

# Non-Native species in the Antarctic

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## Tools for risk assessment and management

Bio-Protection

### Pest Risk Assessment:

Is the second stage of a more broad **Pest Risk Analysis (PRA)** that includes:

1. Initiation of a full pest risk analysis and identification of a pathway (7 steps)
2. Pest risk assessment (32 steps)
3. Risk management (10-11 steps)

**Pest Risk Assessment** comprises:

1. Categorization of individual pest species (7 steps)
2. Evaluation of probability of pest entry, establishment and spread (15 steps)
3. Evaluation of economic and biological consequences (10 steps)

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### Traditional Pest Risk Assessment

- Categorisation of the species
- Assessment of its probability of introduction, establishment and spread
- Assessment of potential economic/environmental consequences

Qualitative assessment

2.2 Assessment of the probability of introduction, establishment and spread

- 2.2.1 Probability of entry of a pest
  - 2.2.1.1 Identification of pathways for a PRA initiated by a pest
  - 2.2.1.2 Probability of the pest being associated with the pathway at origin
  - 2.2.1.3 Probability of survival during transport or storage
  - 2.2.1.4 Probability of pest surviving existing pest management procedures
  - 2.2.1.5 Probability of transfer to a suitable host
- 2.2.2 Probability of establishment
  - 2.2.2.1 Availability of suitable hosts, alternate hosts and vectors in the PRA area
  - 2.2.2.2 Suitability of environment
  - 2.2.2.3 Cultural practices and control measures
  - 2.2.2.4 Other characteristics of the pest affecting the probability of establishment
- 2.2.3 Probability of spread after establishment
  - 2.2.4 Conclusion on the probability of introduction, establishment and spread
    - 2.2.4.1 Conclusion regarding endangered areas

tion

### Quantitative assessment

- Climographs/Climatographs

Christchurch, N.Z. 43.5° S, 173° E Elev. 7 m

McMurdo Station 78° S, 167° E Elev. 2 m

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### Climate matching

Map showing analogous climatic regions to Auckland, New Zealand based on the CLIMEX match function. All areas have a climatic similarity greater than 50%. (Peacock & Worner 2006)

Key

1 = British Columbia	9 = Quito (Ecuador), Bogota (Colombia)
2 = East coast United States	10 = Kenya
3 = United Kingdom	11 = Temuco (Chile)
4 = Western Europe	12 = Montevideo (Uruguay), Porto Alegre (Brazil)
5 = Sukhumi (Georgia), Samsun (Turkey)	13 = South Africa
6 = Lankaran (Azerbaijan)	14 = South West Australia
7 = Guiyang	15 = South East Australia
8 = Osaka, Niigata (Japan)	A = Auckland

### Statistical tools: Principal components analysis

Figure: 4.3 Principal component scores of the combined global distributions of two groups of insect spp 21 species that have established in New Zealand and 15 species that have not established in New Zealand

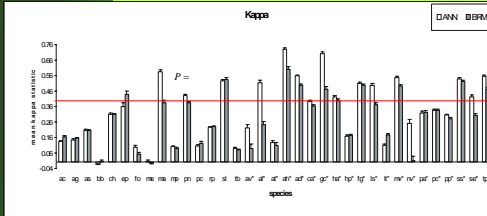
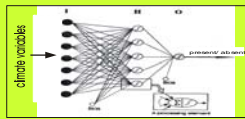
Principal component score plot of the New Zealand climate sites (n=310).

