Spatial Ecology of *Dermolepida albohirtum*, a major pest of sugarcane in Queensland: importance of a landscape approach

An overview of the current research

FR Goebel (CIRAD, Brisbane, Australia
N Sallam (BSES Limited, Cairns, Australia)

The Industry

Northern: 7 Mt

Herbert/Burdekin: 13 Mt

Central: 10 Mt

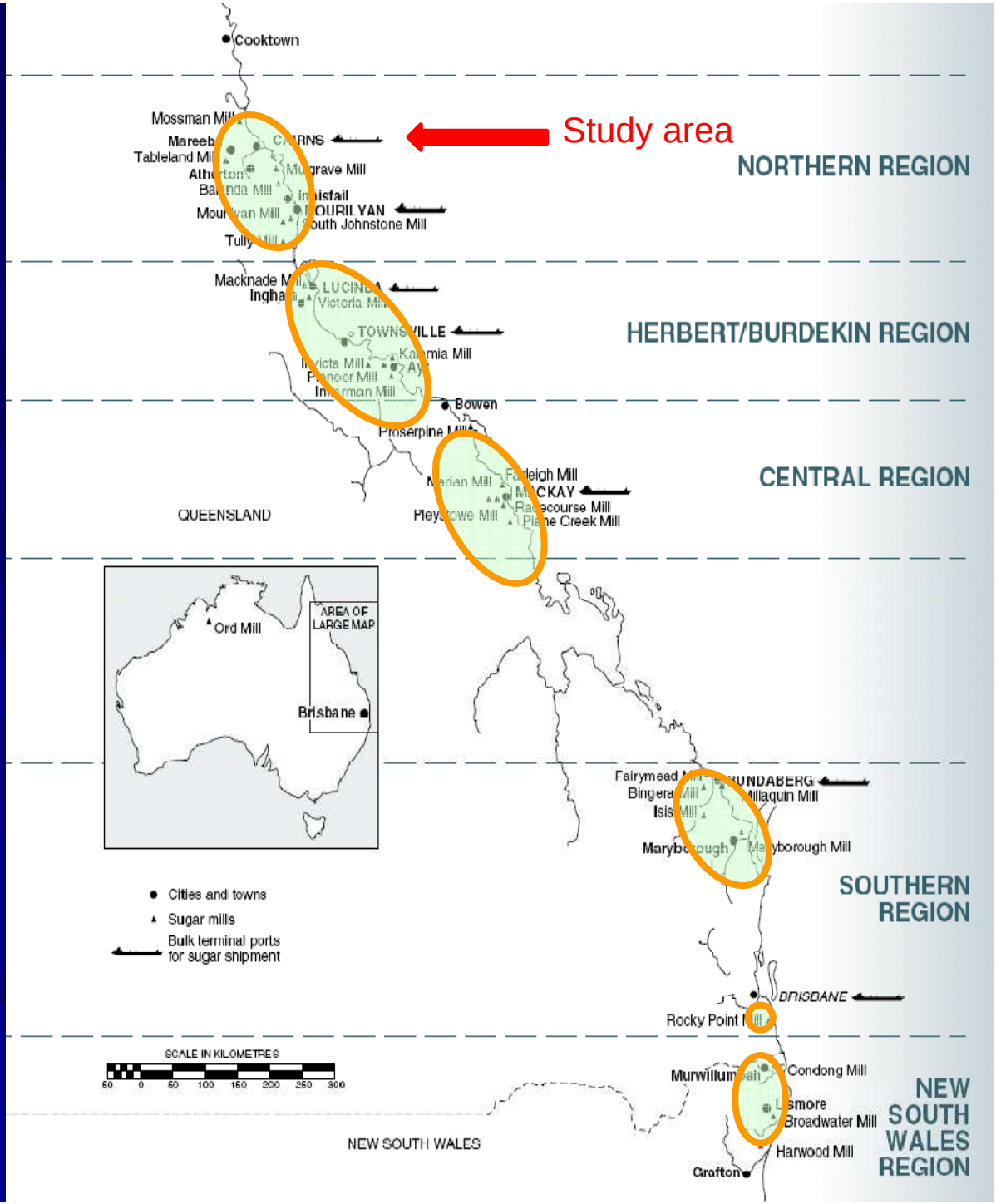
Southern: 4 Mt

QUEENSLAND:
34+ Mt cane

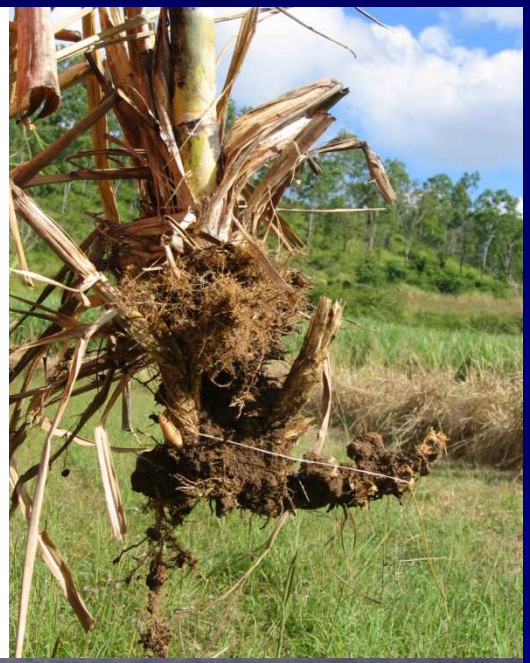
NSW: 3 Mt

AUSTRALIA:
35+ Mt cane
5.0 Mt raw sugar
4300 Cane Growers
26 Sugar Mills
7 Bulk-storage export ports

