Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Protect
Grow
Innovate

Eradication of Bedstraw

(*Galium tricornutum*)

John Moore and Julie Webber

The species

- Three-horned bedstraw (*Galium tricornutum*)
- Cleaver family
- Rings of 4-8 leaves
- Vine
- Square stems
- Feels like Velcro
- Grain contaminant
- Eradicated after a 20 year eradication program.

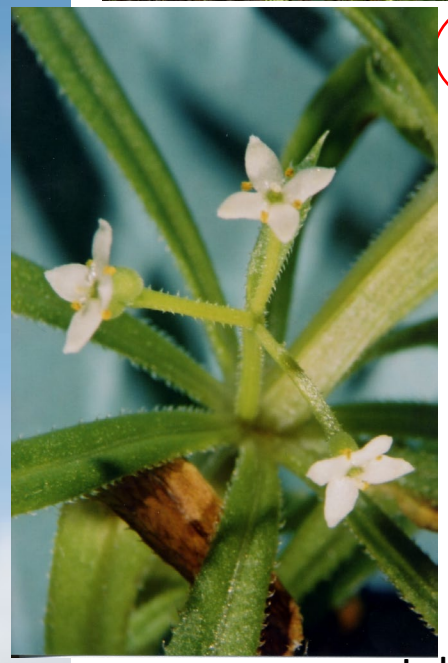
Three-horned Bedstraw (*Galium tricornutum*)

Dog ball fruits on hooked stalks

White, 4 petalled flowers in sets of 3.

Backward pointing tiny prickles on stems that give it a “velcro” like feel.

Three-horned Bedstraw
(*Galium tricornutum*)



July 4, Flowering plants with new seedlings

- Three-horned bedstraw (*Galium tricornutum*)
- Weed of crops
- Photos from Cordering 2004.

Locations of introductions

- Widely spaced locations

  Boddington (1968)
  (100 km SW of Perth)

  Mt Barker <1 ha (2001)
  (350 km SW of Perth)

  Cordering 340 ha on a 1000 ha property (2003)
  (200 km south of Perth)

  Hines Hill 20 ha (2004)
  (200 km east of Perth)

  Cranbrook 1 ha (2005)
  (300 km SW of Perth)

  Nyabing (2014) Seed found in grain delivery
  400 km SW of Perth

- No apparent connections between sites.

Scale Albany to Perth is 400 km.

MBRS

Three-horned Bedstraw
(*Galium tricornutum*)