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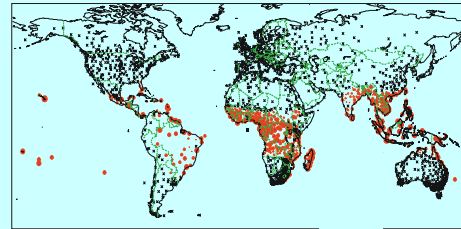
### Statistical modelling

Binary logistic regression compared with ANN models: prediction of the global distribution of invasive insects

Artificial Neural Network (ANN)

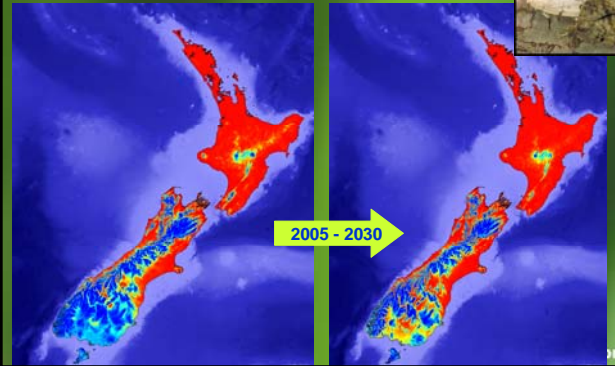


### CLIMEX prediction of establishment and spread of *Aspidiotus destructor* (coconut scale)



Other computer based models: CLIMATE, STASH, BIOCLIM, GARP, DOMAIN, HABITAT

### Mechanistic model indicating successful establishment and spread under climate change for gypsy moth



### More recent approaches

- There are >3000 global insect pest species
- Can we rank these species with regard to their probability of establishment?



A database was constructed from the *Crop Compendium – Global Module, 5th Edition* © CAB International, Wallingford, UK, 2003

- 459 geographic areas distributed worldwide
- 800 insect pest species



### Sample of the database:

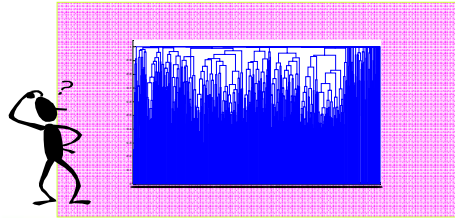
		Country names and codes									
		Armenia AM	India Bihar INbh	Italy IT	Jordan JO	Taiwan CNtw	- - - Barbados BB				
3088 species (descriptors)	Species names and codes	Abraxas grossulariata	ABRXGR	0	0	0	0	0	-	-	0
		Acanthocoris scabator	ACACSI	0	0	0	0	0	-	-	0
		Acanthocoris scaber	ACACSC	0	0	0	0	0	-	-	0
		Acanthocoris sordidus	ACACSO	0	0	0	0	1	-	-	0
		Acaudaleyrodes rachiopora	ACAACD	0	0	0	0	0	-	-	0
		Achaea serva	ACAASE	0	0	0	0	0	-	-	0
		Acanthophilus helianthi	ACAHE	0	1	1	1	0	-	-	0
		-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
Zeiraphera diniana	ZRPHDI	0	0	0	0	0	-	-	0		
Zeiraphera rufimitrana	ZRPHRU	0	0	0	0	0	-	-	0		
Zulia charon	ZULICH	0	0	0	0	0	-	-	0		
Zulia colombiana	ZULICO	0	0	0	0	0	-	-	0		
Zygaena filipendulae	ZYGNFI	0	0	1	0	0	-	-	0		

459 geographic area (objects)

