



Landcare Research
Manaaki Whenua

Assessing environmental benefits of weed biocontrol in New Zealand: can we make silk purses from sows ears?

Simon Fowler

Hierarchy of weed biocontrol monitoring questions



- 1/ Has agent established?
- 2/ Is it abundant/causing damage?
- 3/ Does it reduce weed population size?
- 4/ Does reducing the weed population produce a desired outcome (e.g. biodiversity or productivity?)
- 5/ Is the agent attacking anything it shouldn't?
- 6/ Is the agent causing harmful indirect effects e.g. via apparent competition in food webs?

NZ scorecard – how bad are we?



1/ Establishment

- ✓ 100% - thoroughly good work, albeit an easy subject area

2/ Abundance/damage

- ✓ 70% of agent species with quantitative data – good effort but some room for improvement
- Technology transfer only partly successful
- Stakeholder funding mostly for new agents/targets
- Uncertain timing a challenge for new releases
- Not ‘cutting edge’ science so no research support

NZ scorecard – how bad are we?



3/ Reduced weed population

- 30% of (damaging) agents with quantitative data – need to try harder
- (plans for another 11 agents – so expect progress in next few years)

4/ Measurable benefits

- 12% of (damaging) agents with quantitative data - woeful performance
- (this should get better...)

- Technology transfer not very successful
- Stakeholder funding hard to get
- Not 'cutting edge' science – so research \$\$ also limited



NZ scorecard – how bad are we?

5/ Doesn't attack anything it shouldn't

- ✓ nationwide surveys + detailed follow-up studies
- Funded by research \$\$/published

6/ Doesn't have harmful indirect effects (e.g. in food webs or other ecological connectance)

- Tentative ✓ for promising start in a new area
- Funded by research \$\$

Indirect effects 1. leafminers



Native
parasitoid
species

Introduced *Phytomyza
vitalba* on *Clematis vitalba*



Endemic *Phytomyza
clematidina* on *Clematis
forsteri*



Potential apparent competition not detected in field sampling

Paynter et al 2008 Biological Control 44:248-258

Indirect effects 2. Pollination



Could introduced *Bruchidius villosus* (pollen feeder as adult) be pollinating broom *Cytisus scoparius*?



NO – broom flowers only pollinated (and tripped open) by exotic bees

Paynter et al 2010 J. Appl. Ecol. 47:309-317



Indirect effects 3. More apparent competition

Native magpie moth is now vastly more abundant than before

Rare endemic *Senecio* spp now extinct where ragwort has invaded (although not found in same habitat)

Thus mechanism is likely to be apparent competition via a native moth

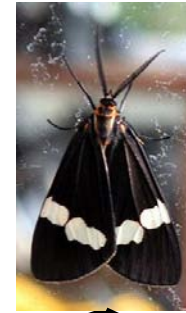
Successful biocontrol should help alleviate this by making the native moth rarer!

John Sullivan, Scot Waring (Lincoln Uni)

Ragwort flea beetle, *Longitarsus jacobaeae*



Endemic magpie moth, *Nyctemera annulata*



Ragwort, *Jacobaea vulgaris*



Endemic, *Senecio* spp

Summary of NZ weed biocontrol monitoring



- Not too bad at:
- Simple establishment and abundance/damage assessments
- Detailed non-target/food web studies – research \$\$ + opportunities to work with universities etc
- Hole in the middle – weed population level effects and demonstrating benefits
- What are we doing about this?
- Trialling some simpler monitoring methods that stakeholders can do

Simpler monitoring by stakeholders?

- Suggest keeping monitoring decisions hierarchical:
- Only invest in assessing abundance/damage for agents where you have confirmed establishment
- Only consider investing in measuring decline in weed and outcome benefits with agents that are abundant/damaging
- More stakeholder monitoring under this scenario?
- Problems – lack of pre-release data?



Do some 'flagship' monitoring

- Choose flagship programmes for more detailed monitoring (e.g. mist flower)
- Care – easy to spend \$\$ (e.g. \$300K grant for monitoring *Hieracum* agents – none common enough in the 3 year study)
- Entire 5 yr mist flower monitoring programme \$250K
- Part funded by Auckland Regional Council – cheap was good for them
- Also trialling cheaper tools/techniques that involve obtaining some pre-release data

Options to include pre-release data?