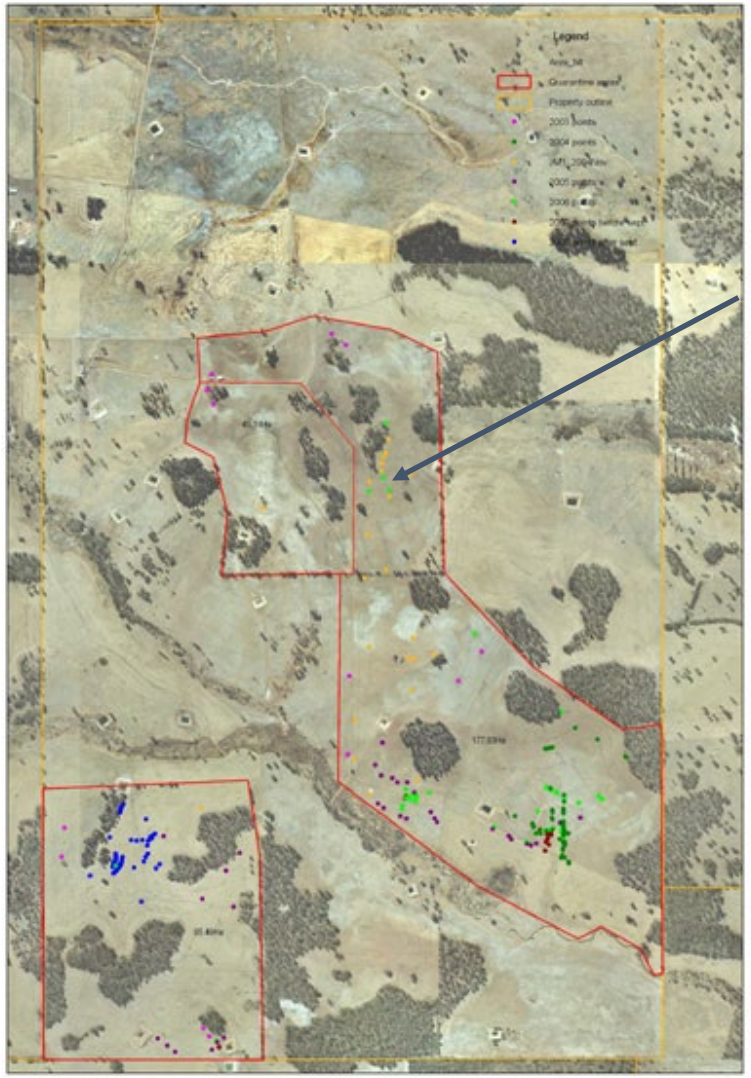
History

Boddington 1968 - from US seed and eradicated

Mt Barker Research Station - 2001 - eradicated?

Grubbed, vacuumed and sprayed

Cordering



None detected for 2 years
Big germination in 2009

Cordering July 4, 2006

Cordering July 4, 2006

- October 9, 2006.

- July 27, 2009

August 1,2009

Controls used

Broadstrike + diuron – pasture, bush, cereals

Bromoxynil + MCPA – cereals, pasture

Hotshot (fluroxypyr + aminopyralid)

Starane ± 2,4-D or bromoxynil + MCPA

Intervix (Imazamox + imazapyr)

2-3 sprays per year. High rates. Permits.

Nitrogen - competition

Tickle cultivation

Grazing

(Hay freezing)

