

Exotic invasions of the Burdekin catchment, North Queensland

Roger Lawes^{1,3} and Anthony Grice^{2,3}

¹ CSIRO Sustainable Ecosystems, Floreat, Western Australia 6913, Australia

² CSIRO Sustainable Ecosystems, Townsville, Queensland 4810, Australia

³ CRC for Australian Weed Management

Email: roger.lawes@csiro.au

Summary The Burdekin River system, situated in North Queensland, Australia, is the third largest in the nation and extends for over 1700 km. Multiple plant species have invaded the riparian zone of this system. A survey was conducted between 2002 and 2006 to determine the frequency, abundance and geographic extent of each detected species in this catchment. The introduced pasture grasses were the most frequent and abundant. Trees, vines and forbs such as *Ziziphus mauritiana* Lam., *Cryptostegia grandiflora* R.Br. and *Parthenium hysterophorus* L. were also frequent and abundant. We briefly summarise information on the spatial distribution of the invasive species in this catchment and identify tributaries that have been heavily invaded. Some tributaries are relatively weed free and are candidates for continued monitoring and regional-scale weed management programs to keep them that way.

Keywords Rangeland, survey, landscape scale.

INTRODUCTION

To develop a catchment scale management strategy for weed invasions, it is essential to understand the abundance and spatial distribution of the species in the catchment. For example, at the catchment scale the goal may be to reduce the impact and spread of individual species, or minimise the combined impact of a suite of invasives across the whole catchment. Regardless, both strategies require detailed understanding of the extent and distribution of species. The Burdekin River system in northern Australia has been invaded by some of Australia's worst weeds, but had never been surveyed extensively. We conducted a survey of this system to identify the geographic extent and abundance of invasive species and to identify areas in the catchment that have few weeds and warrant continued monitoring and ongoing weed management.

MATERIALS AND METHODS

The Burdekin River system is predominantly used for grazing, and has been invaded by at least 66 non-native species (Lawes *et al.* 2006). The Burdekin River and associated tributaries were surveyed between 2002 and 2006 for exotic species (Figure 1). Ninety sites

were surveyed within the riparian zones throughout the catchment to determine the spatial extent of individual species. Sites were positioned at approximately 17 km intervals along the river system. Within each site, transects were stratified on the bank at the water's edge, the mid-slope of the riparian zone, and the levee where the riparian zone ends, giving way to upland areas that are less affected by stream dynamics. These three locations cover the extent of the riparian zone in this landscape. Each transect comprised 10 contiguous 10 m by 5 m quadrats. Each block of three transects was replicated three times. Thus, each site comprised nine transects and 90 quadrats. In each quadrat, the percent canopy cover of every exotic species was estimated visually.

At each site, the number and total cover of every exotic species was calculated by summing data from every quadrat. We discuss the spatial distribution of species number and cover in the 23 tributaries in this catchment. In addition we explore the habitat characteristics of the dominant exotic species.

RESULTS

Sixty six individual non-native species were identified in the survey. Of the 12 most abundant species, five were the introduced pasture grasses, *Urochloa mosambicensis* Dandy, *Bothriochloa pertusa* (L.) A.Camus, *Cenchrus ciliaris* L. and *Megathyrsus maximus* (Jacq.). *U. mosambicensis* occupied 6.9% of surveyed area, and the other grasses occupied 2.0–2.5%. *Ziziphus mauritiana* (chinee apple), an introduced tree and *Cryptostegia grandiflora* (rubber vine) also occupied 1.8 and 1.7% of the riparian zone in the catchment. *Parthenium hysterophorus* occupied 1.0% of the riparian zone. Other abundant forbs included *Alternanthera bettzickiana* (Requel) G.Nicholson (Mexican poppy) and *Xanthium strumarium* L. (noogoora burr), while the perennial shrubs *Lantana camera* L. and *Jatropha gossypifolia* L. (bellyache bush) were also abundant, each occupying 0.4% of the surveyed area. The native increaser shrub, *Carissa ovata* R.Br. also occupied 0.4% of the riparian zone. A further 54 species were identified that at this stage pose little threat to the ecosystem. However, they have established in

this catchment, and in time may become problematic (Figure 2d). See Lawes *et al.* (2006) for a complete list of species and quantitative assessment of their weed status in this catchment.

