Kevin George emphasised the role of **traditional authority** in weeds management. Traditional authority is an important part of the way decisions are made between Aboriginal people, their organisations, and their 'law bosses' or elders. For Kevin, weeds management projects by governments or non-government organisations need to respect traditional authority, as well as local knowledge and priorities. Weeds management is not just a technical, scientific, economic or ecological issue. Weeds management is about how relationships between people, their lands and waters – their country – are respected.

From the research, four weeds management priorities on native title lands were developed:

- **Stakeholder identification:** Identify all the people who have involvement in weeds management at the very beginning of the process
- **Weed threats and priorities:** Work with Aboriginal land managers to determine weed management priorities with consideration of economic, ecological and cultural values
- **Engagement:** Stakeholder meetings should be held with Aboriginal land managers to share information, expertise and concerns and explain cultural protocols and priorities. Evaluate community involvement, potential funding and in-kind support opportunities
- **Planning and decision-making:** Decisions on weed management to be made with Aboriginal people as joint partners. Develop a formal agreement to ensure all parties understand the process; their roles and responsibilities

The AIATSIS research also clarified the legal question around who is responsible for weeds on native title lands. It is likely that the responsibilities largely lie with the native title community, and thus this is where the management and funding activity should also focus.



Photo left: Wunggurr Rangers using chemical spray to kill the weed Gamba Grass, a fire-weed that threatens cultural practice, biodiversity and more. Right: Ranger groups and Indigenous Protected Areas declared across native title land in the Kimberley, Northwest Australia. Photo credits: KLC

Kimberley ranger groups are coordinated regionally through the Kimberley Ranger Network, which is facilitated by the KLC, supported by the Australian Federal Government and founded on Indigenous cultural values. Aboriginal elders direct long-term conservation management plans, promote the transfer of traditional knowledge to younger generations and provide guidance, leadership and authority. Through integrating ecological, social and cultural values to generate economic growth in remote Aboriginal communities, the ranger groups and their supporters are creating not only jobs but long-term career paths in the conservation and land management sector.

Traditional Aboriginal Values and Gamba Grass Invasion of the Remediated Rum Jungle Mine Site

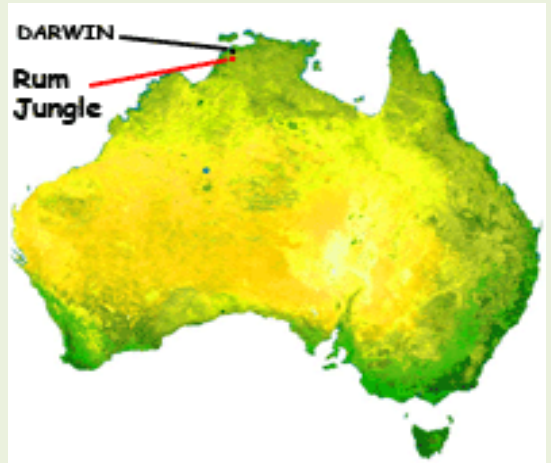


Ross Jeffree

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Ross Jeffree is an aquatic ecologist who has studied the impacts of uranium mining on aquatic biodiversity and Aboriginal foods since the 1970's. The Warrai and Kungarakany Aboriginal people are providing advice on their environmental values to set standards for further remediation of the Rum Jungle mine site in Northern Australia. Previous remedial efforts have been compromised by invasive Gamba grass.



The Rum Jungle Uranium/Copper mine site in the Northern Territory of Australia has been a continuing source of radioactive metal environmental contaminants since the 1950's due to ongoing acid mine drainage processes. The costly remediation of the mine site in the 1980's has been seriously degraded by the invasion of Gamba grass and its destruction of native vegetation on overburden heaps and elsewhere.

The Warrai and Kungarakany are the Traditional Aboriginal Owners of the mine site and receiving waters of the Finniss River System. The mine-impacted region contains many sites of cultural significance or sensitivity for Traditional Owners, however their exact locations are confidential.



Ongoing remedial activities are addressing Traditional environmental values for the site and receiving waters including the following: environmental quality of women's birthing sites typically at natural springs; riverine shape and water flow, abundances and contaminant status of biota with regard to their dietary, medicinal and totemic significance; water

quality suitability for ceremonial purposes, and; riverine sacred sites.