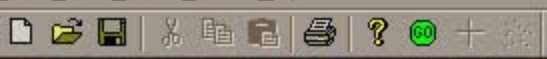


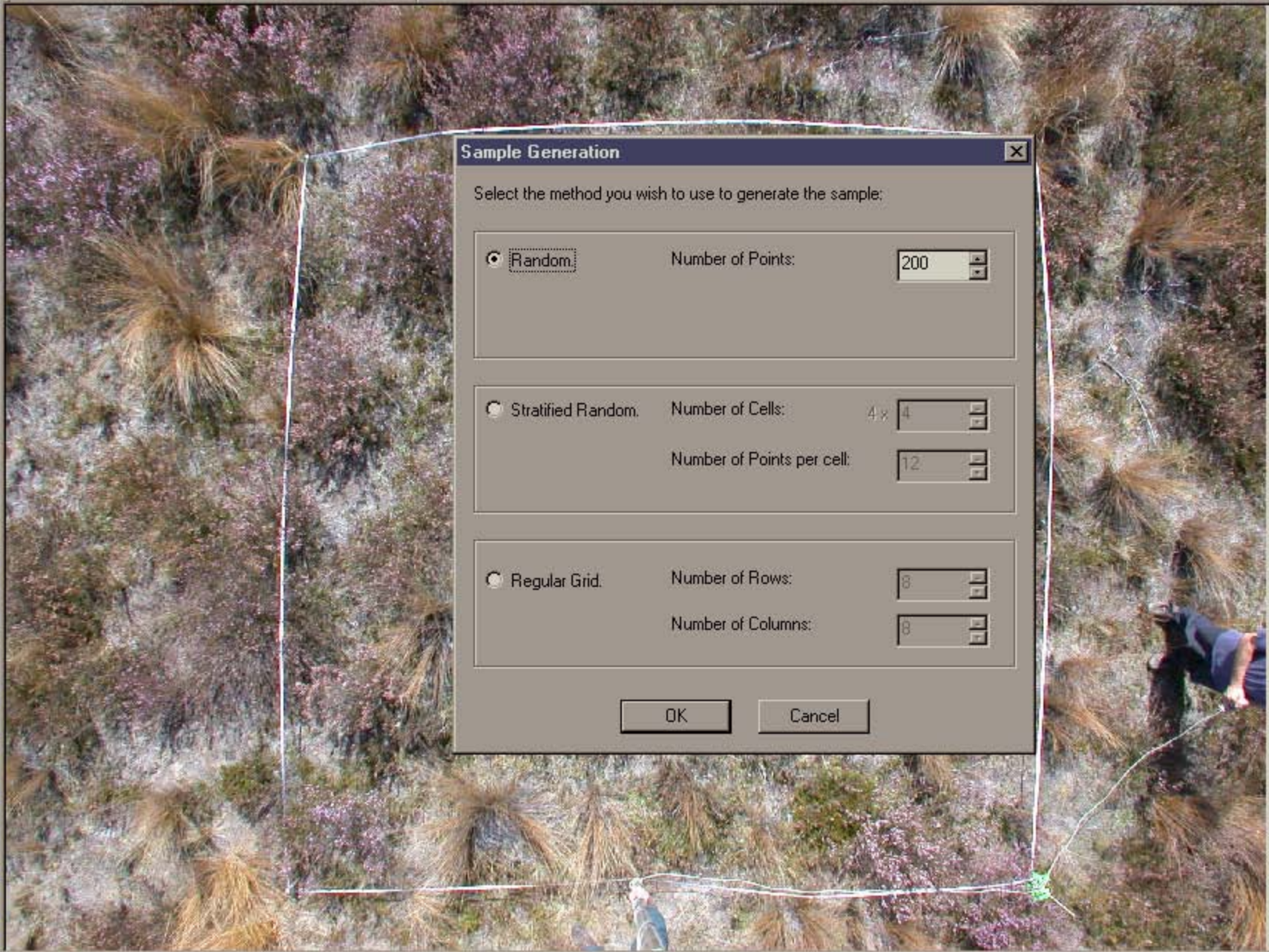
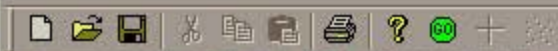
- Idea 1: Paired control/release sites
- Nice idea, little upfront investment
- Complete failure for logistic/political reasons

Simple monitoring by stakeholders?



