ECOS
SCIENCE FOR SUSTAINABILITY

www.ecosmagazine.com

Published: 21 July 2014

Pest-suppressive landscapes: thinking outside the field

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We've all heard of 'thinking outside the box'. Now farmers managing pests in their crops are being asked to think outside the field.

The concept of pest-suppressive landscapes focuses on the capacity of the entire farming landscape, including non-crop vegetation in and around paddocks (such as patches of remnant native vegetation), to suppress arthropod pests. Pest-suppressive landscapes provide habitat and forage for natural enemies – such as ladybirds and parasitic wasps that eat and parasitise crop pests – whilst limiting the same for the pest species.

Credit: Source: David McClenaghan, CSIRO

Taking a landscape-scale approach to managing pests makes ecological sense. After all, pests are mobile – they don't recognise paddock or farm boundaries in their search for habitat, food, and reproduction sites. And insect predators and parasitoids are a free good!

Dr Sarina Macfadyen of CSIRO has recently finished the NSW field component of a 2-year study on pest-suppressive landscapes as part of the National Invertebrate Pest Initiative, a project supported by the Grains Research and Development Corporation (GRDC).

The study was conducted in three different agro-ecological zones: subtropical Queensland, temperate southern New South Wales, and south-west Western Australia with its Mediterranean climate (cold, wet winters and dry summers). Crops included wheat, barley, canola, cotton, mung bean, sorghum and pasture.

'We asked where are pests and natural enemies found throughout the year and which habitat are they using in

agricultural landscapes?,' says Dr Macfadyen.

'We were particularly interested in pests of grain crops and their natural enemies, such as spiders, lacewings and parasitic wasps.'

Credit: Source: CSIRO

Findings have emerged that have been translated into general guidelines for growers that hold across these climatic regions.

'As we've analysed the data sets, we've been quite surprised by the consistency of some of the patterns across these agricultural landscapes or regions,' says Dr Macfadyen.

'There are a lot of differences between regions in terms of the individual species and the densities of those species. However, we found consistently that native vegetation supports quite a large number of natural enemies, relative to the number of pest species.'

This is starting to sound like good news for on-farm conservation. But as Dr Macfadyen explains, communicating the pest-suppressive benefits of native vegetation to farmers needs to take into account the need to manage existing remnants and keep them weed free, as well as the additional expense associated with revegetation.

'So if I said to a farmer – "I want you to revegetate with native plants because I think it's going to be great for providing natural enemies" – that probably wouldn't be a good enough reason for them to revegetate, because we know planting is costly and difficult,' says Dr Macfadyen.

'But if you can start to see additional benefits from existing native vegetation patches – such as erosion control, shelter for stock, and soil health – then you might start to be persuaded to manage those patches better, and perhaps even expand them over time.'

Credit: Source: Sarina Macfadyen, CSIRO

The study included a wide range of native vegetation patches, from roadside verges through to previously logged areas, and revegetated sites. This enabled comparison of the pest-supressive effects of differing levels of weed incursion within patches.

Dr Hazel Parry of CSIRO worked on data analysis and simulation modelling of insect dispersal for the project. She explains that the study has been able to produce some region-specific guidelines for growers outlining '....which particular weeds are key hosts for particular pest species, and which native species are best for beneficial insects. For example, ladybirds and lacewings can be found on flowering acacias, whilst capeweed and fleabane are weeds that harbour pests in relatively higher numbers than other weeds.'

Changes in the populations of pest and beneficial insects are related to both spatial and temporal factors, which interact in complex ways. This gives the system a dynamism, making it challenging to study. Spatial considerations include the insect's dispersal ability, and the arrangement of crop and non-crop areas. Temporal factors include the life cycle of the insect, the varying quality of habitat patches throughout the season or on a longer time-scale, short-term weather patterns, and long-term climatic trends.

Dr Parry and Dr Macfadyen agree that Australia is playing catch-up to Europe in terms of long-term studies on the role of non-crop habitat in the landscape. Europeans are also several years ahead in terms of agro-environment schemes, maintaining perennial grasslands, and planting flower strips.

'Pesticides are more highly regulated in Europe – there are a lot more restrictions on use so they've been looking for alternatives for longer and have a longer history of thinking beyond the crop,' says Dr Parry.

'There is only so much you can do with traditional field-based approaches in the context of rising insecticide resistance and increasing regulation. And what's going on in Europe may impact on Australian exports. So there is increasing incentive to take a more landscape-scale approach.'

This was a collaborative project funded by the GRDC, involving CSIRO: Nancy Schellhorn (project leader), Hazel Parry, Sarina Macfadyen, Lynita Howie, Andrew Hulthen, Anna Marcora, Mick Neave, Paul Yeoh. DAFFQld: Matt Davis, Zara Hall, Melina Miles, Adam Quade. Department of Agriculture and Food, Western Australia (DAFWA): Art Diggle, Tony Dore, Mike Grimm, Svetlana Micic.

From **ECOS** online http://www.ecosmagazine.com/?paper=EC14155