The Warrai and Kungarakany connection to this country is very strong.

Previous remedial activities at the mine site have concentrated on reducing the production and transport of contaminants at the site by soil coverage and revegetation of overburden heaps with native species. After remediation these overburden heaps were invaded by Gamba grass that outcompeted the planted native acacia species. Gamba grass burns hotter than native species, destroying both the native acacias and their seedbanks. Consequent exposure, cracking and erosion of the soil-cover has led to increases in the production of contaminants within the heaps, with predictions of increased contaminant levels both on-site and in the receiving waters. Gamba grass invasion has also been linked to increased sedimentation in the nearby Finniss River. These changes will degrade the qualities of the environment which are valued by Indigenous Traditional Owners.



Strong inference was made by Indigenous stakeholders that a weed-free environment should be considered as an important environmental value in the context of successful mine-site rehabilitation.

Left: hot fires produced by Gamba grass invasion

There is now a new plan being developed, in conjunction with the Traditional Owners for the remediation of Rum Jungle in accordance with Traditional environmental and spiritual values, which will also include the control of the entry and proliferation of Gamba grass.

This long-term study has shown that, through a sequence of ecological and geochemical inter-dependencies, an invasive species has the capacity to cause substantial detriment to environmental values of Traditional Owners.



Increased sedimentation (top) linked to Gamba Grass invasion near the Finniss River

Feral animals in South East Arnhem Land

Indigenous Protected Area, Australia

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The Yugul Mangi Aboriginal Ranger group was established in 2002. The group is based in Ngukurr in the south east of Aboriginal owned Arnhem Land on the northern bank of the mighty Roper River. Ngukurr is a remote Aboriginal community of about 1000 people. The Yugul Mangi Rangers represent the seven Aboriginal clans of the region – Ngalakan, Ngandi, Marra, Wandarrang, Nunggubuyu, Alawa and Ritharrngu – which is reflected in their logo. The SE Arnhem Land Indigenous Protected Area they manage is approximately 20,000km² and includes floodplain, savanna woodland, coastal, stone and freshwater spring Country.



The Yugul Mangi Rangers manage a very large remote area (1 person per 10km²) with very limited resources including an old shed, 2 vehicles, 1 boat and only 9 Rangers – 4 women and 5 men.



There are lots of feral animals in this area including buffalo, horse, pigs, donkeys, cats and cane toads. Local management of each species is different depending on the economic, environmental and socio-cultural values associated with each species. Local people want to get rid of pigs and cane toads. Pigs muck up freshwater wetlands and dig up bush foods like yams and water lily roots that are rapidly disappearing, along with the traditional practice of harvesting them. Cane toads kill other native animals that eat them like goanna and quolls that were also once bush foods but have now become rare.



Edible yam



Feral pig on motion sensor camera

Rangers testing water at feral animal damaged wetland





Cats have only recently been considered a threat to native wildlife but control of them is difficult in such remote areas. It's hard to understand the damage they have caused because they are nocturnal so we don't see them very often.

The community has spiritual and emotional attachments to **horses** as they are part of the region's pastoral history; however, they are eating water lilies and also damaging wetlands. People don't want to cull them but some people are keen to see them used in the pet meat industry or rounded up and tamed for use in current stock work.



Donkeys are increasing in the area but again, they have spiritual and emotional values due to connections with Jesus and Christianity which was brought into the region in the early 1900's. So not all people want to cull them.



Water buffalo are considered a big threat to wetlands mainly because of their size, hard hooves and wallowing activities. They also scare people in towns and fishing places. Recently we have been supporting a local buffalo pet meat industry and some safari hunting for trophy animals. However, there are still lots around and we may always have some of them on our Country.



Left from top: Feral cat caught on motion sensor camera; feral horses; feral donkey; water buffalo
Below: feral animal exclusion fence with lilies growing inside; water lilies eaten by feral horses

In 2009 the Rangers erected **fences** to keep buffalo, horses and pigs out of three culturally significant wetlands and the community has been surprised at all the lilies coming back. The rangers have also been monitoring biocultural features inside and outside the fence. Because the feral animals have been there for a long time people don't know what the country looks like without them. To manage feral animals, the Rangers are working on an integrated feral animal plan for the proposed SE Arnhem Land Indigenous Protected Area.



