

USING IMAGE ANALYSIS TO MAP SNAILS

GRAINCAM - A DEVICE FOR DETECTING CONTAMINANTS IN GRAIN

JOHN MOORE, SVETLANA MICIC, CARLOS BABATIVA RODRIGUEZ, MEHDI RAVANBAKSH
AND ALICE BUTLER FROM DPIRD AND MAPIZY PTY LTD



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GRAINS RESEARCH
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BROADACRE SNAIL PESTS



Vineyard snail



White Italian snail

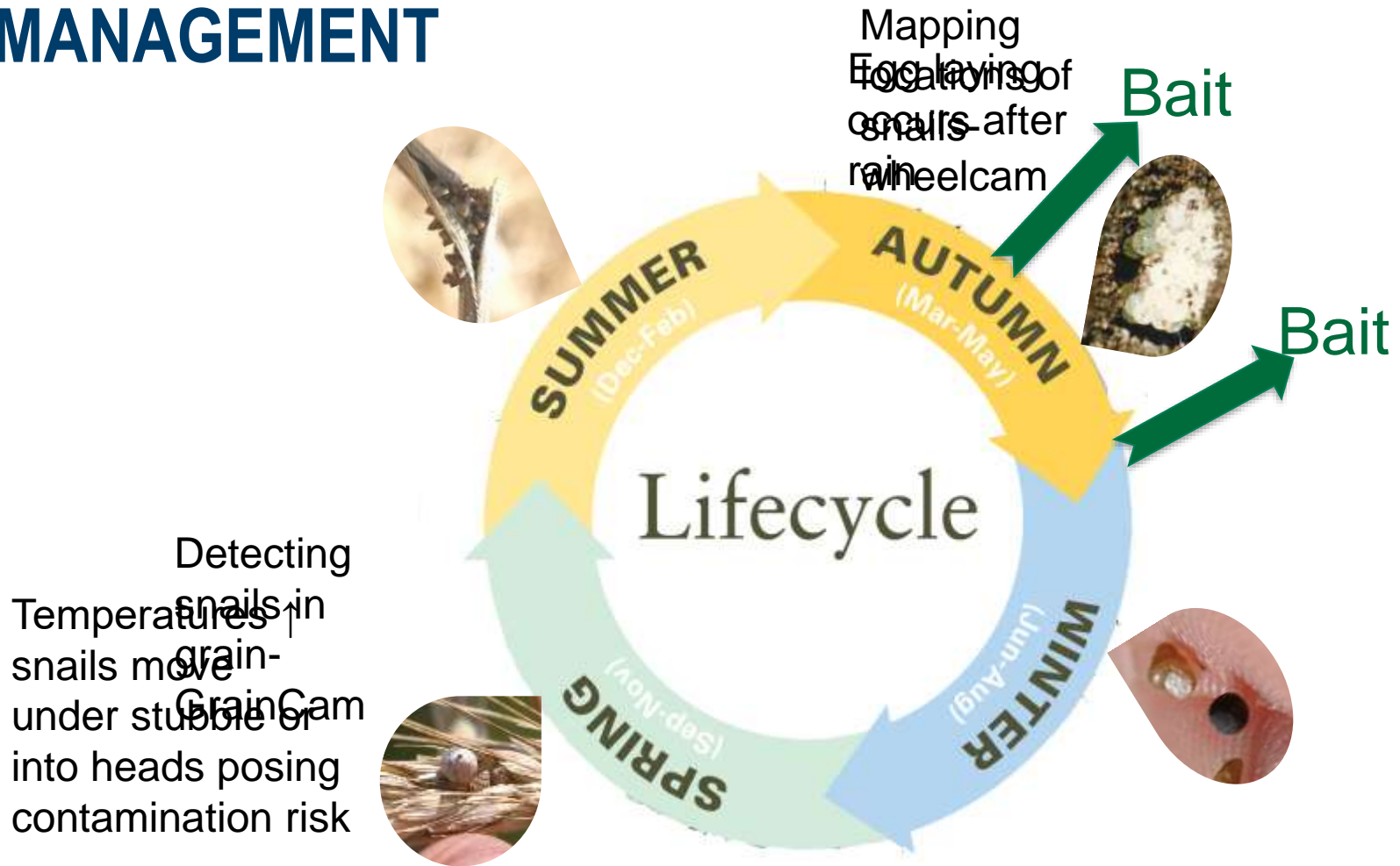


Pointed snail (L);
Small pointed snail (R)