Species were unevenly distributed across survey sites and rivers in the catchment. On average, 16 exotics were present at each site, but this ranged from three to 31 species (Figure 2a). Collectively, these species occupied 18% of the area surveyed (Figure 2b). Keelbottom and Kirk Rivers, situated in the south-eastern portion of the catchment, were the most heavily infested rivers, where exotic species covered 40 and 52% of the surveyed area. Conversely, exotics covered 22% of Hann Creek which is situated between these two rivers. Exotics covered 37% of Dry River sites, situated in the north-western corner (Figure 2c), but less than 2% in many of the minor northern tributaries, including Spinifex Creek, Sandy Creek, Hopewell Creek and Anthill Creek.

Clear geographic trends were difficult to identify. For example, Spinifex Creek had low levels of exotic cover, but it is a tributary of Running River which had high levels of cover (32%). However, most sites and rivers near Charters Towers had high levels of exotic

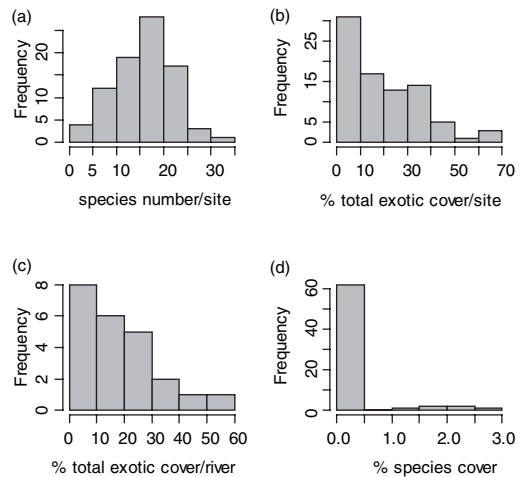


Figure 2. Exotic species number per site (a), percent exotic cover per site (b), percent exotic cover/river (c) and percentage cover of the 65 species surveyed in the catchment (d). *Urochloa mosambicensis*, which occupied 6% of the catchment, is excluded from histogram (d).