Hornwort invading wetlands in New Zealand

Smith, H., Spinks, A., & Poutama, M.

With tribal affiliations that span Ngāti Tukorehe; Ngāti Wehiwehi; Ngāti Kikopiri; Ngāti Raukawa ki te Tonga and affiliated hapū, and Ngāti Toarangatira.

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MTM Team 'selfie' with Moira Poutama, Aroha Spinks and Huhana Smith at Waiwiri Stream swimming hole, Horowhenua, February 2014.

The MTM team consists of Dr Huhana Smith, an independent researcher through Massey University, Palmerston North. Moira Poutama and Aroha Spinks are key researchers employed by TRERU. The team works closely with iwi and hapū representatives on six action-research projects in the MTM Horowhenua case study region.

In Aotearoa New Zealand, Hornwort [*Ceratophyllum demersum*] is described as a pest under the Biosecurity Act 1993. It looks like deer antlers or horn hence its common name.

Hornwort is an invasive and submerged aquatic weed, which creates detrimental effects on habitat quality in freshwater environments. As an enveloping, floating weed in dune wetlands and dune lakes in coastal areas, it forms a dense, unsightly and hazardous mattress-like mass that displaces valuable native plant communities. It removes fish habitat and other freshwater biota. Deoxygenated water is the result of the litter and debris that is laid down beneath the floating hornwort mass.

Even though rehabilitation projects have raised water levels with positive effects on drained, modified dune wetlands and dune lakes in the case study area, **hornwort is a major challenge** for any ongoing management of recovering freshwater ecosystems.

Photos: Hornwort as it looks like on a hand (right top), as a dense weed mass in water (right middle) and in a hinaki [eel trap] (right).

The small, unhealthy eel caught in the hinaki (eel trap) was asphyxiated by the lack of oxygen in wetland waters due to invasive hornwort.



Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and hapū (MTM) is a multi-entity, collaborative, action and kaupapa Māori research project funded by Ministry for Business Innovation and Employment (MBIE), led by iwi and hapū with support from Taiao Raukawa Environmental Resource Unit (TRERU).

Since 2010, the MTM team for the Horowhenua case study (a 17km south western coastline between Levin and Ōtaki, in Horowhenua to Kāpiti regions, on Te Ika ā



Mauī/North Island in Aotearoa New Zealand), has used Mātauranga Māori or local systems of understanding to assess the ecological decline of significant water bodies once renowned for resource gathering, cultural practices and rites. A range of stressors including hornwort, now impacts these water bodies.



Hornwort infestation in Te Hākari Dune wetland

Since 2005 there have been a series of hui (gatherings of experts, both Māori and scientific) to try and find a way forward for hornwort control. The controls discussed have ranged from poisoning; draglines; weed harvester; biological control with grass carp and insect; draining and refilling wetlands and mixed options of use, whereby a mechanical digger or poison (using Endathol-k gel) for initial knockdown could be followed up by biological control and weed harvesting.

Above: Birdlife returning to wetland after spraying, however the positive effects were short lived. Within a year the hornwort was back, but again in 2015 the team is still trying to source sufficient funds for another mixed option approach.

On 29 April 2011, with resource consent from Horizons Regional Council of Manawatū/Whanganui region, to use *Endathol-k* in spray form dropped by helicopter (above middle) this group of agents (above top) met to activate the work required to aerial spray Te Hākari dune wetland.

The team included: Richard Anderson and Rangī Markus Heke of Nga Whenua Rahui, the helicopter pilot, Noel Proctor and James Lambie of Horizons Regional Council and Pat Seymour, Tahamata Incorporation Board member and one of the local kaitiaki from Ngāti Tukorehe and associated hapū (subtribes) for Te Hākari Dune wetland within Māori land holdings.

CABI's overall global programme goal is to improve rural poor livelihoods in the developing world through increased food security, trade and protection of agro- and natural ecosystems, by reducing the threat and impact of biological invasions on natural capital assets, crops, livestock and human health.