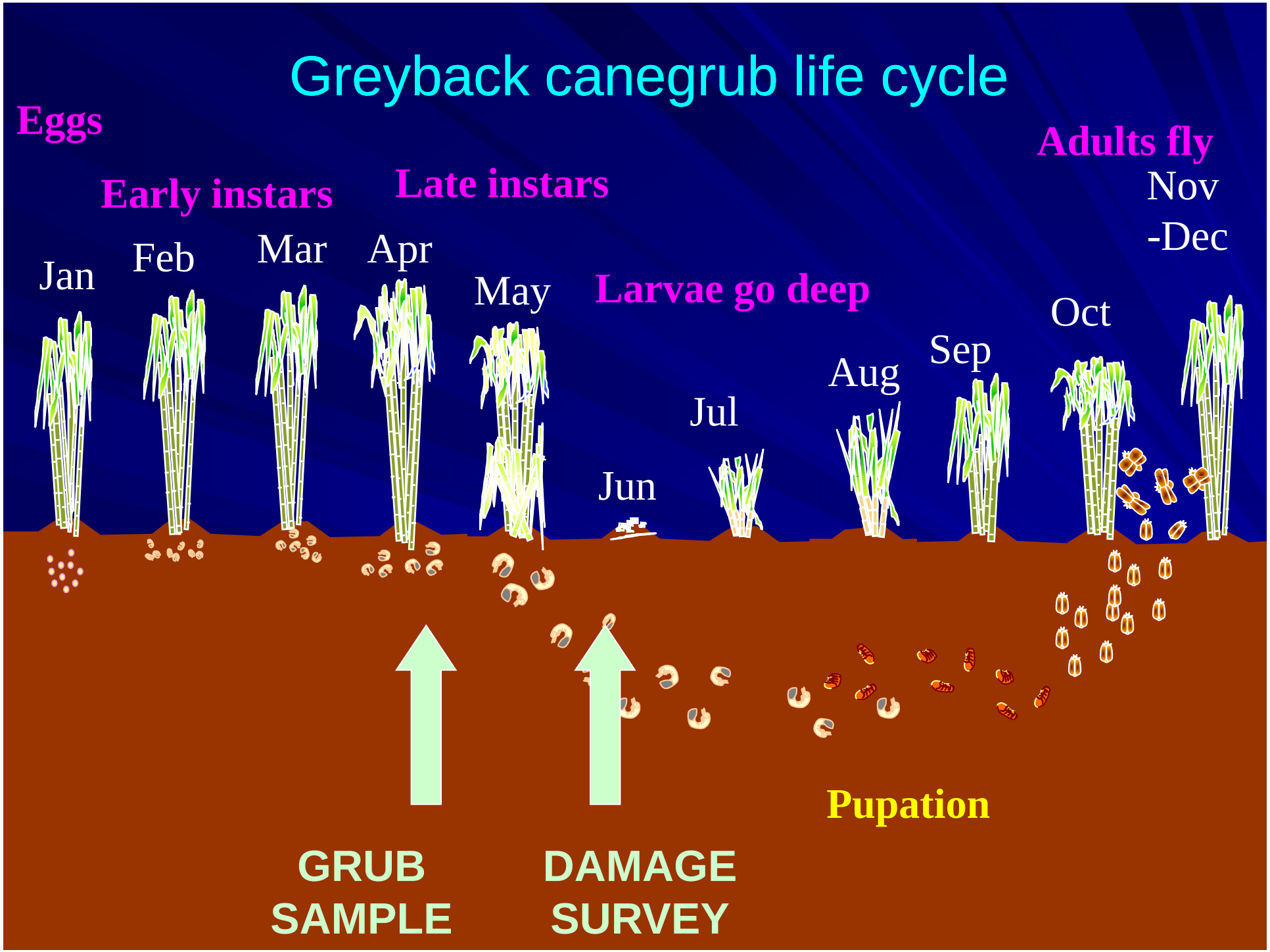
TOTAL VALUE OF PRODUCTION A$1.75 billion
(1.2 billion €)



The Greyback canegrub *D. albohirtum*



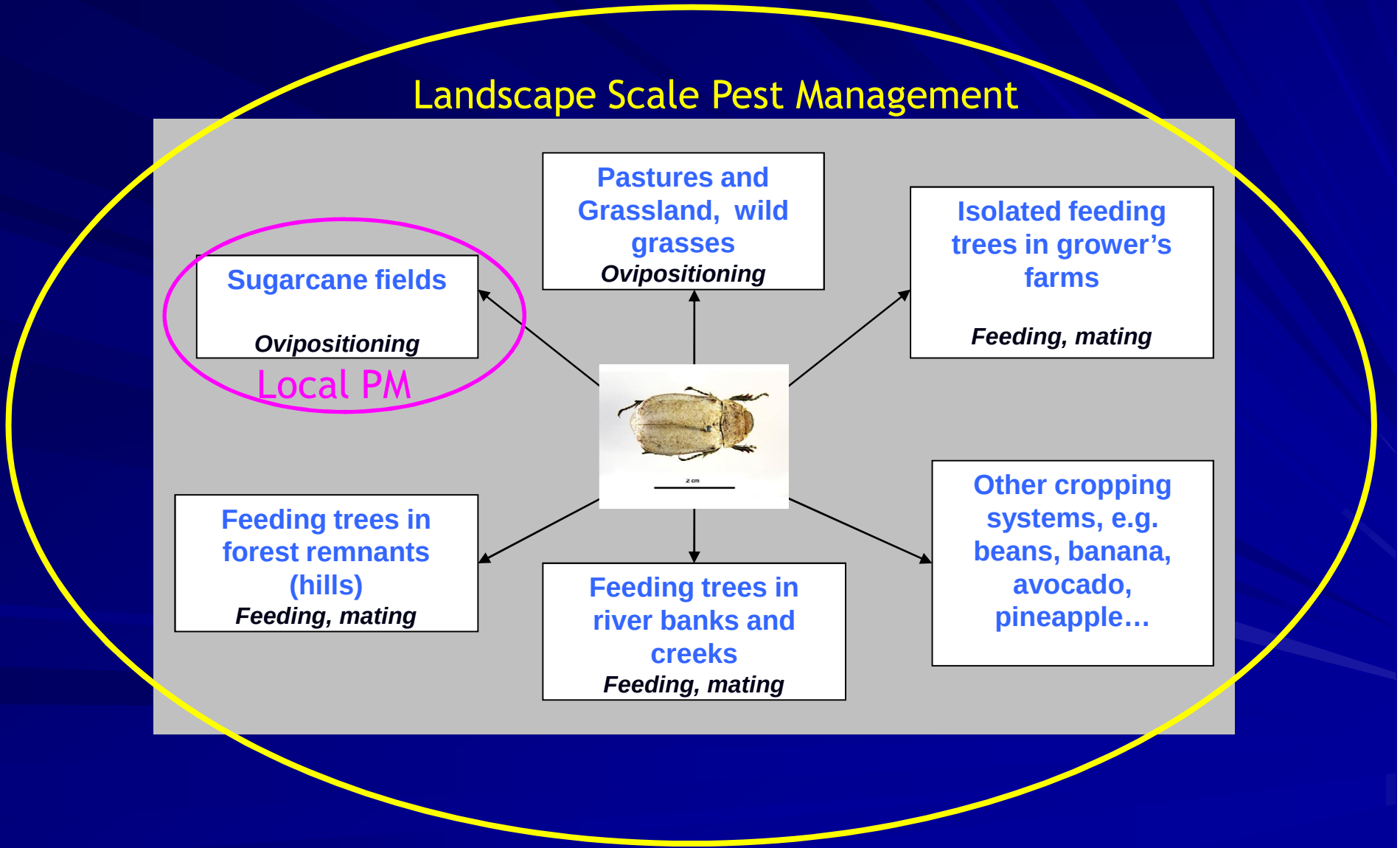
- 19 species of white canegrubs in Australia
- This beetle is the most feared pest in north Queensland
- It causes up to $10 millions (7 M€) of annual loss to industry. $40 ms in high infested areas (Burdekin)
- Chemical treatments recommended in most areas