Aerial spray July, 2006

- July 1, 2006

August 2, 2009

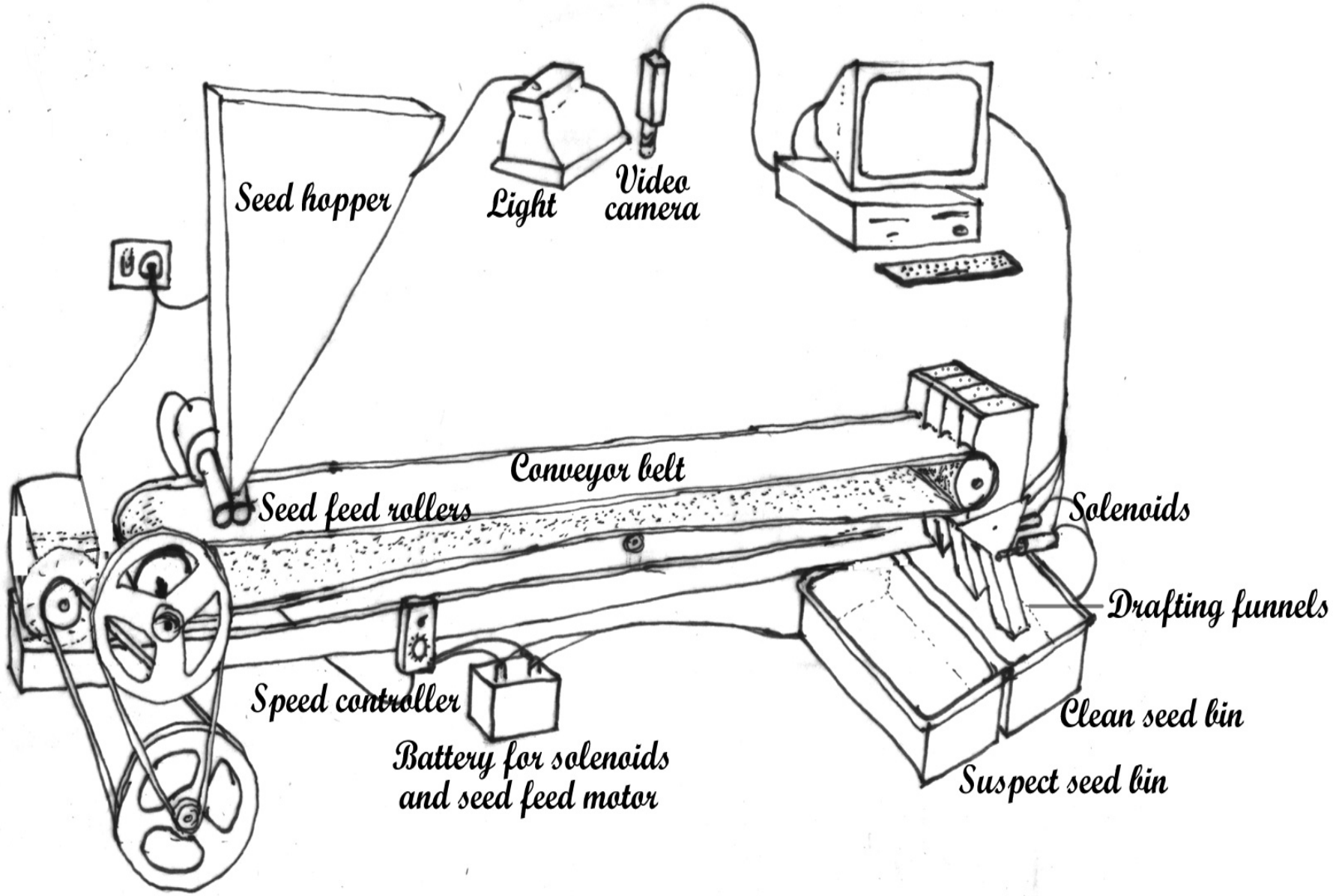
Contract ground spraying follows

- How can you determine the extent of a weed infestation or when it is eradicated?
- How can you economically detect very low levels of weed seed in grain samples?
- Image analysis and Artificial Intelligence
  - To search large quantities of grain to find new infestations
  - To find plants in the paddock
  - To determine the effects of control on pasture or production
  - For surveillance of other areas likely to be infested

Initially done by floatation then visual inspection

Then camera

Now video and image analysis


Seed hopper
Light
Video camera
Conveyor belt
Seed feed rollers
Solenoids
Drafting funnels
Speed controller
Battery for solenoids and seed feed motor
Clean seed bin
Suspect seed bin

GRAINCAM - IMAGE ACQUISITION

CBH EyeFoss

John Moore

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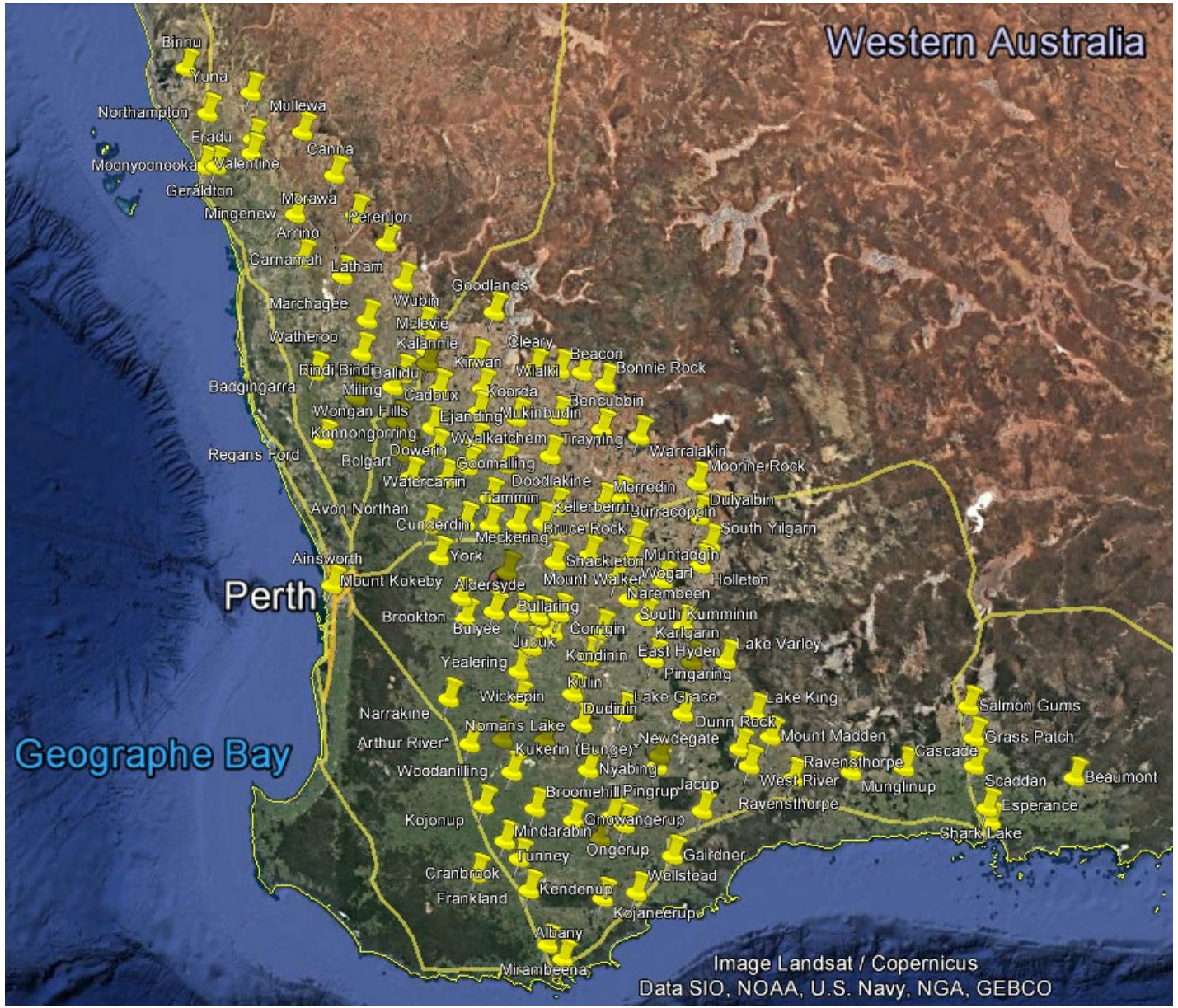
Bedstraw surveillance sites 2018/19