Ecosystem services contribute directly to human well-being through food security and provision; fresh water quality; reduced vulnerability to shocks; regulation of infectious diseases and pests; waste processing; nutrient cycling; regulation of climate and air quality; medicines; timber, building materials, fodder, fibre and fuel; and cultural and spiritual values (Ash and Jenkins, 2007).

These goods and services provided by ecosystems are particularly important to the approximately 750 million of the more than one billion people living in rural areas. Most of these people live in absolute poverty, depending almost exclusively on natural resources and as such are most vulnerable when biodiversity is lost or degraded (MEA, 2005). For example, the annual economic values of the Zambezi basin wetlands in southern Africa are, amongst others, US\$50 million for flood plain recession agriculture, US\$78.6 million for fish production, US\$70 million for livestock grazing, and US\$2.6 million for natural products and medicine (Seyam et al., 2001). Up to 80% of the world's rural populations depend on plants for their primary health care, since western pharmaceuticals are often too expensive, inaccessible or unsuitable (WHO, 1978).

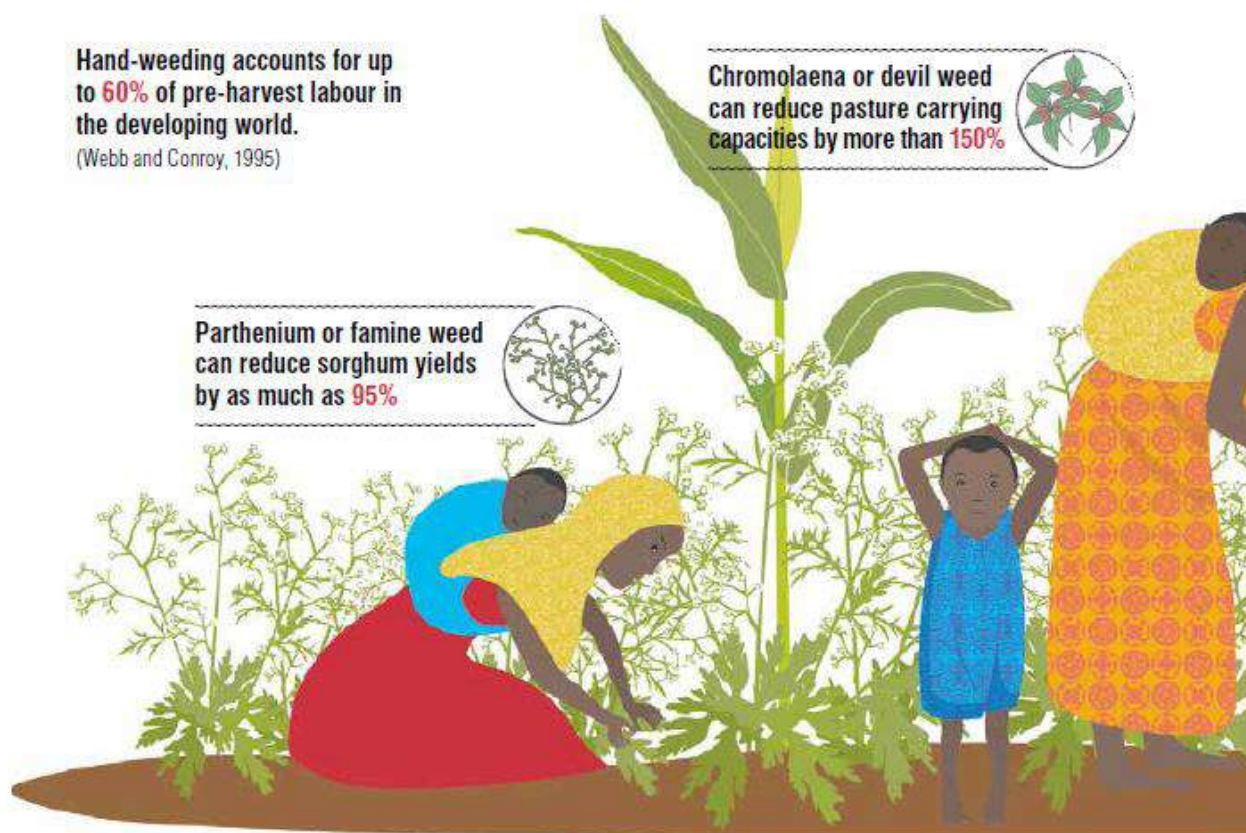
Hand-weeding accounts for up to 60% of pre-harvest labour in the developing world.