Small pointed (conical) snail

MANAGEMENT



IMPORTANCE OF SNAILS

- Costs WA grower is \$3M/ year in control measures and crop losses
- Retard/kill seedling crops especially canola
- Contaminate grain
- WheelCam and GrainCam were used to map snails

WHEELCAM - DETECTING SNAILS ON GROUND

- WheelCam attaches a smartphone to any wheel.
- Phone app (SnapMaps) controls the camera to take a photo, record time and GPS each time it points to the ground as the wheel rotates.
- Can be fitted to any vehicle.

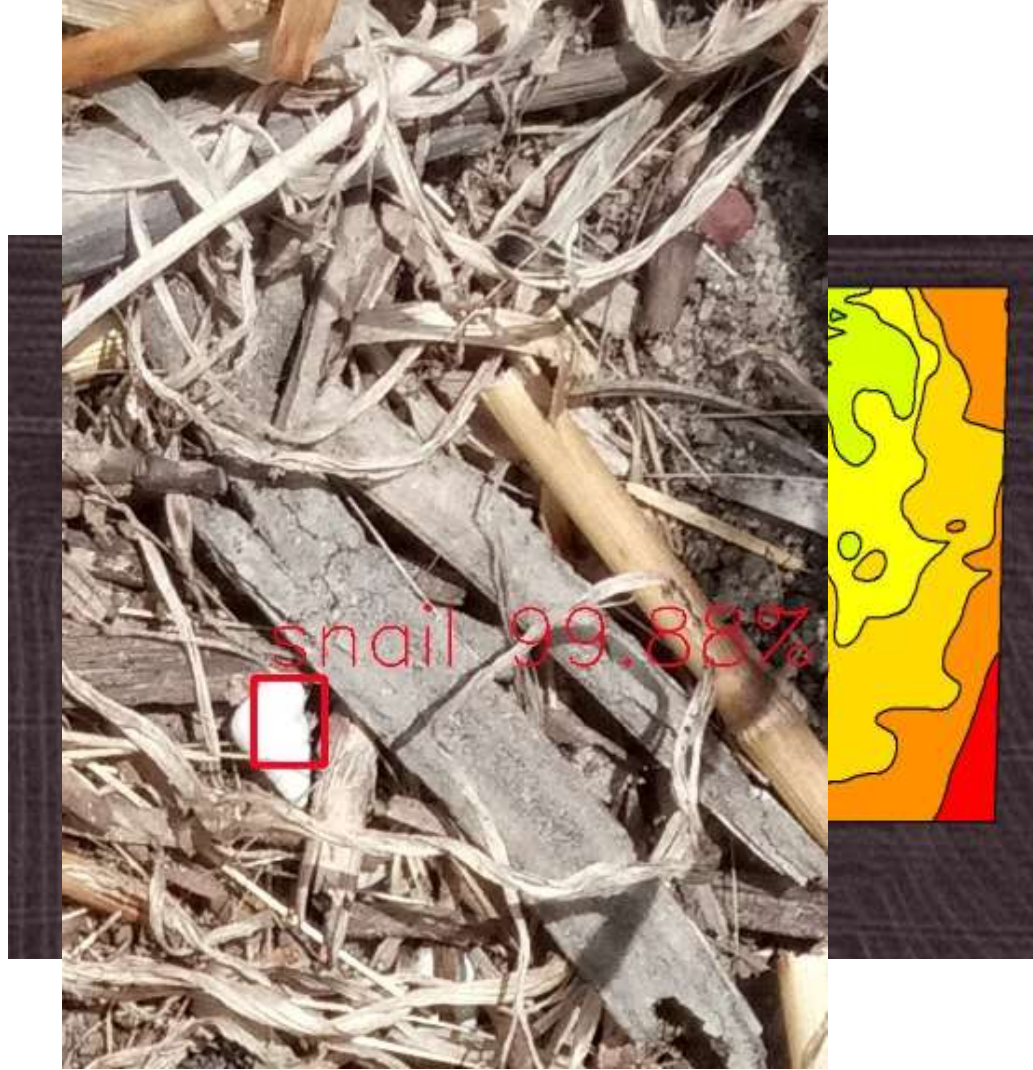


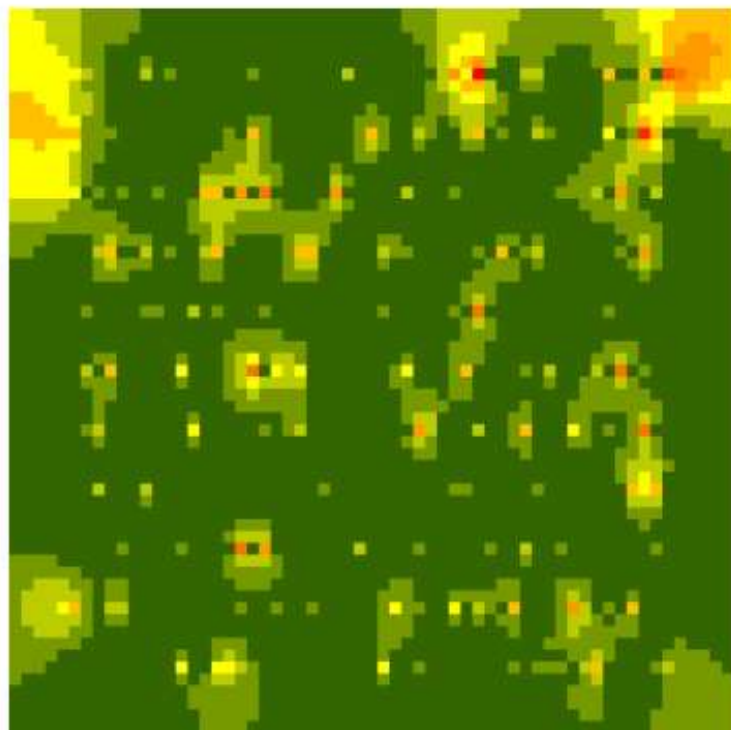
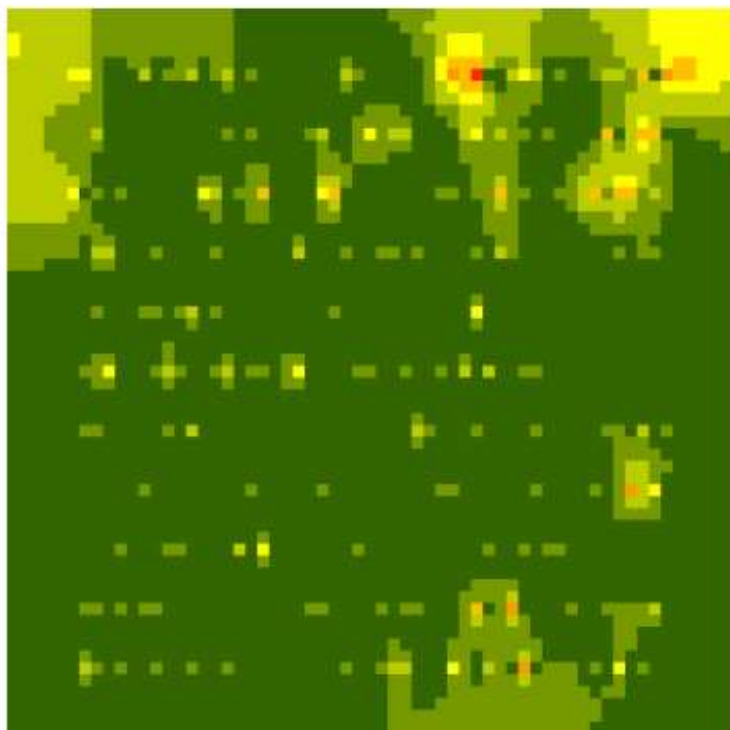
WHEELCAM

Deep neural networks used to produce models to detect snails.