Sampling grain is the most efficient method of finding bedstraw infestations.

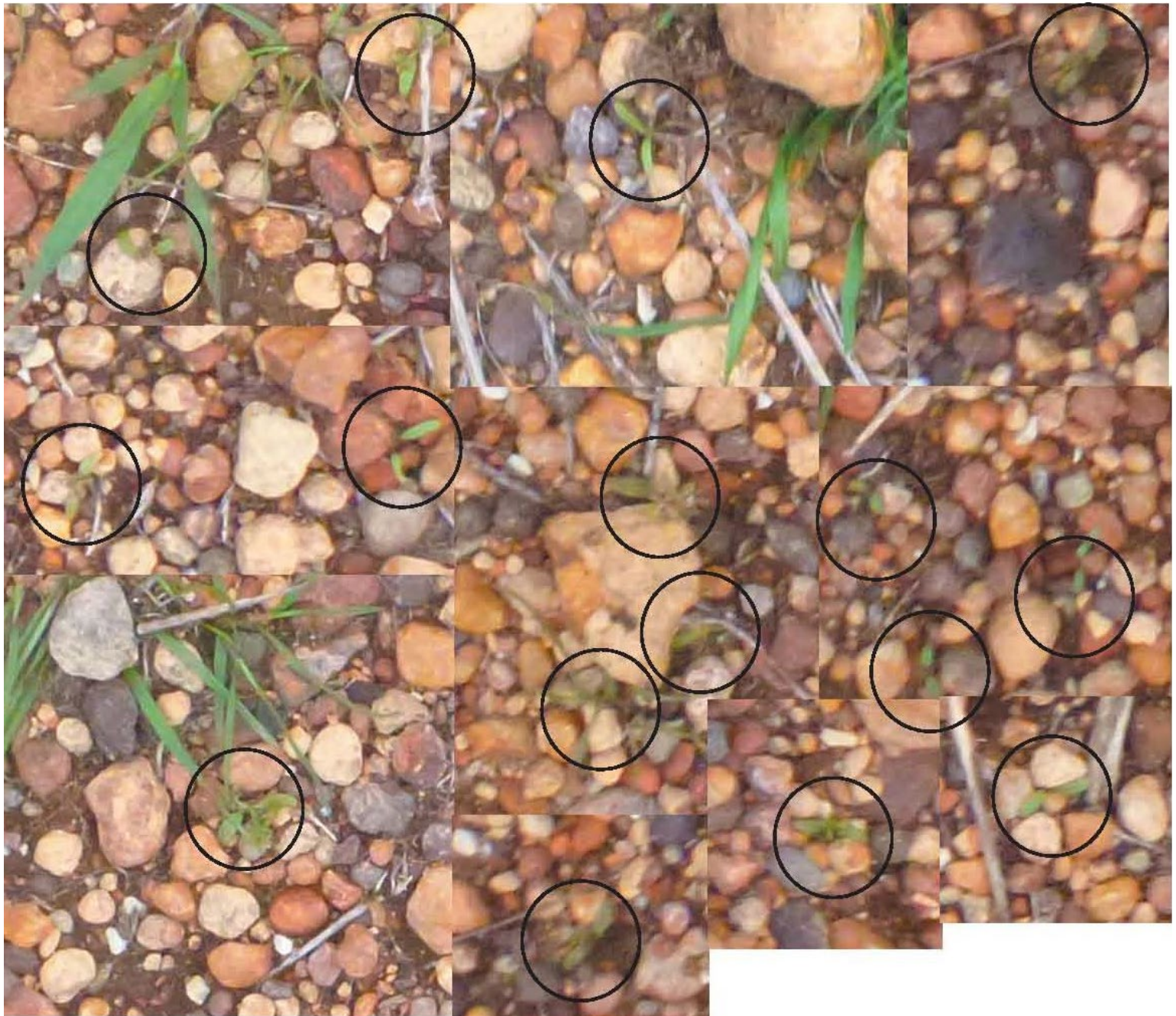
Darkan, Hines Hill, Boddington and Nyabing were found in grain samples.

