An audit system to account for birds and mammals utilising weeds species

Suzanne Lawrie
Environmental Weeds Group, School of Geography, Population and Environmental Management, Flinders University, GPO Box 2100, Adelaide, South Australia 5001, Australia

Summary Recent studies highlight the diverse ways in which introduced plants are incorporated within the contemporary ecologies of native birds and mammals. Current weed management strategies, however, fail to acknowledge these animal-weed relationships. A generic weed management audit is proposed to enable managers to systematically account for animal-weed interactions. The paper examines known animal-weed relationships within Australia and identifies key interactions, which are then applied to formulate an audit system. The audit aims to empower managers to make holistic weed management decisions at the local scale based on broader ecological processes.

INTRODUCTION

Numerous plants introduced into Australia have naturalised and emerged as weeds. The combination of vegetation clearance and proliferation of weeds has altered ecosystems. The negative impacts of weeds and associated threats to natural environments and primary production are well documented (Randall 1996). However, the role of weeds is not always negative (Bass 1999, Date *et al.* 1991). Research reveals that various native animals interact with weeds in a variety of ways. Loyn and French (1991) and Brown *et al.* (1991) highlight cases where animals benefit from utilising weeds as breeding and feeding resources.

Other studies indirectly detail animal-weed interactions. For example, seed dispersal research has predominantly focused on the role of animals (as dispersal agents) in the weeds' ecology. However, the weeds' importance to the animals' ecology remains overlooked yet may be of vital importance. Knowledge of animal-weed relationships is therefore limited. Furthermore, research findings have rarely been applied to inform weed management practices. Where animal-weed relationships are recognised (Turner 2000), no framework exists to resolve management dilemmas. This paper addresses these deficiencies through introducing an animal-weed audit to identify interactions between native animals and weeds and then account for these interactions through establishing appropriate weed management strategies (see Lawrie 2000 for a comprehensive discussion of the audit).

ANIMAL-WEED RELATIONSHIPS

The need to give animal-weed relationships greater recognition becomes apparent when one considers the numerous and diverse interactions that presently occur. This section outlines the results of a literature review undertaken on animal-weed interactions in Australia and identifies key interactions.

Role of weeds in the ecology of birds and mammals A significant number of birds and mammals have been documented or observed utilising introduced plants in Australia (Table 1). A total of 225 bird species were recorded as variously interacting with 482 weed species. The utilisation of weeds as a food source was the most common interaction with nearly 90% of the bird species recorded feeding on at least one of 468 weed species. General habitat interactions were the next most common interaction in terms of numbers of bird species. Some 35 birds were also identified as nesting or breeding amongst weeds. Other relationships identified include birds perching, vocalising (singing) and roosting on/in weeds. In some cases, the interactions between birds and weeds are of conservation significance. One example of this is the role the introduced species camphor laurel (*Cinnamomum*

Table 1. Bird and mammal weed interactions.

	Birds utilising weeds	Weed species utilised	Mammals utilising weeds	Weed species utilised
TOTAL	225	482	43	55
Interaction type				
Habitat (non-specific)	45	10	32	24
Food source	198	468	21	39
Feeding substrate/ under canopy	10	3		
Nesting/breeding	35	36	2	3
Perching site	17	4		
Vocalising	10	2		
Roosting		4		
Protection	8	3	2	3
Corridor	3	1	1	3
Shelter			5	5

camphora) now plays in the ecology of fruit pigeons, particularly topknot (*Lopholaimus aniarcticus*) and white-headed pigeons (*Columba leucomela*) in north eastern New South Wales (Ford 1986, Date *et al.* 1991).

A small but important group of mammals were also identified as interacting with weeds. In total, 43 mammals were recorded interacting with 55 weed species. The most common interaction involved weeds providing general (non-specific) habitat. Interactions relating to specific habitat qualities included mammals breeding and sheltering within weedy areas. Food-resource interactions accounted for the highest number of weeds utilised. A total of 21 mammals were documented as incorporating 39 weed species in their diets. Native vegetation clearance has had a devastating effect on Australia's mammal population (Wilson and Friend 1999) and in some cases the conservation of a species hinges on the existence of weeds. This appears to be the case for the southern brown bandicoot (*Isoodon obesulus*) in South Australia that utilise blackberry (*Rubus fruticosis*) and gorse (*Ulex europaeus*) for 'protection' (Paull 1993, Regel *et al.* 1996).

Key weed and animal interactions While animals interact with weeds in a multiplicity of ways and for a variety of reasons, a number of core interactions are evident (Table 2). These 'key interactions' provide a basis for developing an audit system to account for animal-weed interactions.