Snail densities validated with manual counts.

In map, red areas have ~ 20 snails/ sq. metre.





ACTUAL - SNAIL COUNT DATA

Number of Snails

NEURAL - PREDICTED SNAIL COUNT



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Created by
 David Robinson
 GIS Research Officer, DPIRD Albany
 Date 19 February 2019
 Job Number 2019036

WHEELCAM - KEY MESSAGES

Image analysis of field photographs has the potential to be used to make low-cost maps of snail distribution and density in a paddock.

GRAINCAM – DETECTING SNAILS IN GRAIN

- Images taken while harvesting grain
- Image analysis detected the levels of snails being harvested
- Map validated with on-ground counts



GRAINCAM - DETECTING CONTAMINANTS IN GRAIN



GRAINCAM – BEDSTRAW

- No bedstraw seeds were detected
- Validation –
 - No seeds found in grain samples on the day
 - No seeds were seen by visual inspection of the images
 - Seeds are detected in “salted” samples

GRAINCAM – KEY MESSAGES

- Grain contaminants (weed seeds and snails) can be detected using GrainCam attached to the harvester.
- GrainCam uses common components and is controlled by a smartphone.
- Maps of the locations of where the contaminants were harvested can be produced.
- It has been successfully deployed in rough country under difficult field conditions
- Needs some further work to improve reliability and create more accurate image analysis algorithms.

IMAGE ANALYSIS AND SMARTPHONES

- Brief history
- Why we use it
- Current techniques & general principles
- Practical Applications were WheelCam for snails and GrainCam for snails and bedstraw seeds.
- Our aim is to enthuse you into using these techniques to solve your problems

HISTORY

Old Way

Camera acquires image

Image + Rules (size, cluster then discriminant analysis) → Prediction

Programmer makes up the rules (Feature extraction)

Snail = IF (a x size + b x texture + c x roundness +for 25 characters for each object in the image > threshold)

New Way

Smartphone acquire image (+GPS, date, time, orientation etc)

Image + Prediction → Rules

Machine makes up the rules using a deep neural network like YOLO3.

Snail = IF (Set of neural network weights for each area in the image > p=0.9).

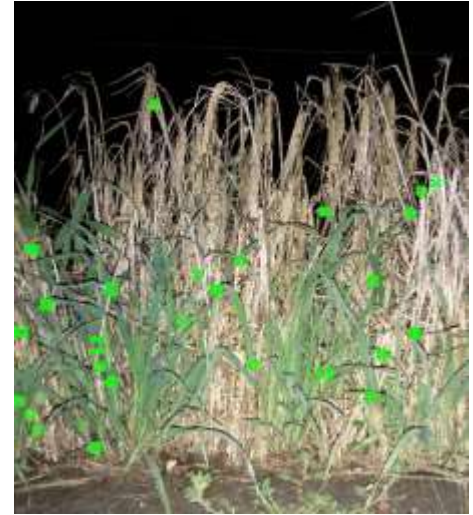



IMAGE ANALYSIS PROCESS

TRAINING

Big computer takes days
Or Cloud based service

Acquire Training Images (photos, videos, sound, genes...)



Create the classifier or deep learning model

PREDICTION

Smartphones are powerful enough

Acquire Field Image



Apply the model and record the prediction



Create an output (map, signal, tone or visual, start a program)

TENSORFLOW BY GOOGLE

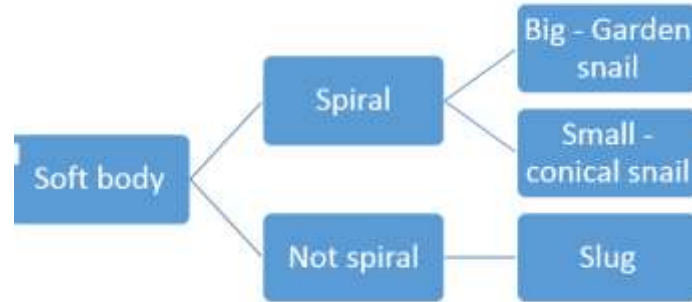
- TensorFlow is a FREE program by Google for manipulating neural networks (released Nov 9, 2015)
- It does the training to provide a model
- This model can be used on a laptop or smartphone to predict the location of objects in an image