Greyback canegrub life cycle
Eggs
Early instars
Late instars
Adults fly
Nov
-Dec
Jan
Feb
Mar
Apr
May
Larvae go deep
Jun
Jul
Aug
Sep
Oct
Pupation
GRUB
SAMPLE
DAMAGE
SURVEY

Pest Management in the Australian sugar industry

- Pesticide-oriented : Chlorpyrifos-Ethyl (granular Suscon Maxi), imidachloprid (liquid) in most areas
- Constant pressure from the industry is on BSES Limited (the research institution) to implement a chemical strategy at field/farm level.
- So far: no pest management at a landscape scale and information on bio-ecology of this pest is lacking.
- The repeated chemical applications pose a threat to the great barrier reef (pesticide run-off): huge debate at the moment as the herbicide Diuron will be suspended
- Urgent need to change the pest management system, through more ecology studies and use of new tools.

Beetle's dispersion : exploiting vegetation and crop diversity in sugarcane landscape



Bioecology of this pest : what is known so far

- Beetles fly twice a day (dusk and dawn) from october to january (warm season) toward trees and vegetation bordering sugarcane fields.
- They feed and mate on specific trees, some are constantly attacked : Ficus, Acacia, eucalypts, palm trees, banana…
- Females return in sugarcane field to lay eggs after spending 1-2 weeks in trees. They prefer to lay eggs in tall cane and sandy soils (Ward 1998, 2003). No varietal preference has been clearly shown.
- Data on adult ecology is lacking, the chemical communication is a mystery! population dynamics and their drivers are not fully unterstood.
- However, data is available for larvae (grubs) allowing BSES to use a population dynamic model to predict grub numbers at field and farm level (decision tool)

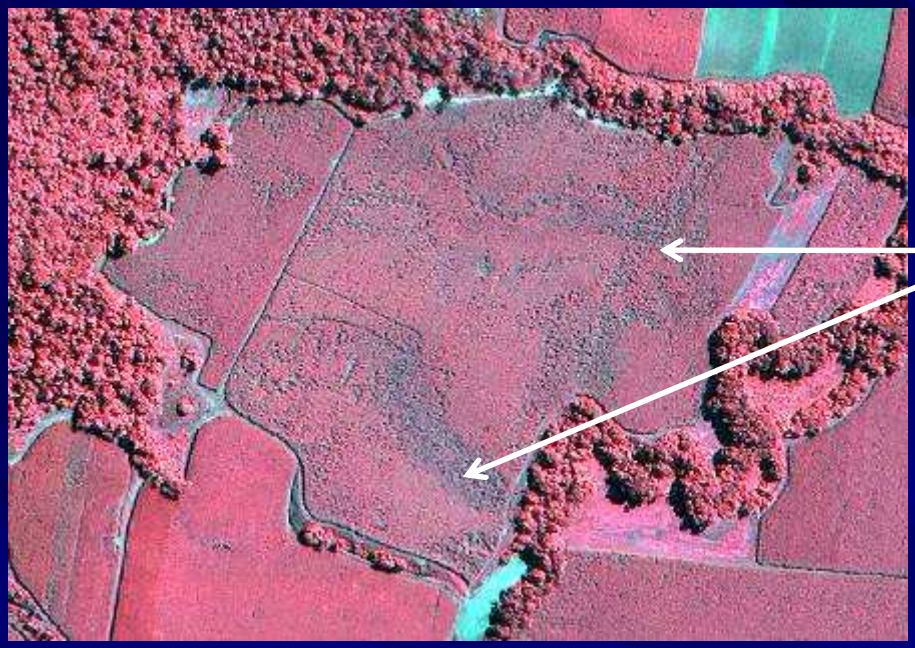
Rationale and Project objectives

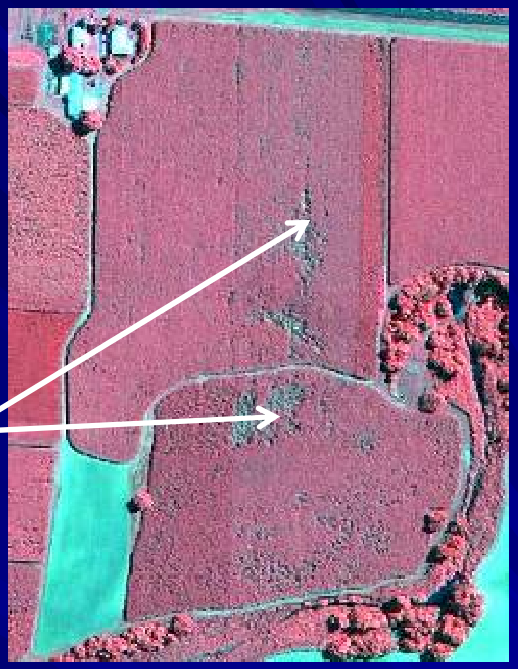
- Our hypothesis: the beetles use the landscape structure (i.e. vegetation patches in corridor & creeks, isolated feeding trees) to move and damage sugarcane fields
- Through a EU project Marie-Curie (2009-2011) with our partner BSES Limited (outgoing institution) and a new project on Remote Sensing (2011-2014) .
- Determine the main drivers that explain damage clusters and generate risk maps for industry/grower use.
- Investigate in particular the flight pattern of beetles and their damage distribution at a landscape scale
- This project mixes up different disciplines: entomology, agronomy, ecology, geography and uses a set of tools (Remote sensing-GIS, telemetry)