Cranbrook and Mt Barker found by weed identifications.

Cordering neighbours found by trace backs.

Image Acquisition to Find plants

- Serial digital colour photos with camera at 80 cm and GPS recorded



Test classification

Post-eradication surveillance

Dec 21-Jan 22 harvest

- GrainCam of “Released Paddocks”
- Suspect seed detected in barley
- Inspections and header waste collection

Dec 22-Jan 23 harvest

- Collection of barley samples
- No bedstraw seed or plant material detected
- Inspections

Interpret images or do something

With 50,000 by 1 kg grain samples from grain receival centres over the last 8 years
We can say –
90% confident there are no infestations greater than 100 ha.
Or 90% confident that infestations < 1 ha are not detected

From sampling grain in quarantined areas we can say
Less than 1 seed per ton of grain

~10% of the cost of visual screening of samples

The Invasive Species Program of DPIRD and the GSHIFS has provided funding and continued support many years.

Current Situation

- History of the infestations is in the Weeds Conference paper.
- Mt Barker – Original infestation a hectare or two. Low levels of seed detected in canola grain from the 2007 season. No plants found after intensive searching in 2008. Released from quarantine.
- Cranbrook – Original infestation < 1 ha, No plants detected for more than three years and released from quarantine.
- Hines Hill – Original infestation of 2-5 ha spread over about 100 ha. The last plants found and sprayed in 2009 and released after a 3 year monitoring phase.
- Cordering – Original infestation of 350 ha on a 1000 ha farm. The whole farm was quarantined. 650 ha released after none found for over 4 years. Two lightly or suspect infested paddocks released after none found for 3-4 years. All arable areas were released in 2020 with 9 ha of bush blocks quarantined. Three fenced bush blocks are still in quarantine in 2023. No plants have been found in the last 3 years. The final bush block will come out of quarantine in 2026.

The last bedstraw

Take home messages.

Flexibility to deal with seasons and landholders
Early detection
Pay someone to be responsible for control
Provide compensation for lost production

Early Detection and Rapid Response is a proven method of dealing with incursions.

Early detection is assisted by more surveillance.

Biology pertaining to control

- Variable triggers for germination. Moisture, cultivation, non wetting soil, maybe frost?
- Very staggered germination. The first plants have set seed before the last seeds have germinated. Multiple sprays or residual herbicides are required for high levels of control.
- In one year there was a big germination on cultivated and uncultivated sites and on sites that have had no seed set for at least 2-3 years.
- Fertilizer, especially N improves growth of Bedstraw.
- Competition probably improves herbicide efficacy and reduces seed set. Adding seed and fertilizer have been used to help control.
- Prefers alkaline soils in other states. (Probably easier to eradicate on acid soils)
- Doesn’t spread quickly. Moved mainly by harvesters and not sheep.
- Cordering and Hines Hill probably have had it for >10 years.
- Early detection has led to rapid eradication. Eg Mt Barker, Cranbrook, McKennas and silo areas.
- It persists under grazing and multiplies under crop.
- Literature says it has a dormancy of ~ 3 years. At Cordering it looks like the dormancy is more likely to be 5-6 years especially on non wetting areas.