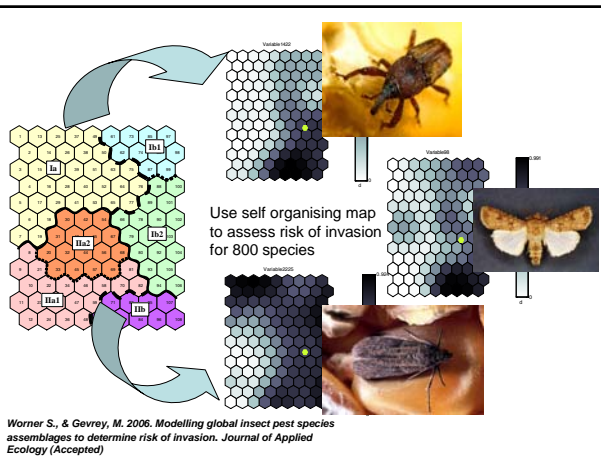
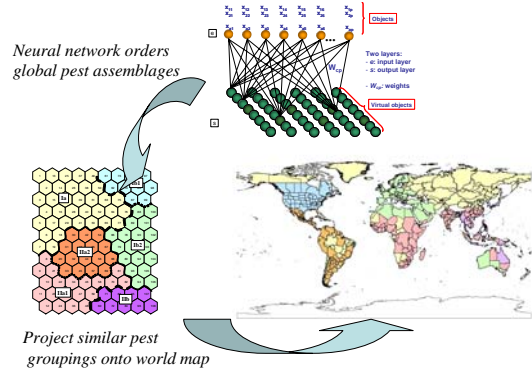


## Conventional clustering algorithm:

800 species and all sites



## The Self Organising Feature Map (SOM)



## Species not established in NZ

Species not present in NZ	Common name	Risk
<i>Ceratitis capitata</i>	Mediterranean fruit fly	0.66
<i>Chrysomphalus dictyospermi</i>	Spanish red scale	0.66
<i>Aphis fabae</i>	Bean aphid	0.64
<i>Sitophilus zeamais</i>	Greater grain weevil	0.63
<i>Lepidosaphes beckii</i>	Purple scale	0.62
<i>Cadra cautella</i>	Dried currant moth	0.61
<i>Pieris brassicae</i>	Cabbage caterpillar	0.61
<i>Trichoplusia ni</i>	Cabbage looper	0.59
<i>Agrotis segetum</i>	Black cutworm	0.58
<i>Hadula trifolii</i>	Clover cutworm	0.58
<i>Chrysomphalus aonidium</i>	Florida red scale	0.57
<i>Ceroplastes rusci</i>	Fig wax scale	0.55
<i>Scolytus rugulosus</i>	Shothole borer	0.55



## Six most likely phytophagous insect species to co-occur with the oat aphid, *Rhopalosiphum padi*

- Myzus persicae
- Agrotis ipsilon
- Plutella xylostella
- Delia platura
- Acyrtosiphon pisum
- Aphis gossypii
- Green peach aphid
- Black cutworm
- Diamond-backed moth
- onion or seed corn maggot
- Pea aphid
- Melon aphid

## Naturalized Aliens Marion island

- Thrips: *Apterostrips apteris*
- Flies: Blow-fly (*Calliphora vicina*), Lesser house fly (*Fannia canicularis*), Vinegar fly (*Scaptomysa sp.*), Moth fly (*Psychoda parthenogenetica*), Midge (*Limnophyes minimus*)
- Moths: Diamond-backed moth (*Plutella xylostella*), Noctuid moth (*Agrotis ipsilon*)
- Butterfly: Painted lady (*Vanessa cardui*)
- Aphids: Potato aphid (*Macrosiphum euphorbiae*), Aphid (*Myzus ascalonicus*), Oat aphid (*Rhopalosiphum padi*)

## *Delia platura* (bean seed fly)



## *Agrotis ipsilon* (black cutworm)



## *Myzus persicae* (green peach aphid)



## *Plutella xylostella* (diamondback mo)



## Other tools that may be important for management:

### DNA Diagnostics and Barcoding

(Lincoln University - Bioprotection Centre, AgResearch, Landcare Research  
Massey Uni)

Stable isotope technology (Lincoln University - Bioprotection Centre  
AgResearch)

Sniffer Technology (AgResearch, Lincoln University - Bioprotection  
Centre, Canterbury University)

### Modelling insect spread over heterogeneous landscape

((Lincoln University - Bioprotection Centre, Canterbury University)

Modelling weed spread over heterogeneous landscape  
(Lincoln University - Bioprotection Centre, Canterbury University,  
Landcare research)