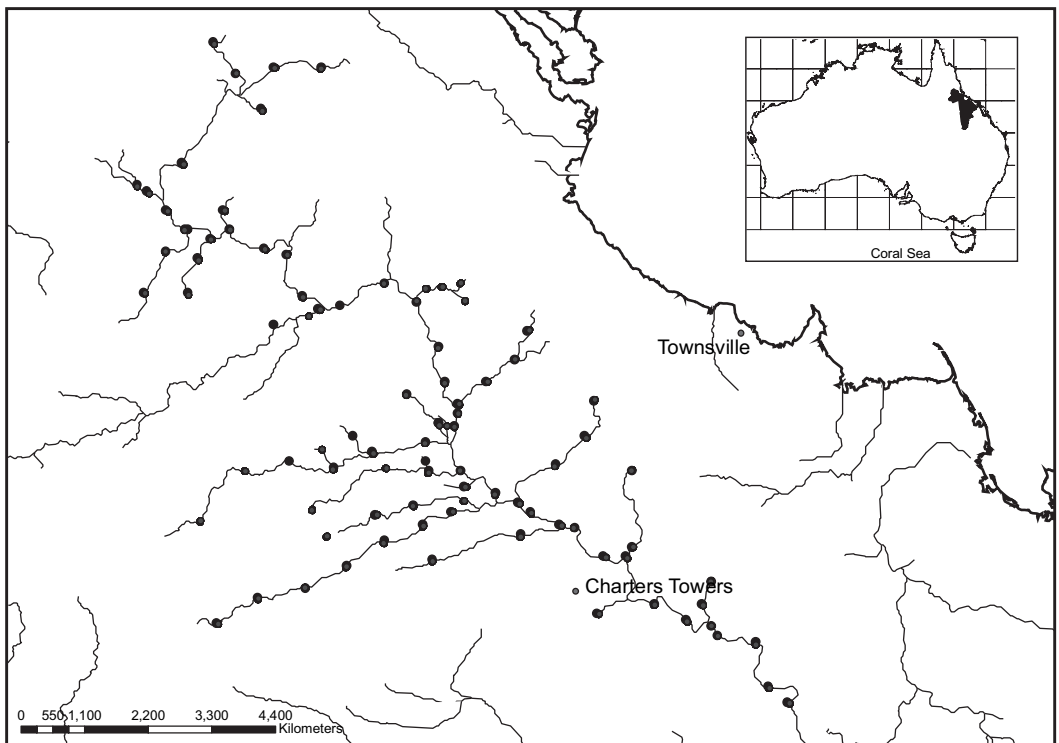


Figure 1. Location of sample points within the Burdekin River system.

cover and these weed communities were dominated by *Z. mauritiana* and *C. grandiflora*. In contrast, *L. camara* has appeared in the minor tributaries of the northern and north-eastern portions of the catchment. The exotic grasses have almost uniformly occupied every river in the catchment and are more abundant when larger exotics are scarce, possibly because *Z. mauritiana* is the most competitive invasive species in the catchment (Lawes *et al.* 2008).

Distinct, transect-level patterns of invasion emerged for three of the 12 most abundant species, providing they were present at the survey site. *L. camara*, *C. ciliaris* and *P. hysterophorus* had strong, and therefore consistent, transect level signals. More *L. camara* was found on the first transect, close to the river's edge and the second transect, situated in the middle of the riparian zone, than on the third transect on the levee. In contrast, more *C. ciliaris* was found on the third transect than on the second or first transect. More *P. hysterophorus* was found on the first transect than on the third. The cover of all other species, when present, was not influenced by the transect location within the site.

Although transect location had a minor impact on species cover, transect did influence the likelihood that a species would be present. *Z. mauritiana* was more likely to be present in the middle transect. The exotic pasture species *U. mosambicensis*, *B. pertusa* and *C. ciliaris* were all more likely to be present in the second and third transects. In contrast, the small forbs *P. hysterophorus*, *X. strumarium* and *A. bettzikiana* were most likely present on the first transect. *C. grandiflora* was also more likely to be present on the first transect.

DISCUSSION

This survey provided a useful benchmark for monitoring and helped to identify the most frequent and abundant invasive species in the catchment. Twelve species had spread widely throughout the catchment and were abundant on occasions. In addition, 54 other species were identified, including well known invasives *Datura stramonium* L. (common thorn apple), *Ricinus communis* L. (castor oil), *Acacia nilotica* (L.) Delile (prickly acacia) and *Parkinsonia aculeata* L. (parkinsonia).

This complex amalgam of species complicates weed management activities. Weed management is traditionally conducted at the species level, but in this catchment, such an approach would simply result in another invasive replacing the managed species. This outcome is inevitable when on average 16 species inhabit a 1 ha site.

Managers are left with the complex decision either to manage heavily invaded sites or to manage sites with few invasions and minimise the weed invasion in these sites with continued ongoing levels of management. On occasions, transformer species (Richardson *et al.* 2000) such as *C. grandiflora* and *Z. mauritiana* had invaded sites with low levels of weed cover. Although the weed loads in these sites are minor, they will require continued management to maintain low levels of weed cover.

Distinct habitat preferences for individual species were identified, but, in general, the distribution of individual weeds was site specific. Thus, the dispersal of weeds throughout the catchment could be viewed as random, particularly in the context of predicting the location of individual species. Managers need to evaluate their weed populations and base management decisions on the species mix and relative abundance of each species.

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