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Agroscope Reckenholz-Tänikon Research Station ART

Case-control studies for risk-assessment in ecology and agriculture

Matthias Suter & Andreas Lüscher

Background

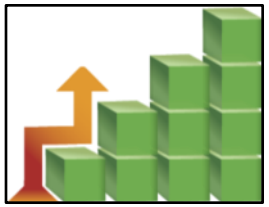
Complex research questions?

- Case studies: Ambiguous statistical foundation
- Experiments: Treatments? Range? Duration?

Investigation on site

combined with

optimised statistical design



Case-Control Studies

Agresti 2002 Wiley

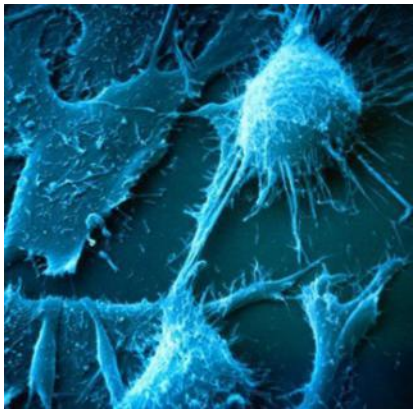
Case-control studies

Well known in human health research

- Cases: persons with disease

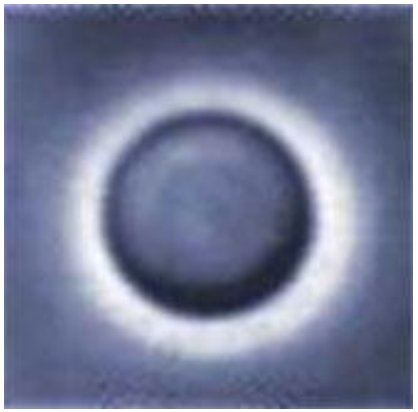
  are being compared with

- Controls: persons without that disease



cancer

- age
- gender
- nutrition
- social background
- smoker
- …



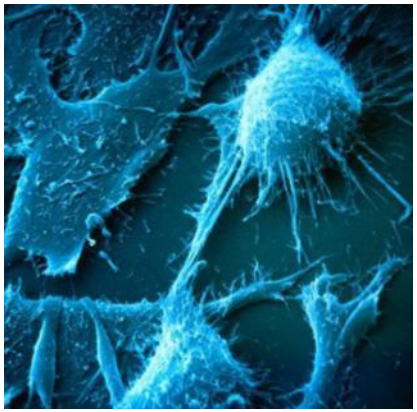
no cancer

Peto et al. 2000 Brit Med J

Case-control studies

- Analyse the relative risk for the occurrence of cancer with smoker compared to non-smoker

Trait	Relative risk for cancer
Non-smoker (comparison)	
Smoker	3



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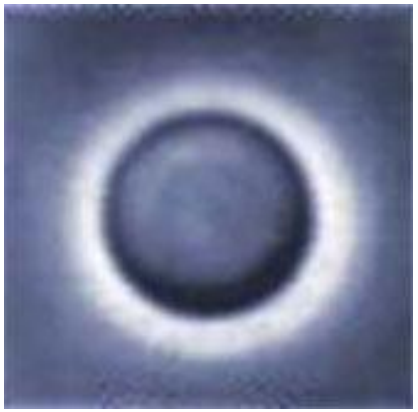

no cancer

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Applikation in agriculture

- What is the relative risk for the occurrence of poisonous *Senecio* species in managed grassland?

Good to know about *Senecio* sp.