Flexibility

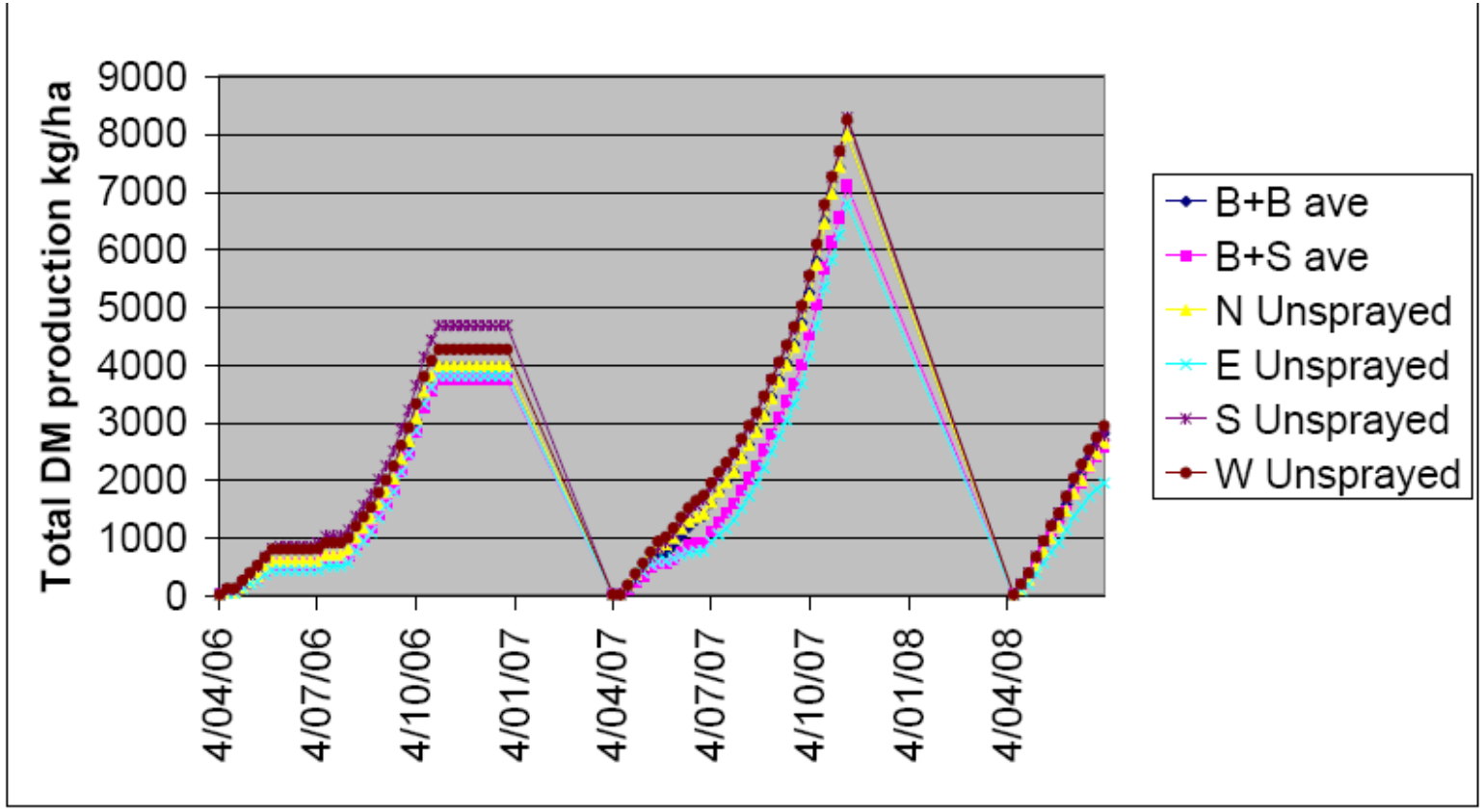
- Program flexibility is essential for good results.
- **2008** May – First Bedstraw germinated
  Aerial spray - Mid June
  Ground spray – Mid August
  Follow up spray – Late October (flowering plants)
- **2009** – Early June - First Bedstraw germinated
  Aerial spray - August 1-2 (none flowering)
  Ground spray – Mid September (none flowering)
- **2010** – June 24 – 1st plants found. cotyledon-3 weeks old
  Ground spray - Aug 1
  Sept 6 – New emergence up to 4 weeks old
  Ground spray – Oct 10
  Nov 4 – No plants found

Satellite Images

- Bedstraw satellite images
- NDVI to determine effects of control on pasture production
- To predict areas where other infestations may occur (e.g. non wetting soils)
- Pastures from Space used

Interpret images or do something

Dry matter production on areas sprayed with Broadstrike followed by Broadstrike (B+B), Broadstrike followed by Starane (B+S) and surrounding unsprayed areas.