- Next idea: Replicated before/after photographs
- Acquiring & sending images now cheap & easy
- Store and analyse later (if agents perform)
- We have developed simple software to score photos
- Not suitable for all weeds/needs some ground-proofing and agent assessment
- Problems – we'll see (currently trialling)





Sample Generation

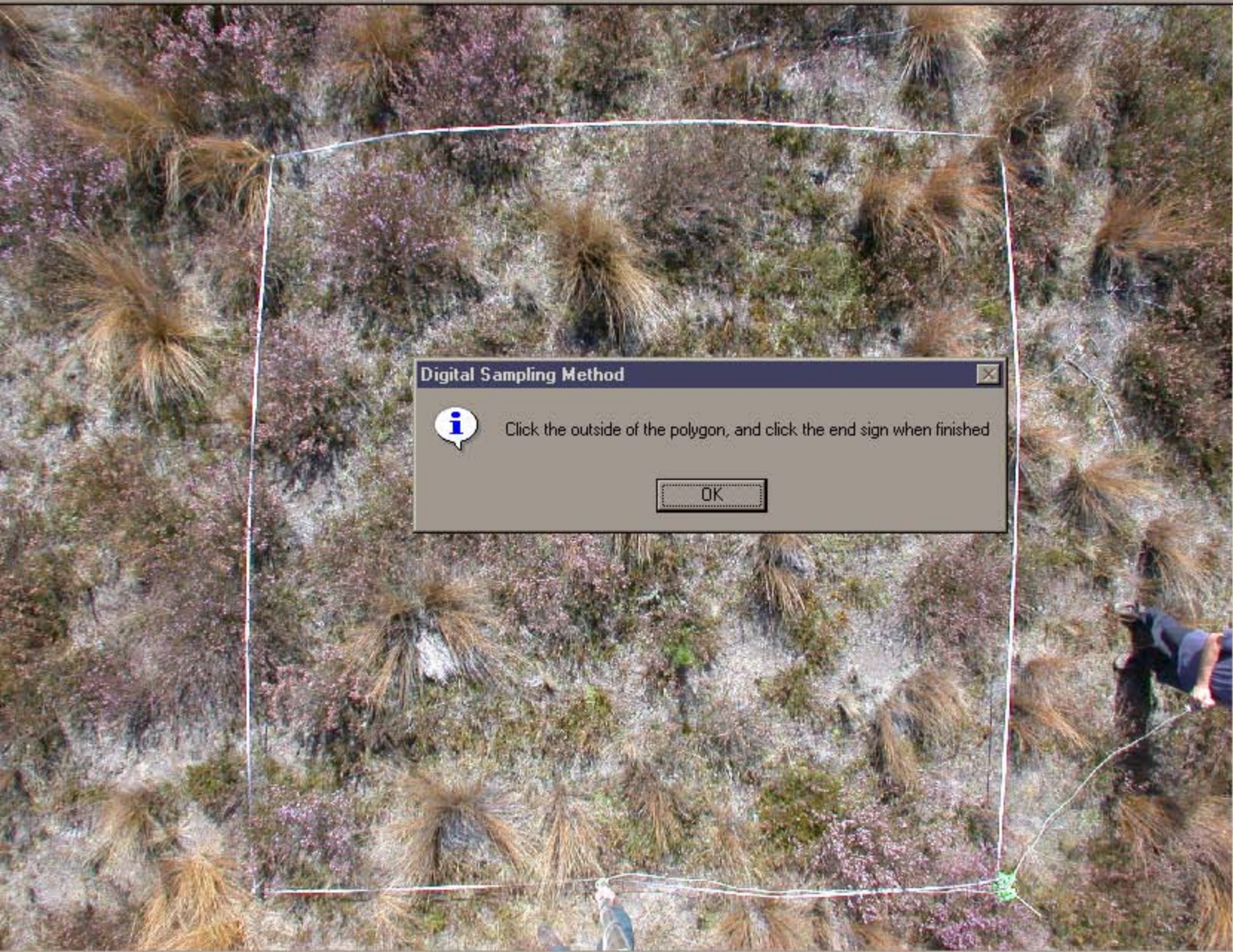
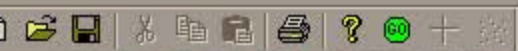
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Random Number of Points:

Stratified Random Number of Cells: 4 x
Number of Points per cell:

Regular Grid Number of Rows:
Number of Columns:

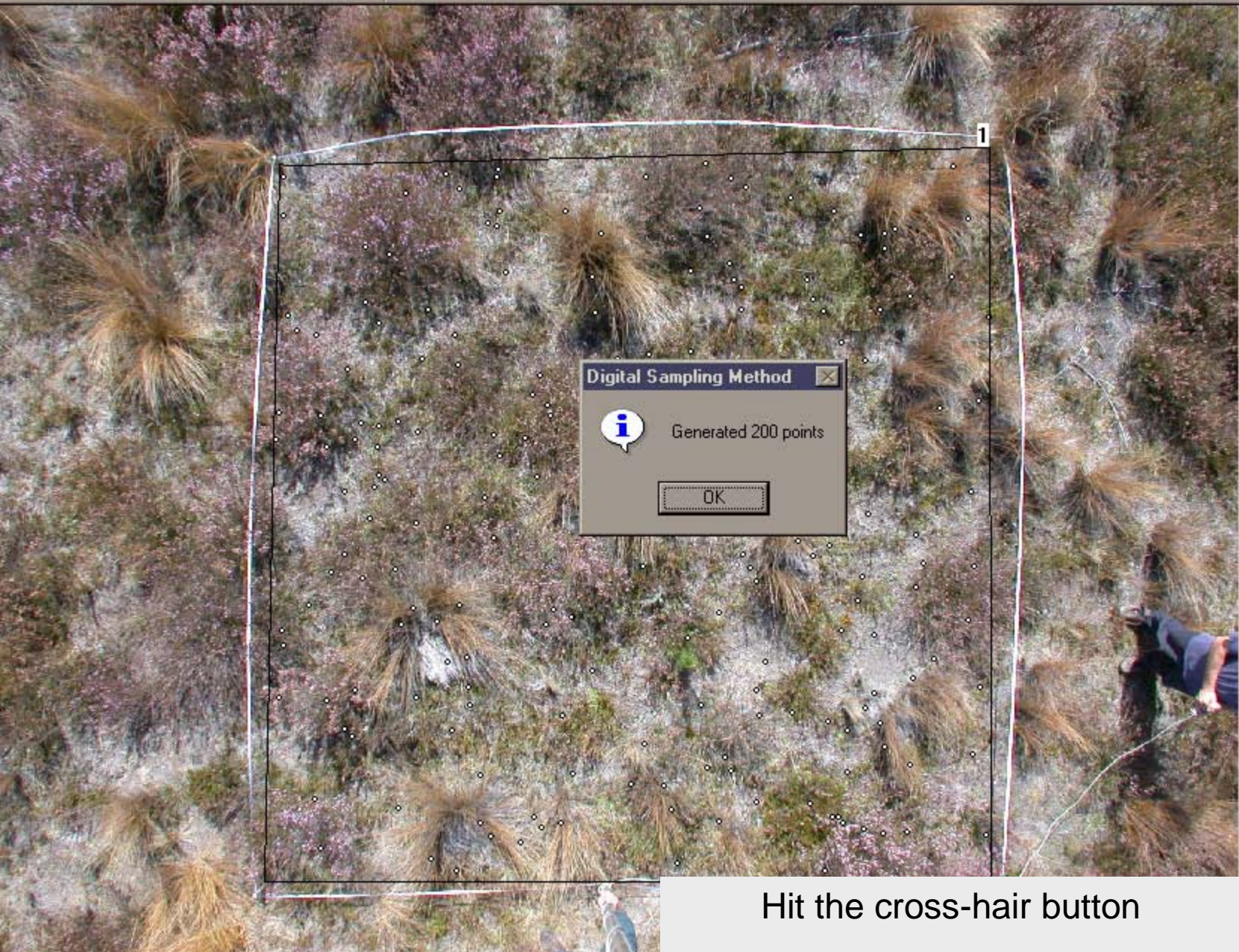
OK Cancel



Digital Sampling Method [Close]

 Click the outside of the polygon, and click the end sign when finished

[OK]