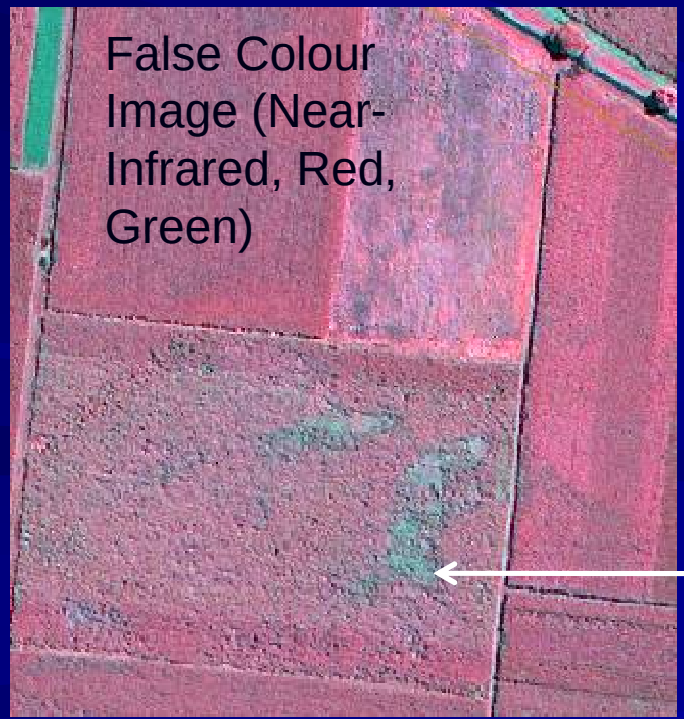
CURRENT RESEARCH ACTIVITIES

- Quantify sugarcane landscape elements on a selected sugarcane area of 72 km2 in Mulgrave (Cairns) captured by GeoEye1 satellite imagery.
- Start image processing with RS and GIS specialists: identify crop stress and grub damage; check with damage spotted by helicopter and ground truthing (digging)
- Create different map layers (vegetation, others factors) associated with damage on selected farms using ArcGis.
- Determine interactions between key factors (vegetation, soil, cane age, treated blocks, fallows) and damaged areas using spatial analysis.
- Radiotracking of beetles using active tags of 0.26gr

Mulgrave mill area/Cairns- IKONOS image captured 26th May 2010





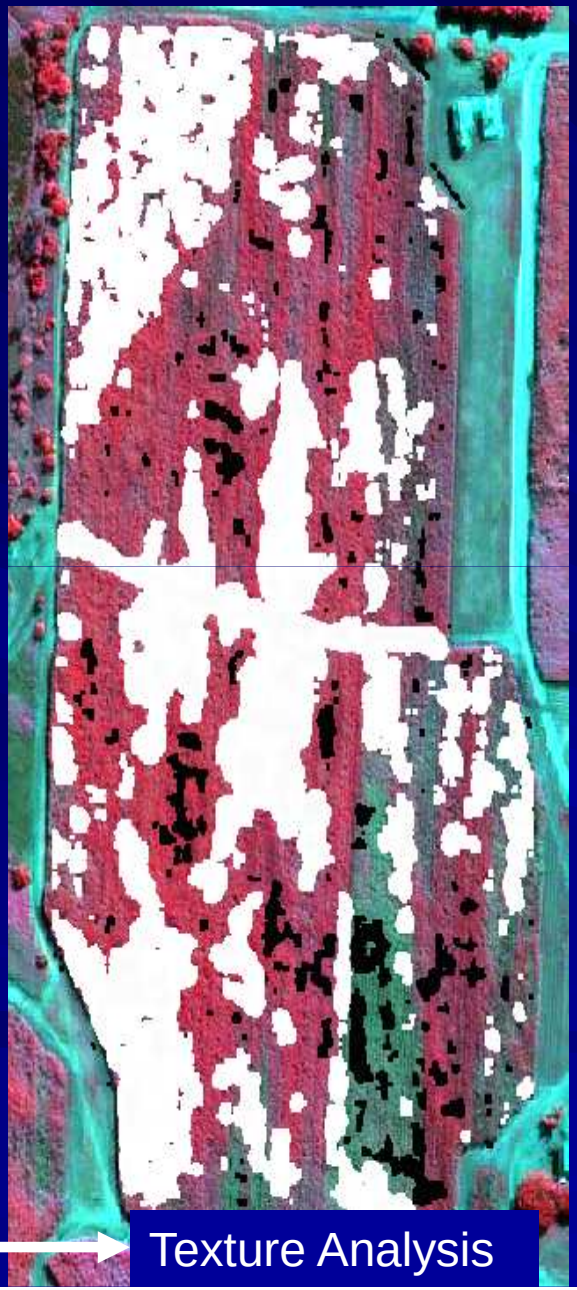


- Satellite images are currently processed to identify grub damage distribution through the landscape.
- Current work = Textural analysis : Positive grub damage appear like a ‘shot gun scatter’

