8 Research on beetles: a summary of findings and future research

Dr Regis Goebel has been working with BSES on analysing beetle movement in relation to damage distribution for the past 3 years. Regis is a scientist from the French research organisation CIRAD and is returning to his homeland at the end of 2011. In this article he summarises his findings and flags future research for our Bulletin readers.

During my time here I have always been interested in beetles because they are the 'immersed part of the iceberg – being responsible for the damage distribution in the sugarcane fields and able to disperse and spread the damage. Working on beetles was a real challenge and the collaborative work at BSES gave me this opportunity.

After my arrival here, I discovered that there was very little information available on the adult stage of the well-known greyback cane grub. In fact, I grabbed an old and thick book from the library containing most 'beetle' studies conducted almost 100 years ago. This book has never left my office since!

BSES has worked for many years on grub management, which is normal. But at the same time research on beetles is lacking. In fact, there are many questions still unanswered around beetle biology, behaviour, chemical ecology, dispersion, flight patterns, environmental and agricultural drivers of the damage. As part of my European project, I decided to concentrate my work on some of these aspects using new tools.

I realised from the moment I started here in January 2009 that time would pass so quickly! Here, I also should mention that as part of the agreement with BSES I was involved in a biosecurity project in Indonesia, dealing with stem borers – my area of expertise. After being with BSES for 3 years – thinking, meeting with BSES entomologists, writing papers and reports – I would like to share some important findings. These relate particularly to the Cairns/Meringa area where I concentrated my studies and give some 'take home messages' for future research.

TELEMETRY AND RADIOTRACKING

Despite much progress in miniaturising the technology, radiotracking experiments were particularly difficult to manage and posed a number of issues that have been described in previous BSES Bulletins. They included detection range of tags being lower than expected in natural habitats (forests, riparian vegetation, etc.) the cost of radio transmitters, weight, battery life, etc. However, such challenges are part of research, and we have made some progress in implementing the radiotracking system, setting up attachment methods for the tags (to make sure the flight is not

disturbed) – all of which will prove useful in any future studies.

We also tried another tracking system called 'harmonic radar', which is used to retrieve the skiers buried after a snow avalanche. The system is manufactured by Recco, a Swedish company, and it uses a portable receptor and diodes (without a battery) to capture signals. We have tried it out on beetles by gluing tiny diodes equipped with copper wires on the beetle's head. After many tests we came to a conclusion that it was only suitable for short distances (10-20 metres). Tough life!

So, we went back to the original system and tried hard to get some results. We were able to get only 5 flight trajectories of beetles after many tests. However, these trajectories seem to indicate that:

1) The beetles doesn't move very far and stay around.
2) They use feeding or roosting trees to move in and out of sugarcane fields.
3) The beetles are resting most of the time.
4) There are important trees in the landscape that play a major role in the distribution of damage.

The application of such equipment is unfortunately limited by cost and the tags.

FEEDING AND ROOSTING TREES: CAN THEY BE USED AS INDICATORS OF LOCAL BEETLE POPULATIONS?

Vegetation studies are particularly interesting to conduct as part of grub management, as they allow us to understand the bio-ecology of beetles. If the vegetation mapping can help, ground-truthing to identify the botanic groups of trees in a given area is a key point. Since feeding trees (food source) and roosting trees (aggregating source) are key elements of vegetation surrounding sugarcane paddocks, surveys should be done on a regular basis to inspect these 'hot' trees and estimate the beetle population.

For example, in 2010 we discovered an almond tree (*Callophylum inophylum*) along Russel Road near BSES Meringa that attracts hundreds of beetles each year. However, this tree is unusual as there is no leaf damage! The beetles are just swarming there, calling for each other and then mating. I think this type of tree can serve as a population indicator in the main flight period. Based on numerous data and observations, we are convinced that the presence of preferred trees near sugarcane fields heavily contributes to increased damage in the local area.

The distance that a beetle is capable of flying is still poorly documented, but the distance from feeding trees to highly infested patches in paddocks is quite short. This is probably why the most damaged areas in Burdekin are the ones located along the river. I have the impression that if these areas were treated by strips from the vegetation edge to 200 metres inside the paddocks, this would significantly reduce the damage on a wide scale.

CHEMICAL ECOLOGY OF GREYBACK CANE BEETLES: PHEROMONES AND KAIROMONES

Undoubtedly, chemical ecology is a new research avenue to progress in the beetle ecology. Not only is the pheromone unknown (there have been some attempts made by BSES), but there is no information on green leaves volatiles (GLV) from the tree that could be involved in beetle aggregation and activity around specific trees. During our observations on the *Callophyllum* tree mentioned previously, we noticed that it was highly attractive to beetles. At this stage, further work has to be done by a chemical ecologist to collect the volatiles and analyse them in a laboratory with specific equipment. The lack of research in this area deprives any chance of identifying a sexual pheromone and its use in a monitoring system for the beetles.

GEOGRAPHIC INFORMATION SYSTEMS (GIS), REMOTE SENSING AND SPATIAL ECOLOGY

GIS and mapping of damage have already shed substantial light on the bioecology and management of pests around the world. Since grub damage is easily seen from the sky (helicopters, light planes, drone) it is perfectly suitable to generate GIS maps. Convinced by the interest of this approach, SRDC has recently funded a project called 'Remote sensing to implement an effective pest management strategy for canegrubs' (BSS342), involving GIS specialists from the Queensland Government (DEEDI).

When I started my project on spatial ecology, I was immediately convinced that these tools will revolutionise the way we view pest management. It is proving to be the case for this grub. Today it is essential to change scale, from field to landscape or even a region, if we want to better manage insect pests. Insects have no boundaries, and all landscape elements including agricultural areas are viewed as sources and sinks of populations.

BSES has a great challenge ahead: to invest in these tools, train people to manipulate them and then to generate map risks. Grub management could ultimately be optimised in most infested areas. By accurately identifying risk areas, for instance, it would be possible to target interventions better and reduce the field pesticide treatments that are conducted throughout Queensland. This will be especially important since sugarcane plantations are located close to the Great Barrier Reef, whose protection is essential.

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