(Webb and Conroy, 1995)

Chromolaena or devil weed can reduce pasture carrying capacities by more than 150%



Parthenium or famine weed can reduce sorghum yields by as much as 95%



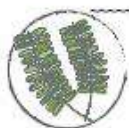
Invasive Alien Species (IAS) pose the biggest threat to biodiversity after habitat destruction and as such pose a very real threat to millions of people directly dependent on natural resources for their survival. In some taxonomic groups the majority of pests are IAS.

On average, pests, including weeds, can cause yield losses of more than **50%** in some important crops in Africa (Oerke, 2006).

It has been estimated that weeds in general cause a yield loss of about **10%** in developed countries and **25-30%** in the least developed countries (Akobundu, 1987).

Lantana has invaded millions of hectares in Africa and Asia significantly reducing pasture production.

CABI provides support to developing countries and in so doing improves livelihoods by developing and implementing IAS management strategies; building capacity; creating awareness and developing best management practices for many IAS from a range of taxonomic groups. To date CABI has also led or made major contributions to over 50 invasive species management projects in developing countries using biocontrol or integrated pest management and continues to do so. For example, the CABI led biocontrol project against the mango mealybug, an invasive insect that severely reduced yields of mango and other smallholder tree crops over much of West and Central Africa, resulted in complete control with a benefit cost ratio of 808:1. CABI plans to benefit 50 million small-scale farmers, including pastoralists, by enhancing countries capacity to prevent; detect and eradicate; and control, in a sustainable and environmentally compatible way, the most damaging IAS in Africa and Asia.



Prosopis species have invaded millions of hectares of pastoral land in Africa, reducing forage species and water resources and driving people from their land

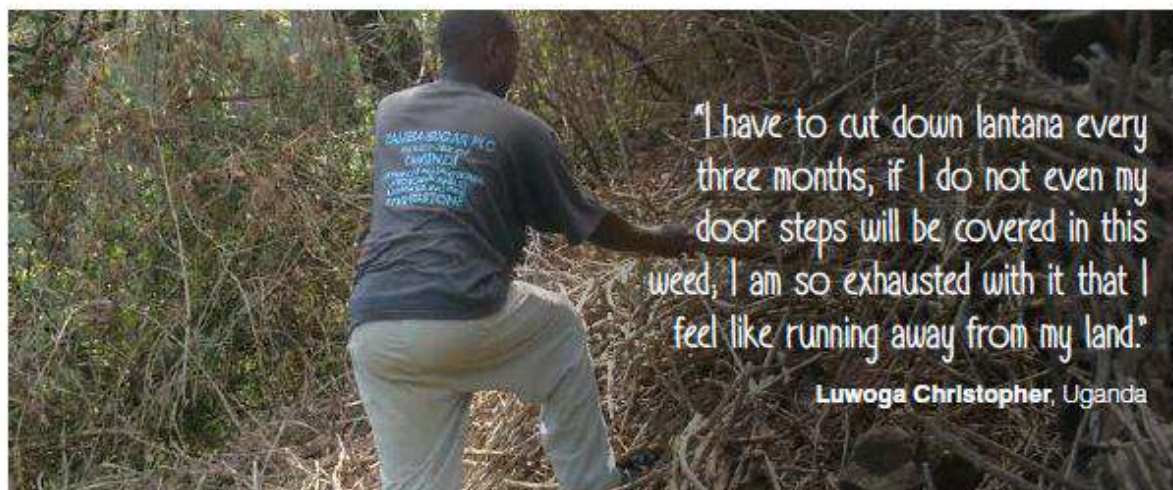
Women contribute more than **90%** of the hand weeding labour for most crops.

(Ukekje, 2004)

and **69%** of farm children between the ages of 5-14 are forced to leave school and are used in the agricultural sector, especially at peak periods of weeding.