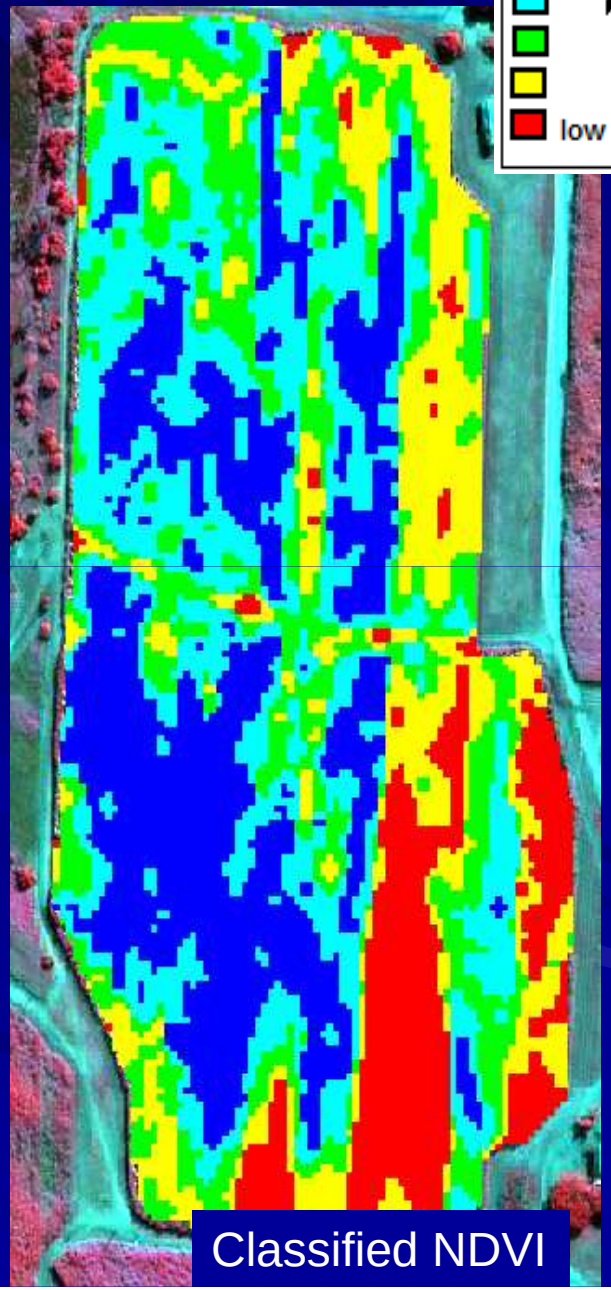
IKONOS (MAY 2010)

Identify stress from grub damage

Panchromatic (0.8m)

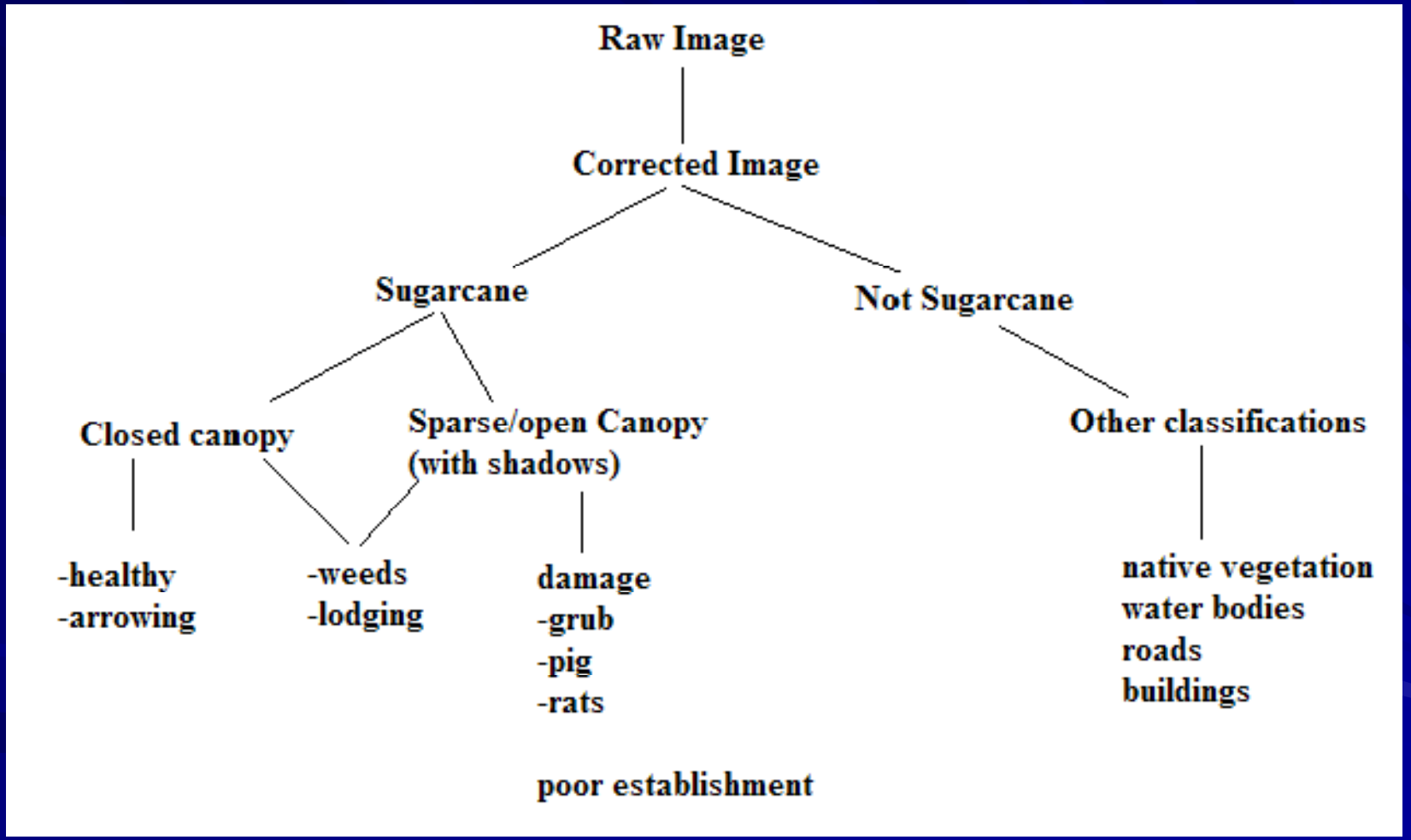


Texture Analysis



Classified NDVI

Image Processing: what we need to sort out



Vegetation study: transects are used to identify feeding trees in vegetation bordering fields and in farm yards (isolated trees)