Many of the key interactions can be interpreted from field evidence. The principal types of field evidence for identifying animal-weed interactions include:

- Scats/regurgitates
- Tracks
- Run-ins and paths
- Nests
- Shelters
- Eggs (shells)
- Burrows
- Damaged fruit, seeds and foliage
- Depressions
- Flattened grass
- Diggings
- Fur
- Feathers
- Snake skins
- Bones
- Scratches/scrapings and rubbings

These signs can be 'read' or interpreted to identify the animal species. For example, from scats it is possible to identify the animal as the size, shape, location, contents, smell and colouring of scats can be characteristic of particular species. Some evidence gives little indication of the animal's activities and reveals only an animal's presence while other forms indicate specific activities or interactions.

Table 2. Key animal-weed interactions.

Habitat (non-specific)	Protection from predators
Food source	Roosting
Feeding substrate	Perching site
Feeding under canopy	Vocalising
Nesting/breeding	Basking
Shelter	Corridor movement

The presence of animals and the relationships between plants and animals or weeds can also be directly observed. A number of types of behaviour such as perching, feeding (e.g., foraging, frugivory) and breeding (e.g., display, presence of juveniles in nests) can all be viewed in the field.

ANIMAL-WEED AUDIT

Observing and recognising the range of interactions and interpreting field evidence are important steps towards acknowledging animal-weed relationships. Systematically recording such information has to date been difficult. As a consequence potentially important interactions have largely been overlooked. Developing an audit that can be used to record animal-weed interactions may help overcome such problems.

The audit provides a systematic method for surveying weedy sites to identify and record interactions between animals and the target weed(s). The audit is divided into the five sections:

1. Target weed and field familiarisation.
2. Surveying the site.
3. Looking for evidence.
4. Interpreting interactions.
5. Developing a weed removal strategy.

Detailed instruction guides the user through the audit from pre-fieldwork weed and site familiarisation to identifying suitable weed management options. The audit contains several checklists or data sheets to record weed and site information and animal-weed relationships. Weed removal strategies are then outlined and suitable approaches identified. While a thorough examination of the audit is outside the scope of this paper (see Lawrie 2000), the following discussion highlights a number of important features.

Field observation In searching for evidence of interactions, particular checklists are used to encourage managers to look under, around and amongst target weeds. An example of a checklist involving looking for evidence of scats is shown in Table 3. Areas where scats are commonly deposited are listed as 'prompts'. Where the scat is located may indicate a particular interaction

or assist with animal identification such as when a scat is found next to the entrance to a burrow or run-in. If managers are able to identify the animal from the scat they must then determine its status, for example, if the animal is endangered or common. An animal's status may influence weed management activities.

There are a number of other checklists included in the audit, similar in layout to Table 3 that record other types of evidence of interactions such as tracks, run-ins, shelters and feeding signs and also direct observations. The types of evidence identified in undertaking the audit will generally fall into two basic categories: signs of animal-weed interactions or signs of animals using the general environment. In some cases it is possible to piece together multiple signs from an animal to establish an interaction. The significance of these findings will vary considerably, as will the implications for weed management.

After identifying interactions, the audit then asks managers to consider the appropriateness of native species for revegetation. The attributes the target weed provides (e.g. fleshy fruits, dense habit, etc.) and its structural component (e.g. shrub, scrambler) must be identified and then used to search for similar indigenous plant species. For example, a prickly shrub such as gorse (*Ulex europaeus*) may be replaced with kangaroo thorn (*Acacia paradoxa*) which has similar attributes.

Prior to deciding on appropriate weed management strategies, it is often necessary to prioritise interactions based on their potential significance. While the audit offers some guiding principles for prioritising interactions, this assessment needs to be done at a local scale with local knowledge.

Weed removal strategy In making weed management decisions it is necessary to consider spatial, temporal and structural elements of the weed, the interacting animal(s) and removal methods. The audit directs users to consider these aspects to identify minimal impact weed management options. Questions addressed by the audit include: Where and what area to remove weeds? When and how to remove weeds? What to plant as replacements? What is the lag time before native plants provide similar ecological functions to the removed weeds?

It is necessary to determine the appropriate weed control time to minimise adverse impacts on interacting animals. The audit prompts managers to work through a 'weed management calendar' to record when the weed is being utilised, the preferred time for weed removal/treatment, and identify a weed management window (where no overlap exists between periods of interactions and preferred weed treatment times).

Table 3. Recording and identifying scats.

Location	Animal scat type			
	1	2	3	4
Under weed				
On weed foliage				
Under tree/shrub				
On tree/shrub foliage				
Top of tussock				
Top of rock				
Top of a log				
On/near animal track				
Next to a digging				
Next to a run-in				
Next to shelter/nest				
Next to burrow				
Other				
Scat is from:				
Bird				
Mammal				
Reptile/Amph.				