DEEP NEURAL NETWORKS & MACHINE LEARNING

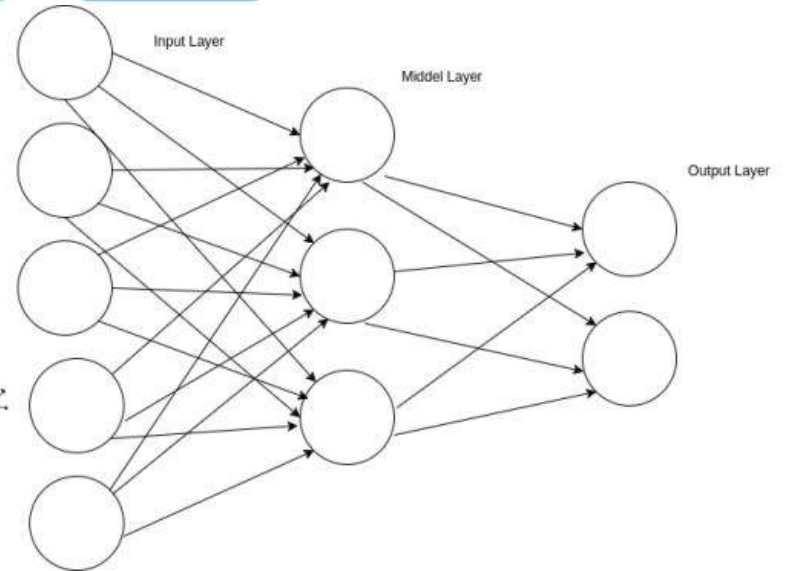
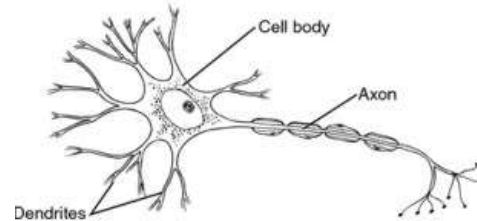
- Extract useful patterns from data
- We use the Python programming language and Google TensorFlow
- You need to specify a good problem and get good data
- Why now – Hardware (smartphones and big computers, Moore's Law), data, tools
- Areas – Image classification and object detection (Bedstraw seeds, snails, caterpillars), facial recognition (cows), speech recognition (starlings), handwriting translation, animal and plant disease diagnosis, gene analysis, auto steering, searches, social analysis, education & games
- Deep network – because it uses many layers of neurons