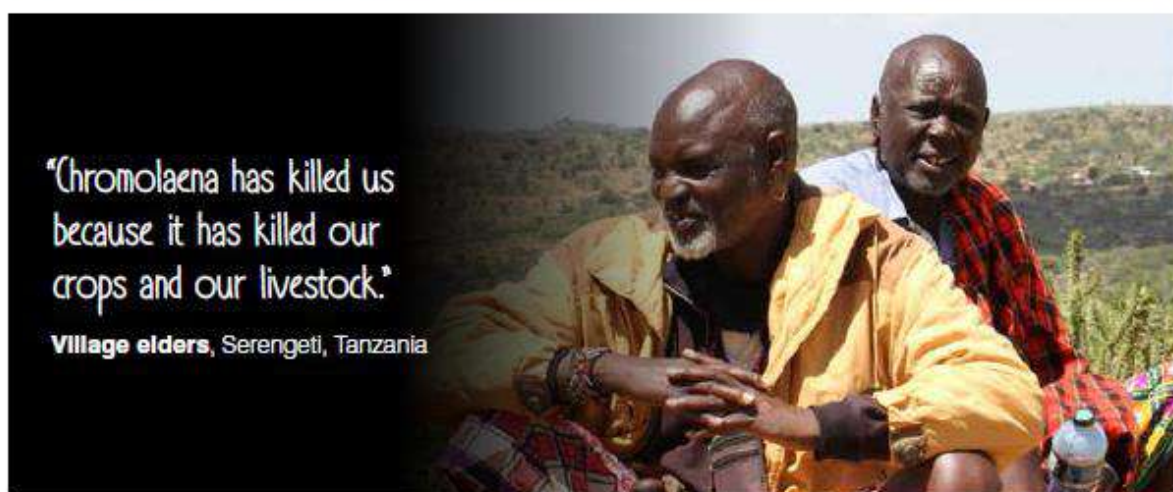
(Ishaya et al., 2008)





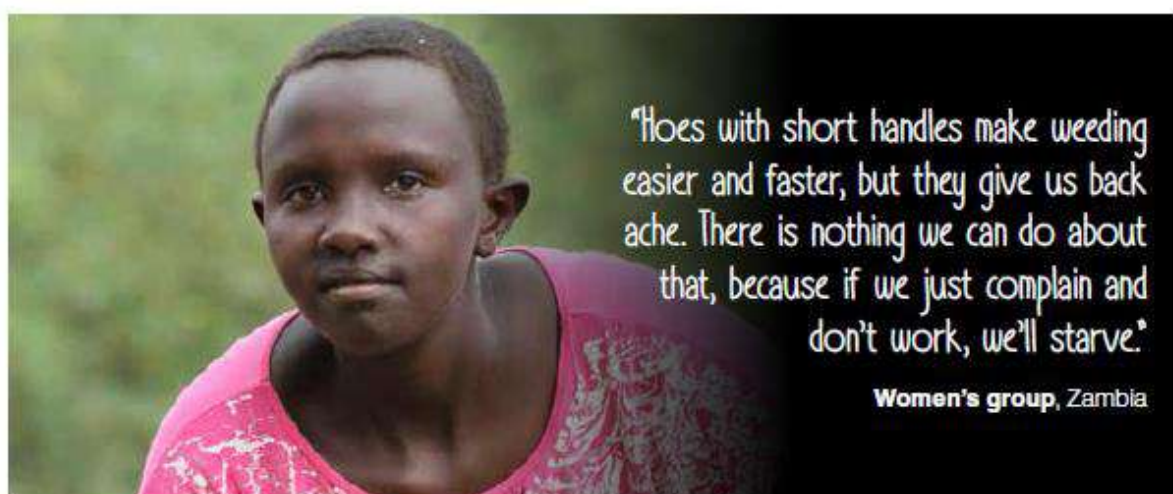
"I have to cut down lantana every three months, if I do not even my door steps will be covered in this weed, I am so exhausted with it that I feel like running away from my land."

Luwoga Christopher, Uganda



"Chromolaena has killed us because it has killed our crops and our livestock."

Village elders, Serengeti, Tanzania



"Hoes with short handles make weeding easier and faster, but they give us back ache. There is nothing we can do about that, because if we just complain and don't work, we'll starve."

Women's group, Zambia

www.cabi.org/invasives

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