- Increase of *Senecio* species in agricultural grassland in recent years
- *Senecio jacobaea*, *S. aquaticus*, *S. erucifolius*
- *Senecio* sp. contain pyrrolizidine-alkaloids that are toxic for animals and human

S. jacobaea

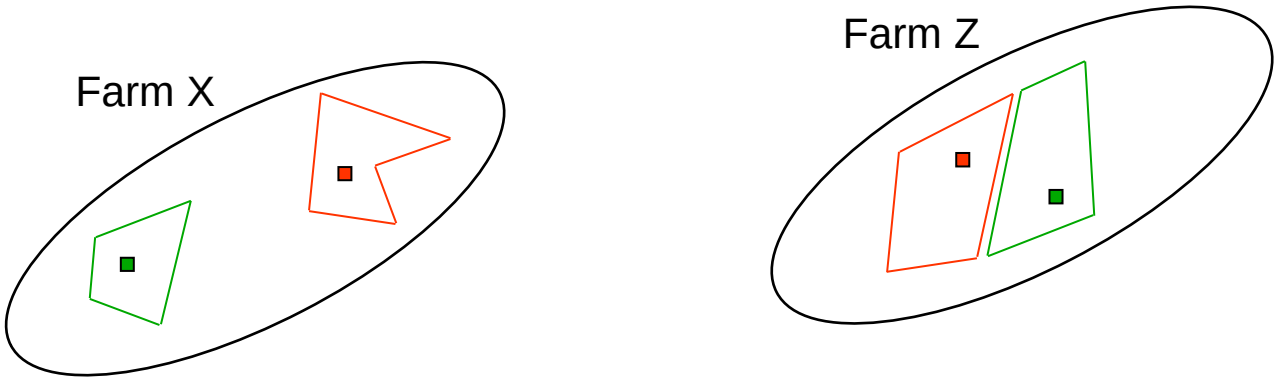
S. aquaticus

- Produce up to 50‘000 seeds per individual and year (*S. jacobaea*)
- Achenes with pappus: wind dispersion
- High germination percentages (up to 80%)

Bosshard et al. 2003 AFo

Approach

- On-farm
- Case: parcel (management unit) with *S. jacobaea*
- Control: parcel without *S. jacobaea*
- Paired case-control design
- Similar environmental conditions, management may have differed (or not)
- Measurements: vegetation (5 x 5 m^2), site conditions, management, disturbance
- 62 parcels investigated



Factors for risk analysis

Tested variables

Environment	Unit or class
Inclination	%
Exposition	N, E, S, W, none
Soil	
P	ppm P
K	ppm K
Mg	ppm Mg
pH	-
Texture (4 variables)	%
Management and vegetation	
Plant available N applied	kg ha^{-1} yr^{-1}
Type of management	Mowing, Rotational grazing, Continuous grazing
Changes in management intensity	No change, Increase, Decrease
Disturbance	No, Yes
Openness of sward (bare ground)	Low (≤ 25%), High (> 25%)

High-risk areas for *S. jacobaea*

Analysed with generalised linear models (GLM)

Variable	Relative risk	*P*
Intercept (comparison)		
N applied (100 kg ha^{-1} yr^{-1})	0.2	**0.008**
Openness high (> 25%)	40.3	**0.005**
Continuous grazing *vs.* mowing	11.6	**0.017**
Rotational grazing *vs.* mowing	1.0	0.953

Intercept: mown grassland, N applied 50 kg ha^{-1} yr^{-1}, low openness (≤ 25%)

Low nutrient,
continuously grazed pastures
with open patches

Suter et al. 2007 Weed Res

Evaluation case-control

Benefits

- Reliable statements in relatively short time
- Test of challenging treatments such as grazing systems
- Test of influences with very broad range or composed of several components
- Effects can be assigned to factors that acted over long time
- Close to practice, on-farm ⇨ relevant for application

Evaluation case-control

Limits

- Only existent factors can be investigated
- Correlated factors cannot be separated

  Experiments can test extended factors, ranges, and correlations, once first evidence is gained

Applications

- Success in sowing (e.g. field margin strips)
- Wild boar attacks in crop fields
- Economy of farms

Conclusions

Case-control studies

- Offer a great opportunity for dealing with complex questions
- Great potential in surveys and on-farm research – close to application
- Can be applied to a wide range of research topics