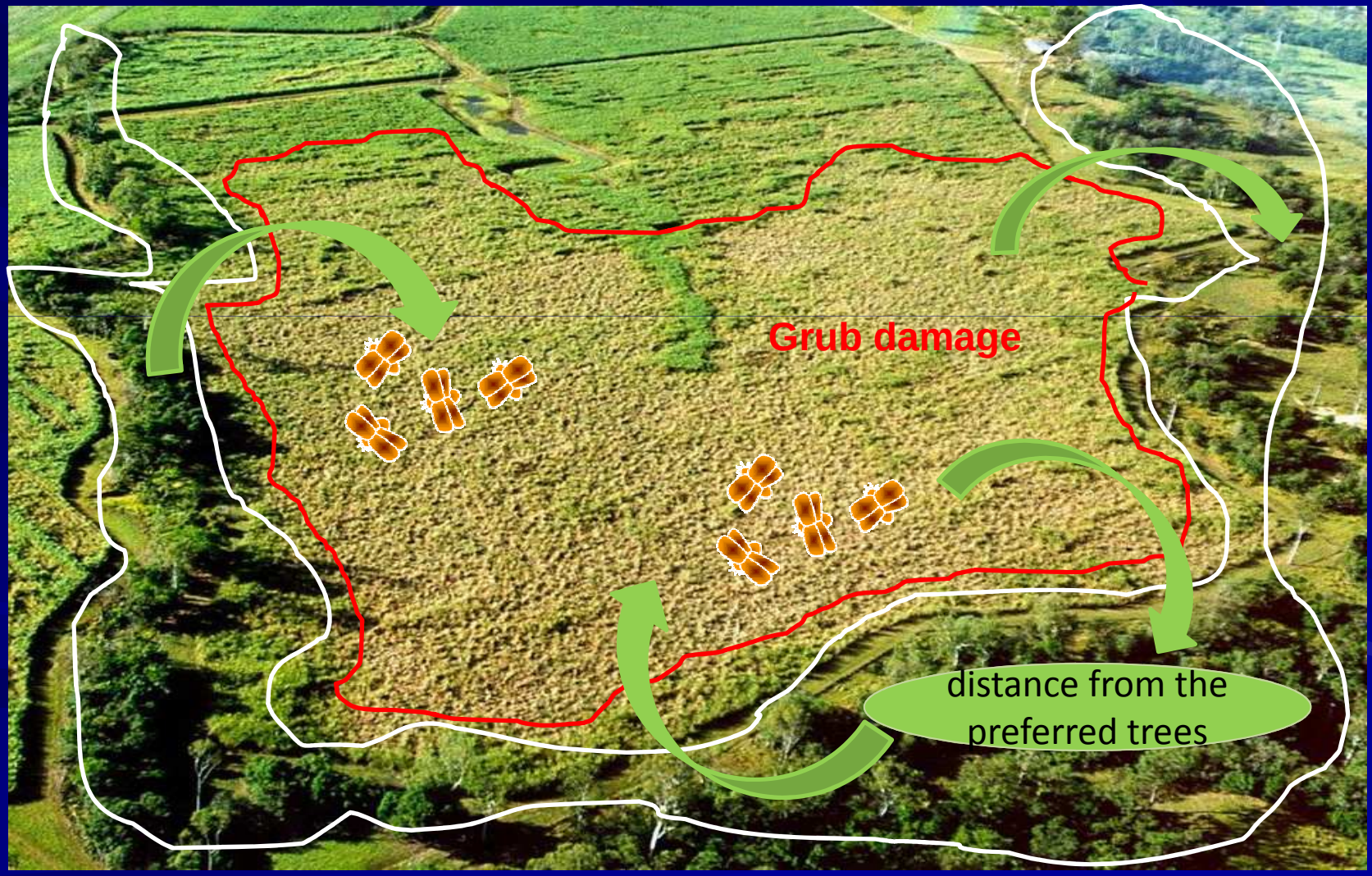
Scientific name	Family	Local names	Rating *
Acacia mangium	Fabaceae	Broadleaf wattle, Salwood	1
Acacia holosericea	Fabaceae	White (Silky) wattle	1
Acacia polystachya	Fabaceae	Grey Wattle, Spike Wattle	1
Acacia flavescens	Fabaceae	Yellow Wattle	1
Acacia cincinnata	Fabaceae	Daintree Wattle	1
Castanospermum australe	Fabaceae	Black bean	1
Melaleuca leucadendra	Myrtaceae	Weeping tea tree, paper bark	1
Corymbia tesselaris	Myrtaceae	Moreton Bay Ash	1
Corymbia torelliana	Myrtaceae	Cadagi Tree	1
Eucalyptus corymbosa	Myrtaceae	Bloodwood	1
Eucalyptus tereticornis	Myrtaceae	Blue Gum	1
Cocos nucifera	Arecaceae	Palm tree, coconut tree	1
Archontophoenix alexandrae	Arecaceae	Alexander palm	1
Livistona decipiens	Arecaceae	Weeping cabbage palm	1
Glochidion ferdinandi	Phyllanthaceae	Cheese Tree	1
Aleurites moluccana	Euphorbiaceae	Candle Nut	1
Ficus infectoria	Moraceae	Strangle Fig.	1
Ficus nesophila	Moraceae	Allied strangle Fig	1
Ficus drupacea	Moraceae	Brown Wooly Fig	1
Ficus benjamina	Moraceae	Weeping Fig	1
Ficus elastica	Moraceae	Rubber-tree	1
Ficus opposita	Moraceae	Sandpaper Fig	1
Ficus racemosa	Moraceae	Cluster Fig	1
Artocarpus integrifolia	Moraceae	Jack-Fruit	1
Semecarpus australiensis	Anacardiacae	Tar-Tree, Cashew nut	1
Imperata cylindrica	Graminae	Blady grass	1

40 species identified, 26 prefered trees (updated list from 2009-11 surveys)