NEURAL NETWORK

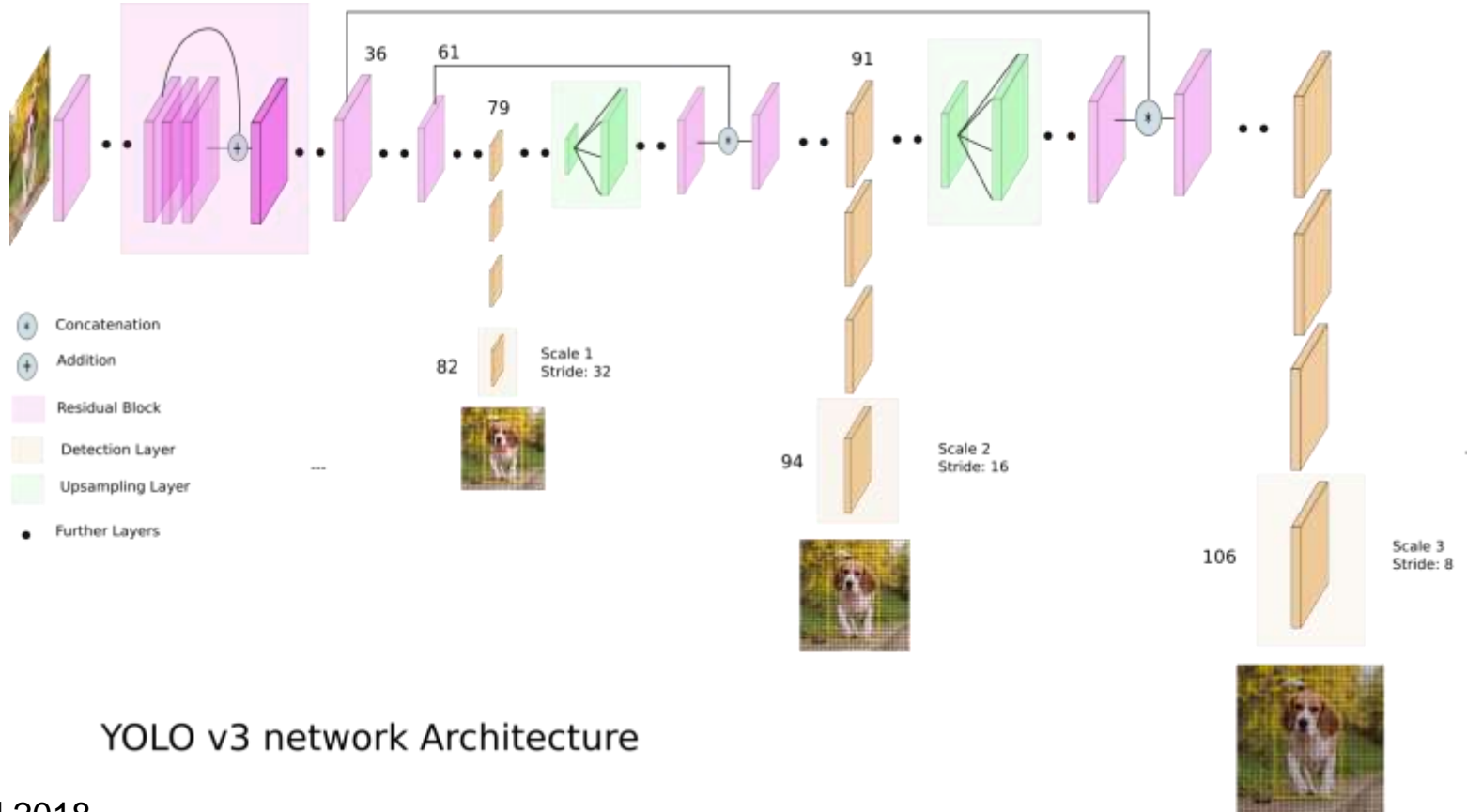
- Dichotomous key
- Multi-clave key
- Decision tree



- Neuron & Neural Network



YOLO3 – A DEEP NEURAL NETWORK



SMARTPHONES

Integrate a range of useful functions and variables very cheaply.

- Very high resolution camera
- Accelerometers – movement and direction.
- Gyroscope – Which way is up.
- Magnetometer or compass – N,S,E,W
- GPS – Absolute position and time.
- Light sensor, proximity, barometer, humidity, temperature, motion detection
- Touchscreen, fingerprint, barcode, Geiger counter (Japan)
- Microphone, speaker, email, web, Wi-Fi, Bluetooth, storage, SD card,
- CAT now has one with an infra red camera (Potential for NDVI)
- Smartphones can process images on board for real time applications

ECONOMIC IMPACT

- Early detection of weed seeds like bedstraw will save \$\$\$ in eradication costs. (CBH is using image analysis with the EyeFoss machines).
- GrainCam can detect new infestations of snails allowing control before they spread.
- GrainCam can allow avoidance of snail infested areas at harvest saving dockages of \$20-\$40/ton.
- Mapping snails using WheelCam is likely to halve baiting costs ~\$10/ha.
- Image Analysis and smartphone technology has a plethora of applications with a wide range of economic benefits.

Thank you

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