Thanks to

John Connolly

Willy Kessler

Agricultural Advisory Service

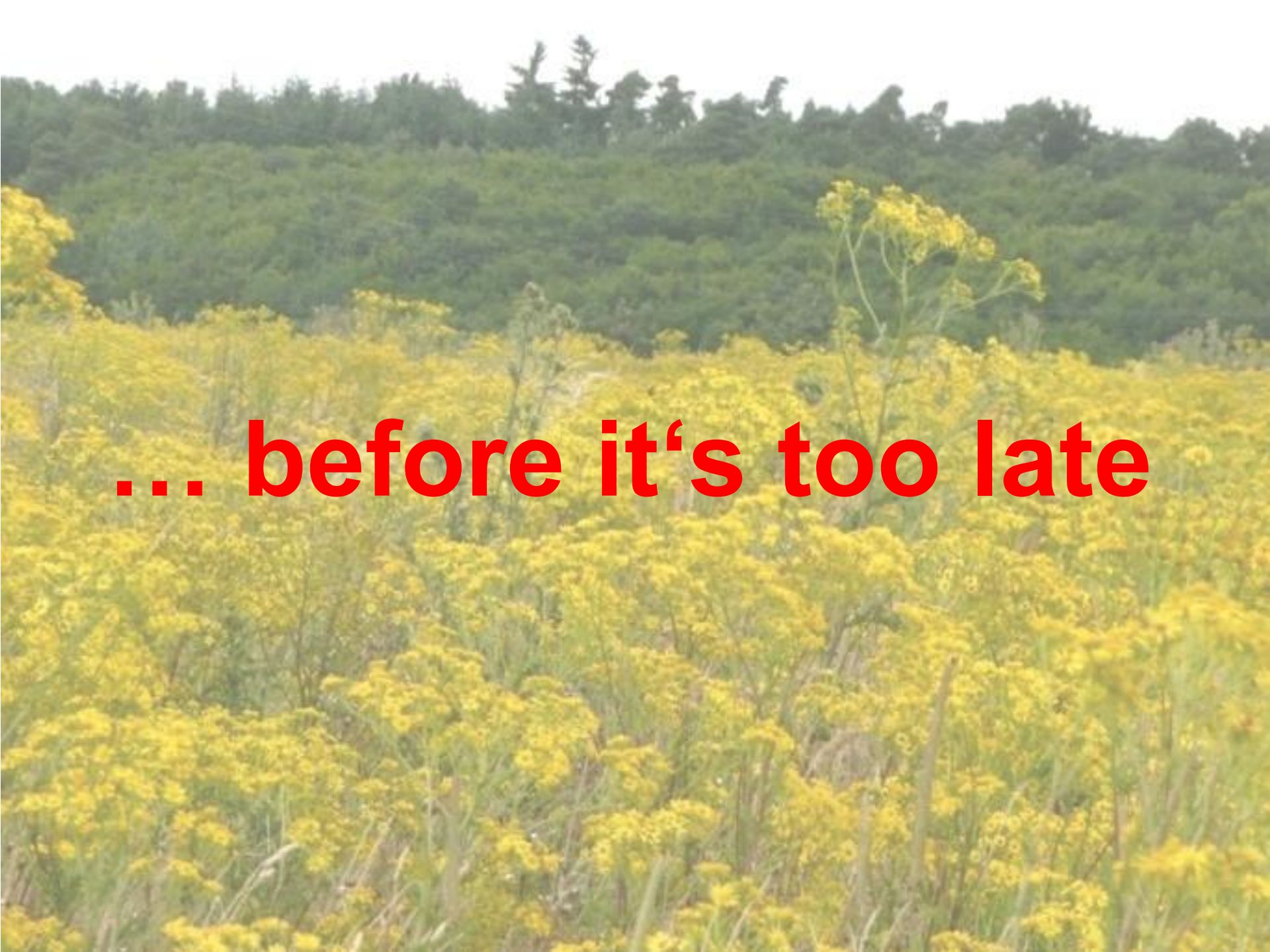
Swiss Federal Office for Agriculture FOAG

Strategies

for the control of the species

- Prevent sward damage
- Replace set stocking by rotational grazing
- Adjust grazing rates, avoid overgrazing
- Maintenance parcels ⇨ cut weeds
- Prevent seed formation in meadows and local environment
- Act early, when the species arrives ...

Suter et al. 2007 Weed Res


… before it‘s too late