Beetles feeding on *Ficus benjamina*

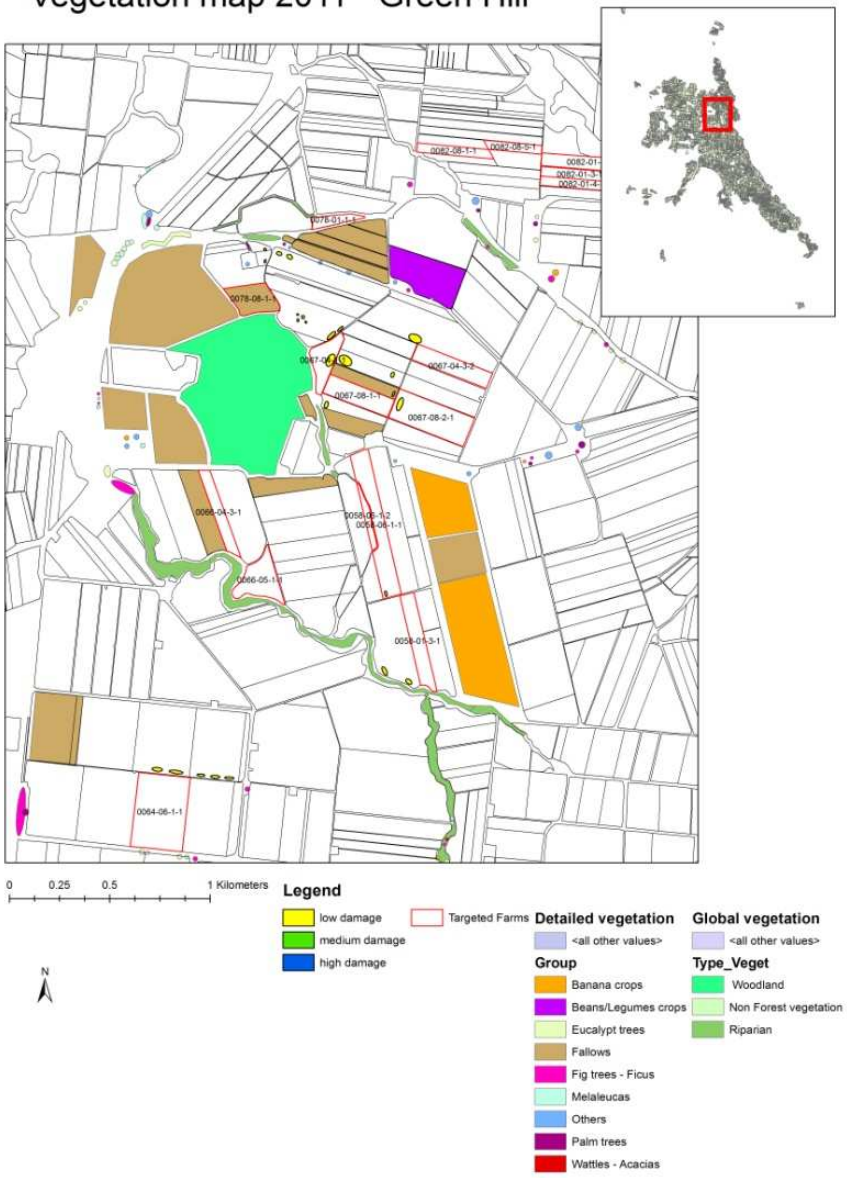
Quantifying vegetation density (and specific trees) surrounded the fields that may influence grub damage

An extreme situation with many feeding trees

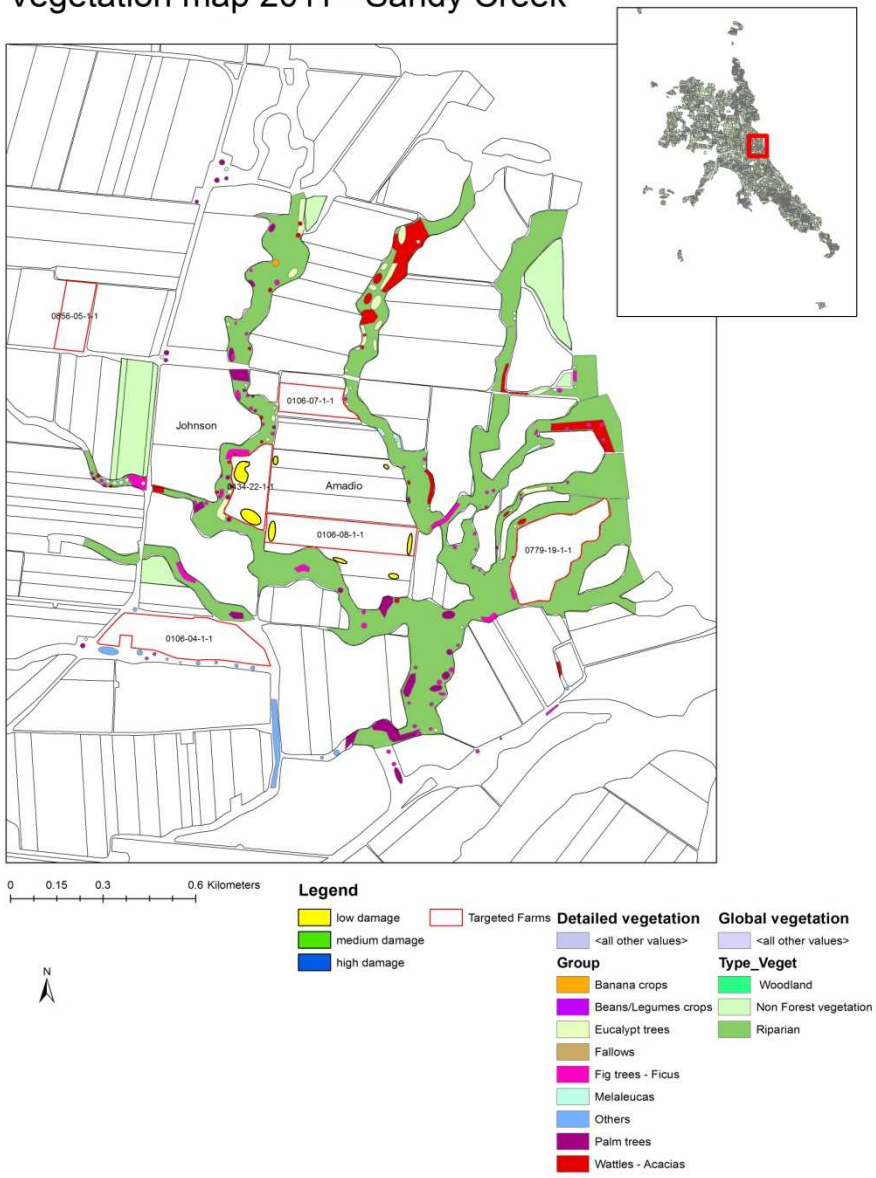


Vegetation maps: taking into account the different elements of the sugarcane landscape and classify them using ArcGis