The calendar provides a straightforward assessment of when weed removal would have the least impact on animals.

Weed management should always be considered as a long term and gradual process, with infestations rarely being cleared entirely in one go or even over a couple of years. Even when revegetation programs follow weed removal, there is a lag time before native plants provide similar ecological functions. The audit addresses spatial aspects of weed removal in two ways by considering where to focus weed removal and the area to be managed. This involves identifying preferential habitat within weed infestations (e.g. where most interactions occur). In addition, consideration is given to patchy weed removal strategies and the staging of management activities.

After examining spatial and temporal aspects, the final element to plan is the weed removal technique to employ. It is common belief that weed management activities predominantly involve killing and removing weeds off site. This could be to the detriment of interacting animals and there are other methods that can be used to control weeds without resorting to total weed removal. The best method will depend on the weed and animal characteristics and the nature of the infestation. The audit guides users through weed

management strategies and their appropriateness for various situations. Types of animal-weed interactions are identified and applied to weed management scenarios. For example, if the interaction was a bird roosting in an olive (*Olea europaea*) tree then an appropriate management option may be to control the weed through stem injection without removal, thus leaving the structural component of the tree intact. Other options are detailed in the audit.

The audit discusses in detail the spatial, temporal, structural and methodological components of weed management to provide a solid foundation for managers to make an informed decision. However, appropriate weed removal strategies will vary greatly depending on local circumstances. Managers must adapt weed management activities based on local knowledge, experience and follow up monitoring to ensure the continued survival of animal populations with the guidance of the audit.

CONCLUSION

This paper has highlighted the fact that the relationships between animals and plants are dynamic and intricate. The introduction of weeds creates further complexities. For weed management to be effective, it is essential that animal-weed relationships be given appropriate consideration. The audit, summarised in this paper, aims to account for such relationships by observing and systematically recording 'evidence' of animal-weed interactions. Only through undertaking such an approach can weed management be considered holistic – one that considers broader community processes to address the previously unrecognised impacts on native animals that stem from weed removal.

The audit discussed in this paper empowers managers to make weed management decisions on a local basis while accounting for contemporary ecological processes. This paper presents the field of weed management with a challenge to engage more actively with concepts of habitat. To think of introduced plants as only negative or at best benign components of landscapes leaves weed management vulnerable – potentially replicating the impacts that have ensued from native vegetation clearance.

ACKNOWLEDGMENTS

I would like to thank David Bass for his enthusiasm and guidance in supervising this project. Thanks also to Tom Jenkin for tirelessly helping me develop and improve the audit.

REFERENCES

Bass, D.A. (1999). The ecological interactions between weeds and animals in Australia. Proceedings of the 5th International Conference on the Ecology of Invasive Alien Plants, 13–16 October 1999, Sardinia, Italy.

Brown, P.R., Wallis, R.L., Simmons, D. and Adams, R. (1991). Weeds and wildlife. *Plant Protection Quarterly* 6, 150-53.

Date, E.M., Ford, H.A. and Recher, H.F. (1991). Frugivorous pigeons, stepping stones and weeds in northern New South Wales. *In* 'Nature conservation 2: The role of corridors,' eds D.A. Saunders and R.J. Hobbs, pp. 241-45. (Beatty and Sons, New South Wales).

Ford, H.A. (1986). Use of fruit and nectar by birds in the rainforests of southern Australia. *In* 'The dynamic partnership: birds and plants in southern Australia,' eds H.A. Ford, D.C. Paton and D.J. Woolman, pp. 59-63. (Government Printer, South Australia).

Lawrie, S.L. (2000). Finding animals amongst the weeds: an audit system for animal-weed relationships. Unpublished Honours thesis, Flinders University, Adelaide, South Australia.

Loyn, R.H. and French, K. (1991). Birds and environmental weeds in south-eastern Australia. *Plant Protection Quarterly* 6, 137-49.

Paull, D. (1993). The distribution, ecology and conservation of the Southern Brown Bandicoot (*Isoodon obesulus obesulus*) in South Australia. Unpublished MA thesis, University of Adelaide, Adelaide, South Australia.

Randall, J.M. (1996). Weed control for the preservation of biological diversity. *Weed Technology* 10, 370-83.

Regel, R., Lehmeyerl, T., Heath, D., Carr, S., Sanderson, K. and Lane, M. (1996). Small mammal survey in Belair National Park. *South Australian Naturalist* 70, 25-30.

Turner, M.S. (2000). *Biodiversity Plan for Metropolitan Adelaide*. Urban Forest Biodiversity Program, Adelaide.

Wilson, B.A and Friend, G.R. (1999). Responses of Australian mammals to disturbance: A review. *Australian Mammalogy* 21, 87-105.