Digital Sampling Method

 Generated 200 points

OK

Hit the cross-hair button



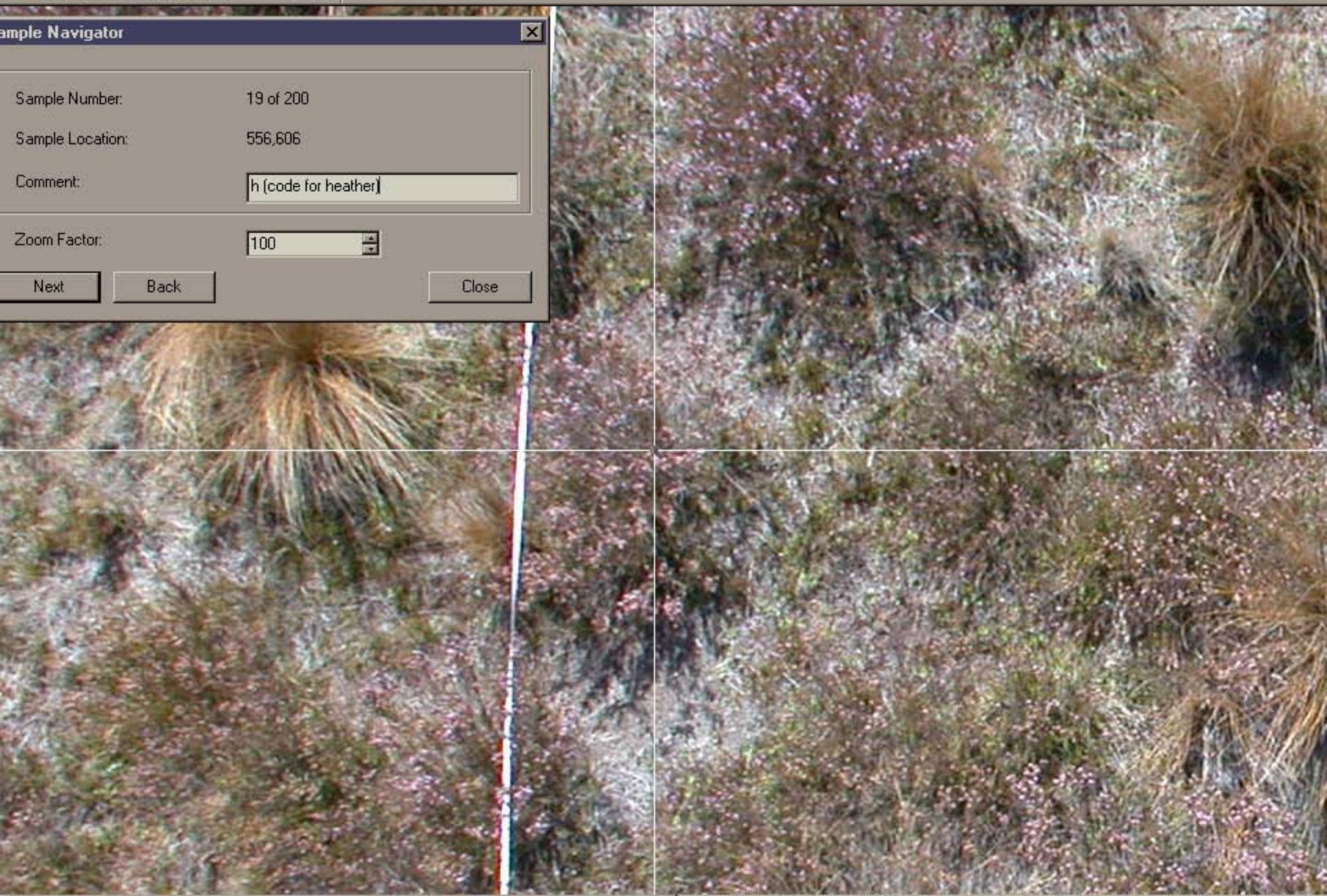
Sample Navigator [X]

Sample Number: 19 of 200

Sample Location: 556,606

Comment:

Zoom Factor: [up/down arrows]