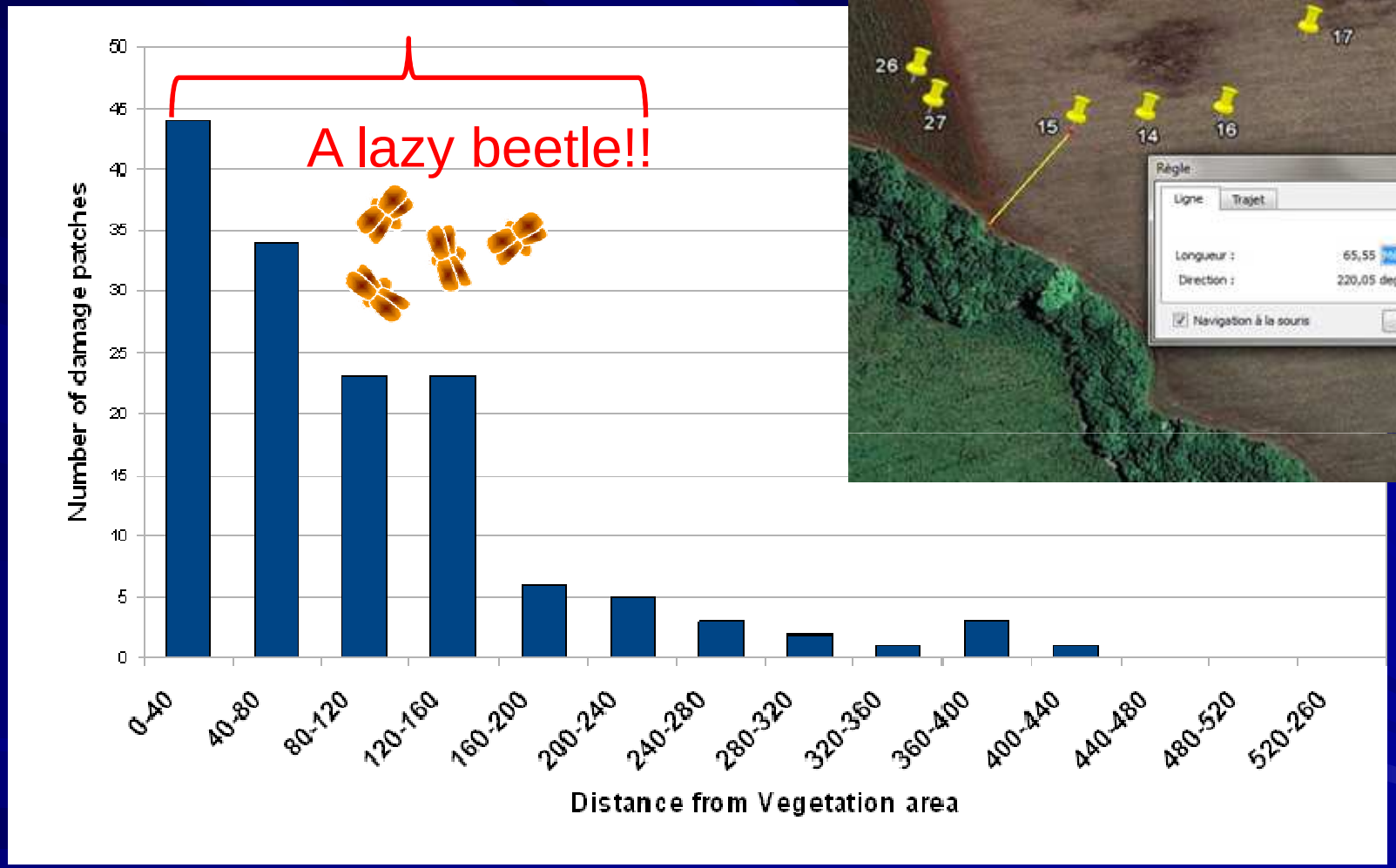
Vegetation map 2011 - Green Hill



Vegetation map 2011 - Sandy Creek



In most cases, Infestations are strongly related to the proximity of vegetation in untreated paddocks/fields



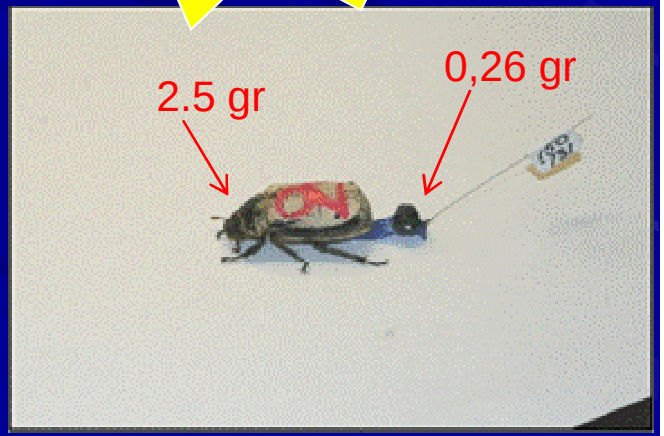
Results from 2009-2010 Surveys in Mulgrave mill area (Cairns):

Radiotracking: understanding insect mouvements and behaviour

- Our study uses small radiotransmitters (or tags) glued on the insect, plus a scanning portative receptor and a signal detector (antenna)
- Each tag has is own frequency (ex: 1,512 Mhz)
- Very few studies on flying insects due to the weight of tags, the detection range and the battery life
- But today a range of tiny tags (0.20 - 0.30 gr) are on the market.
- Study the flight pattern in pilot sites and get info on beetle habits and behaviour: flight activities in different habitats, resting, feeding, laying eggs…
- location of trajectories are recorded using a GPS.

Current activities on radiotracking

One tag = AUD $ 150
(€ 100)



- ✓10 beetles tracked so far, only 6 retrieved after 5 days of tracking. Only one flew to fields
- ✓Flights recorded mainly in trees with distances <300m: beetles seem to stay at same location
- ✓In lab, basic activities and longevity were not affected by the tag (cage experiments)
- ✓Many questions and problems : battery life, detection range, tag attachement , predation…

Exemple of a beetle trajectory (5 days)

Most of beetles fly from trees to trees and return to the roosting tree (Callophylum inophyllum) where they aggregate and mate