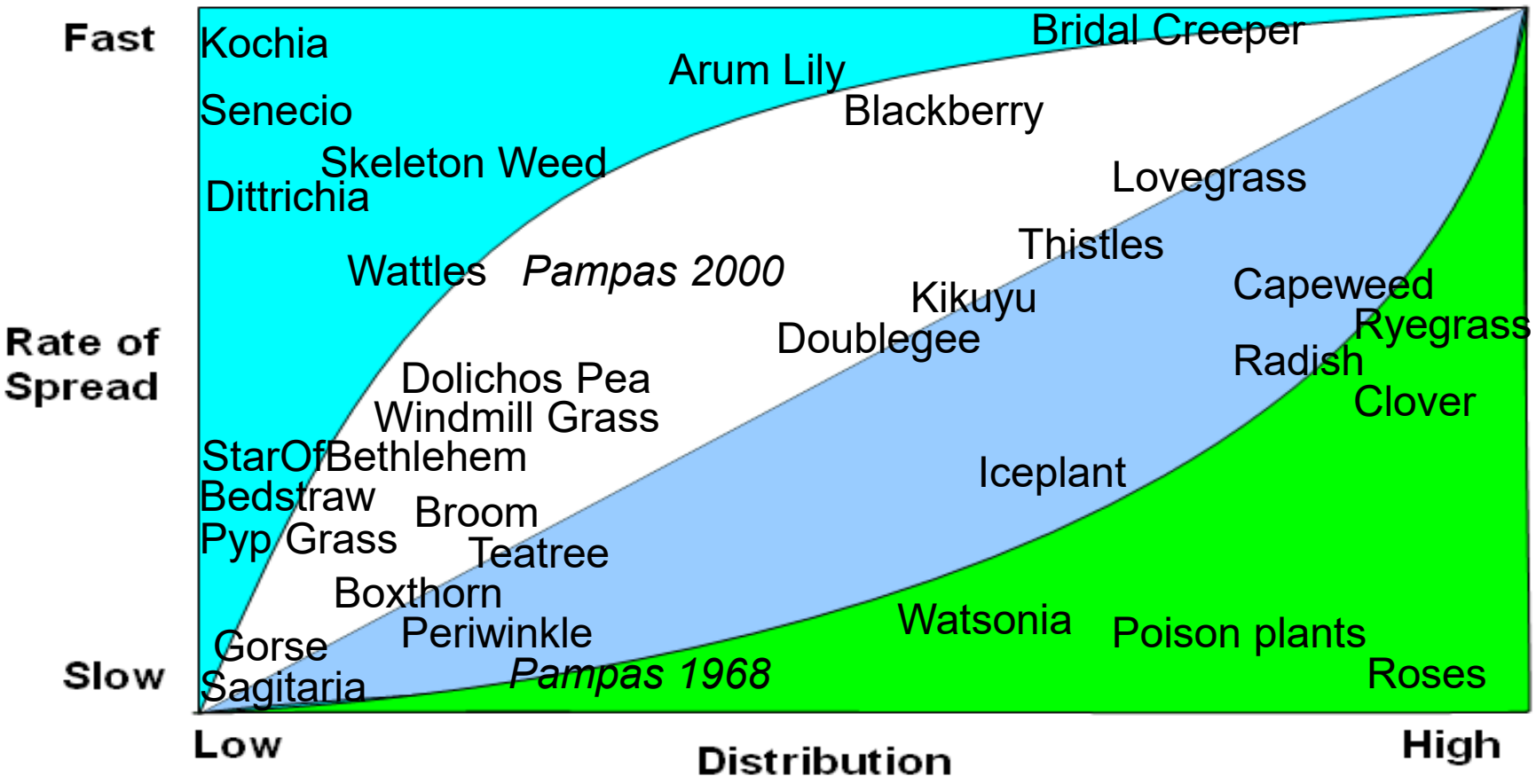
How much does it cost

Guesstimated costs per year are about
$160,000 for operations
$40,000 for DPIRD in kind support
$100,000 for compensation and volunteer support

$300k/year for 20 years
~$6 million for eradication
~$75k/year for ongoing surveillance

For comparison Kochia eradication cost ~$2m over 8 years

Categorizing Weeds



Individuals most effective

Government most effective

John Moore, ISEB

Acknowledgements

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