REVEGETATION

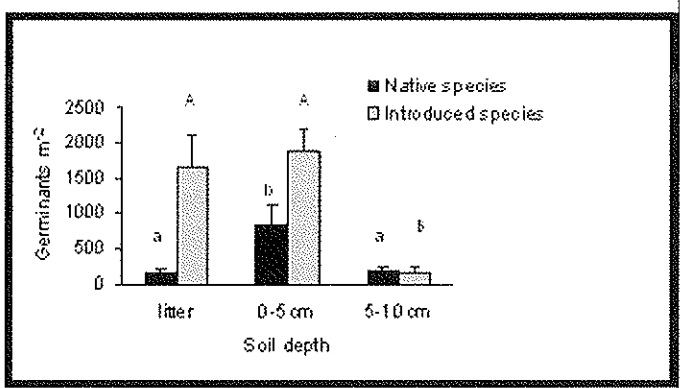
SOIL SEED BANKS - A TOOL TO CONSERVE AND MANAGE ECOSYSTEMS AGAINST WEED INVASION

Judy Fisher

Seeds in the soil provide us with knowledge of the past vegetation and the potential future vegetation, while enabling us to predict the restoration potential of invaded areas. Seeds arrive in the soil through seed dispersal and leave the seed bank through germination, consumption or death. If the remnant vegetation has a mixed seed bank of all native species in sufficient numbers, we would feel confident that the plant community will be resilient and able to resist weed invasion following disturbance. However if the soil seed bank contains a 'healthy' mixture and representation of weed seeds along with, or instead of, a native seed bank we would have less confidence in the plant community's future resilience. Results of a soil seed bank study in a banksia woodland in Bold Park, Perth, a 437-hectare reserve, demonstrate the potential to formulate management protocols for remnant vegetation to control weed species and conserve biodiversity utilising knowledge of the soil seed bank. The two dominant weed species studied were perennial veld grass (*Ehrharta calycina*) and rose pelargonium (*Pelargonium capitatum*).

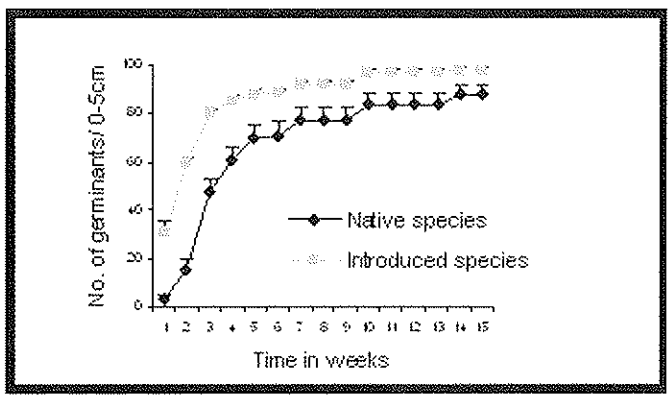
The study found that native and weed seeds, and by association plants, behave quite differently to each other*. Differences of relevance to managing remnants are the depth of seed in the soil (Fig. 1), germination timing (Fig. 2) and the large quantity of weed seed produced compared to the native seed (Fig. 1).

Fig. 1. Density of native weed seed at three depthe in a banksia woodland.



Weed seed dominates the litter and 0-5cm depth, while the majority of native seed is located at the 0-5 cm depth. Rapid germination of introduced species (30% in week one) compared to native species (4% in week onr) provides the potential for their early dominance at the start of winter rains. Consequently, if we have a large weed seed bank, those located in the litter have first access to water when the summer drought breaks, rapidly establishing their below-ground root structure and above ground biomass, before the native species have had the opportunity to germinate. If the germination season follows fire, weed species are able to rapidly exploit open spaces and increased nutrients, out competing the native species.

Fig. 2. Cumulative germination of native and weed seed over 15 weeks.