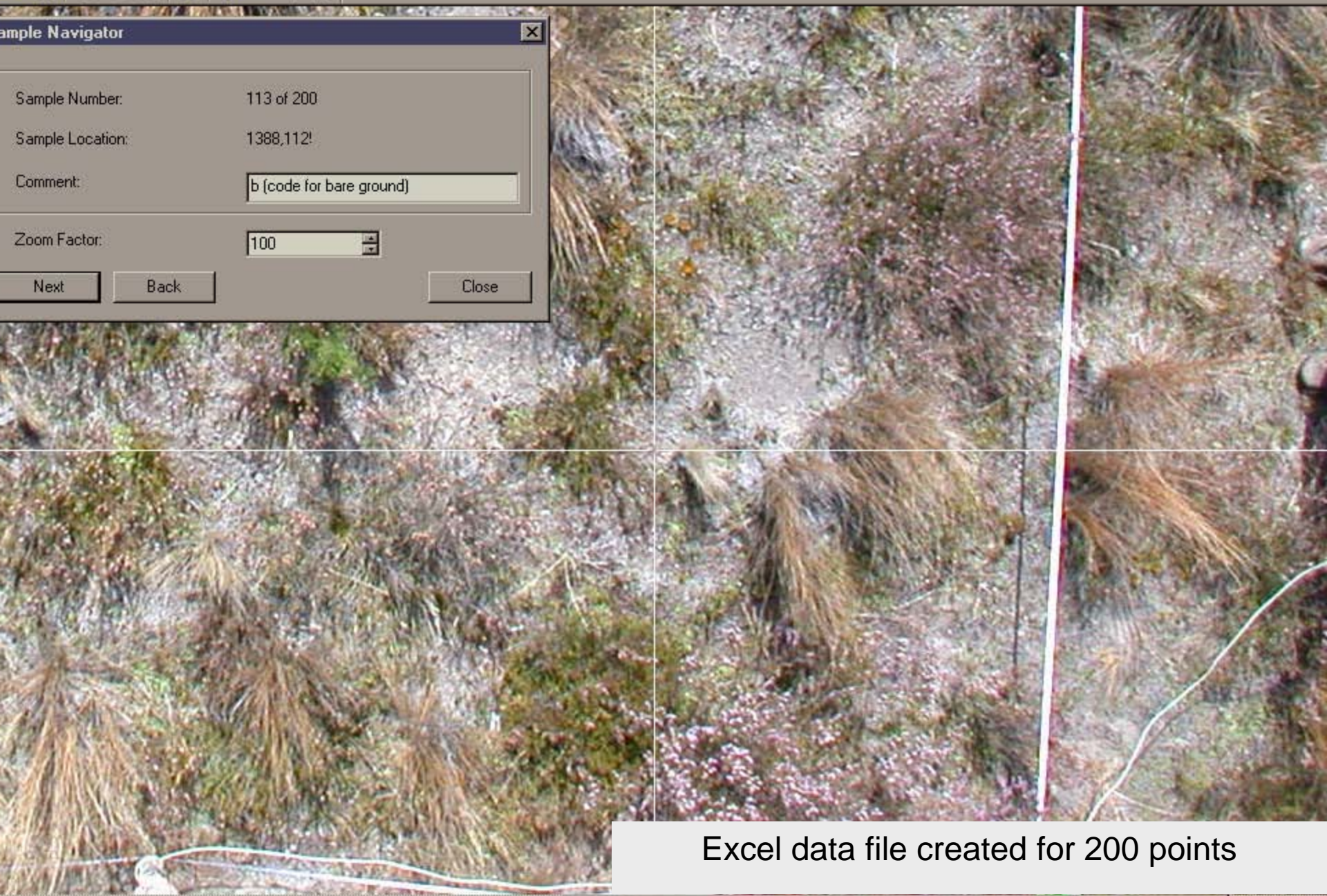
Sample Navigator [X]

Sample Number: 113 of 200

Sample Location: 1388,112!

Comment:

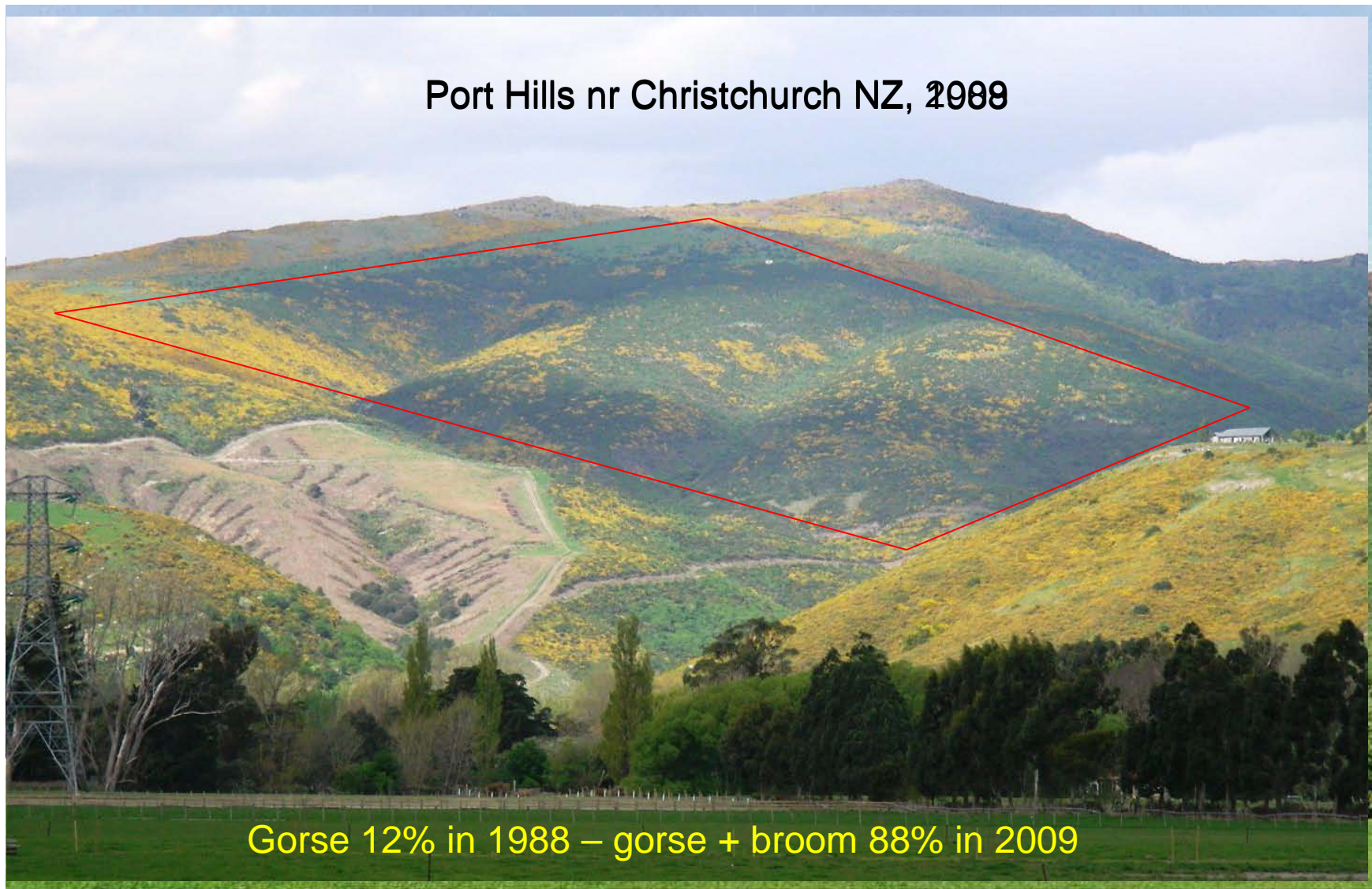
Zoom Factor: [up/down arrows]



Excel data file created for 200 points



Port Hills nr Christchurch NZ, 2009



Gorse 12% in 1988 – gorse + broom 88% in 2009

Other simple monitoring by stakeholders?



- Simple assessment of weed density at all or most release sites (photos/qualitative assessment?)
- Repeat after xx years – analyse photos for % cover or compare qualitative assessments (sign test)
- Other cheap/simple methods – questionnaire of landowners



Caveats and opportunities

- For all these methods still need experimental studies to show cause/effect
- Can be addressed by detailed studies later e.g. chemical exclusion
- Opportunistic – observed death of broom plants on which mite was released 3 yrs earlier
- Low mite dispersal: 2-3 yr release expt (with matched control bushes)



Silk purses from sows ears?

- For non-target impacts e.g. complex food web effects
- NO – will always need detailed ecological studies (and for that you need ecologists and \$\$)
- Also NO if you want to show small (but important) changes in weed distributions
- For simple agent/weed monitoring – PERHAPS
- Aim to get stakeholder engagement/funding
- Can be geographically extensive and highly replicated (will need to be!)
- If photos/site assessments are good enough then simple methods may demonstrate vegetation benefits from weed reductions
- Cause/effect will always need an experimental approach