As found in this study, a high proportion of the weed seed bank may be persistent; meaning the seed has the ability to arrest development and persist long into the future, potentially existing as sleeper species awaiting ecological change to confirm their presence in the vegetation. Frequent fire can assist the establishment of a large weed seed bank, due to weed species' large and rapid seed production, compared to native species which require lengthy periods to attain seed production rates that ensure their replacement following fire. So how can this knowledge of similarities and differences between native and introduced soil seed bank contribute to the formulation of conservation protocols to control dominant invasive species in remnant vegetation?

An example is the perennial *Ehrharta calycina* which was found to have smoke-responsive seed, the ability to germinate in the dark (i.e. from depth), rapid germination following water addition, and an extremely large annual seed production, with the parent plants able to regenerate following fire. Based on these competitive

continued on page 7

continued from page 6

Soil seed banks

REVEGETATION

survival strategies we can make the following restoration assumptions as to what will occur for *Ehrharta calycina* seed following an inadvertent fire:

1 The large seed load in the litter will be incinerated.
2 Seed at depth will be stimulated by the fire to germinate.
3 This seed will germinate rapidly following the onset of rains.
4. Parent plants will resprout in the period between fire and the start of the rain season.

Based on this knowledge, the Botanic Gardens and Parks Authority decided to trial a different management response in Bold Park following a fire started by an arsonist. An *Ehrharta calycina* control programme was started once the germinating seedlings had established, targeting the resprouting adults and the germinating seedlings. Essentially this should have virtually depleted the *Ehrharta calycina* soil seed load, eliminated the resprouting individuals prior to sufficient growth to return seed to the soil seed bank. This management method virtually eliminated *Ehrharta calycina* from both the above ground vegetation and the soil seed bank, that is, elimination of a species known to transform an ecosystem. This example indicates how knowledge of soil seed banks in remnant vegetation can assist in determining the best way to manage the weed seed bank and so the future weed population.

Determining the soil seed bank both in areas in good condition, as a reference, and where you may have difficult weed species is an excellent management tool and easy to conduct. Collecting soil samples before the start of winter rains from the litter, and a depth of 0-5cm, enables you to gain knowledge of the underground environment and the potential future vegetation within your remnant bushland. Spread the soil thinly in trays and begin to water, keeping the soil moist - if you have access to smoke water this can be applied initially. Over the next eight weeks, monitor the germinating seedlings - if you are unable to identify the seedlings transplant them to a pot to allow them to grow to maturity. Not only will this provide you with knowledge of your soil seed bank but it will assist your seedling identification skills, valuable knowledge when caring for your remnant. Gaining an understanding of the soil seed bank will help determine the best way to tackle invasive species which may be impacting the biodiversity of your remnant vegetation.

It is clear from the banksia woodland study that poor vegetation condition may well be associated with significant changes in the soil seed bank, namely, a depletion of native seed, and a predominance of seeds of introduced species. These shifts in the soil seed bank are likely to be signs of shifts in remnant vegetation species and life form composition, and highlight the importance of considering the soil seed bank in conservation management.

[* For ref contact Ed]

Judy Fisher is an ecological consultant. This PhD research was conducted through the School of Plant Biology, UWA and the Botanic Gardens and Parks Authority

Congratulations from the LFW team!

to **Suzanne Dennings** who was awarded the 2009 Great Southern Development Commission Medal for Excellence in Natural Resource Management. Suzanne was nominated by *LFW* for her leadership in the Malleefowl Preservation Group (MPG) and her success in promoting the malleefowl as an icon species to promote wider NRM issues. The MPG is now recognised internationally, while maintaining its grass-roots base.

to **Mike and Mary McCall**, winner of the Landholder Award in the Cape to Cape Catchments Annual Awards.

The McCalls have put a great deal of time, energy and money into not only their own property but also surrounding neighbouring properties and Shire reserves. They have contributed all of this initially separate from any outside funding, paying for all the works themselves. This included weed control, feral animal control, feral proof fencing, rehabilitation works, creekline re-establishment, fauna habitat creation and finally translocations of local native animals. They funded initial blackberry control within their property, adjoining properties and along the Shire reserve so that a strategic approach was taken. At a later date, the Cape to Cape Catchments provided funding for this initiative to continue for a further few years.

Mike and Mary, like other *LFW* property owners, well deserve this award.