Monitoring of Pesticides in New Zealand groundwater systems

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Manaaki Tangata Taiao Hoki
protecting people and their environment through science

Outline

- Monitoring of pesticides
- Temporal variability
- Point sources
- Interpretation of results

Detection of pesticides in NZ groundwater

- Three main types of monitoring
  - drinking water supplies
  - targeted “at risk” areas
  - general groundwater resource
- Each type show different results
- Drinking water supplies
  - one well with dieldrin at >50% MAV
  - 4 out of 483 with very low levels

National surveys

- Surveys in 1990, 1994, 1998 & 2002
- 1990 to assess if there was a problem; limited to 6 areas
- 1994 more widespread
- 1998 every region, looked at ELISA kits & metabolites
- 2002 every region - used ELISA kits to screen samples
- Surveys analysed for acid herbicides & semi-volatile organics - range of organochlorine, organophosphorus & organonitrogen pesticides
  - ♦ 1990 & 1994 : DL around 0.1 ppb
  - ♦ 1998 & 2002 : DL around 0.01 ppb

Pesticides in NZ Groundwater

- **If a DL of 0.1 ppb is used for comparison, then**

  1990 : 82 wells; 7% with detectable pesticides
  1994 : 116 wells; 14% with detectable pesticides
  1998 : 95 wells; 11% with detectable pesticides
  2002 : 133 wells; 9% with detectable pesticides

- **For a DL of 0.01 ppb, then**

  1998 : 95 wells; 35% with detectable pesticides
  2002 : 133 wells; 21% with detectable pesticides

Detailed results from 1998/98 survey

- 33 wells with pesticides detected (35%)
- 18 wells had two or more pesticides detected (19%)
- 20 different pesticides were detected
- 76% of pesticides detected were triazines (74%< 0.1 ppb)
- Only one well with pesticides > MAV; known point source
- 11 out of the 15 regions had one or more wells with pesticides present

Individual Pesticides Detected

Pesticide	Number	Range (ppb)
2,4-D	1	0.9
Alachlor	2	0.02 – 0.25
Atrazine	7	0.01 – 0.08
Cyanazine	1	1
Diazinon	4	0.01 – 0.03
Hexazinone	2	0.12 – 0.23
MCPA	1	61
MCPB	1	2.1
Mecoprop	1	420
Metolachlor	1	0.21

Individual Pesticides Detected

Pesticide	Number	Range (ppb)
Metribuzin	2	0.14 – 1.2
Pendimethalin	1	0.03
Picloram	1	0.3
Pirimiphos methyl	1	0.01
Procymidone	1	0.17
Propazine	4	0.01 – 2.5
Simazine	18	0.01 – 0.32
Terbuthylazine	10	0.01 – 3.5
Triclopyr	2	0.14 – 0.3
Trifluralin	1	0.02

Summary for 2002 survey

- 133 wells were sampled throughout New Zealand
- 28 wells (21%) with one or more pesticides detected
- 19 different pesticides detected plus 2 metabolites, most detections were triazines
- Most pesticides were < 0.1 ppb
- Only 3 detections were above 1 ppb

Summary for 2002 survey

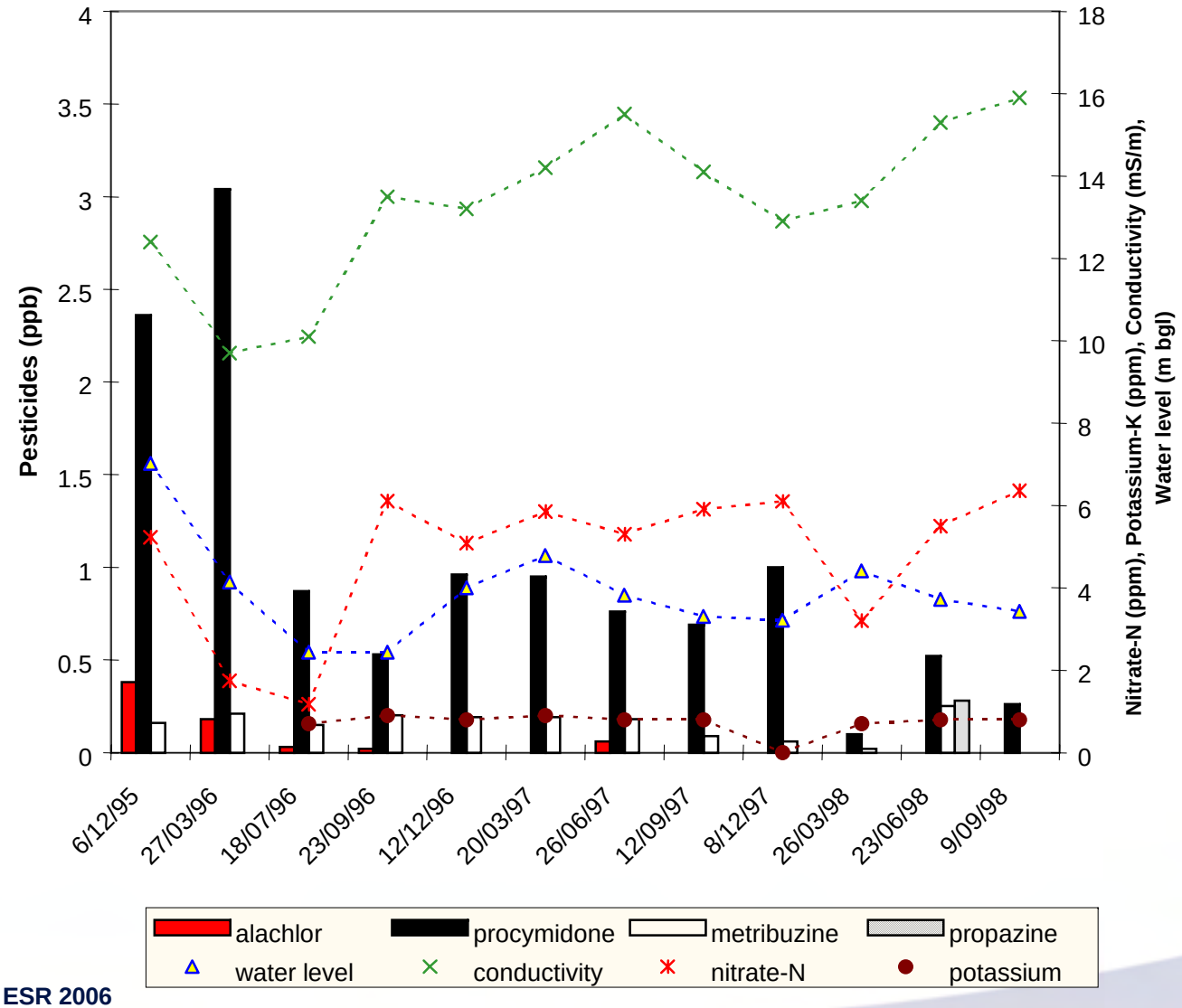
- Contamination more in unconfined compared with confined aquifers
- More pesticide detections with :
  - shallower wells screened near the water table
  - lower temperatures
  - higher nitrate levels

Regional Council surveys

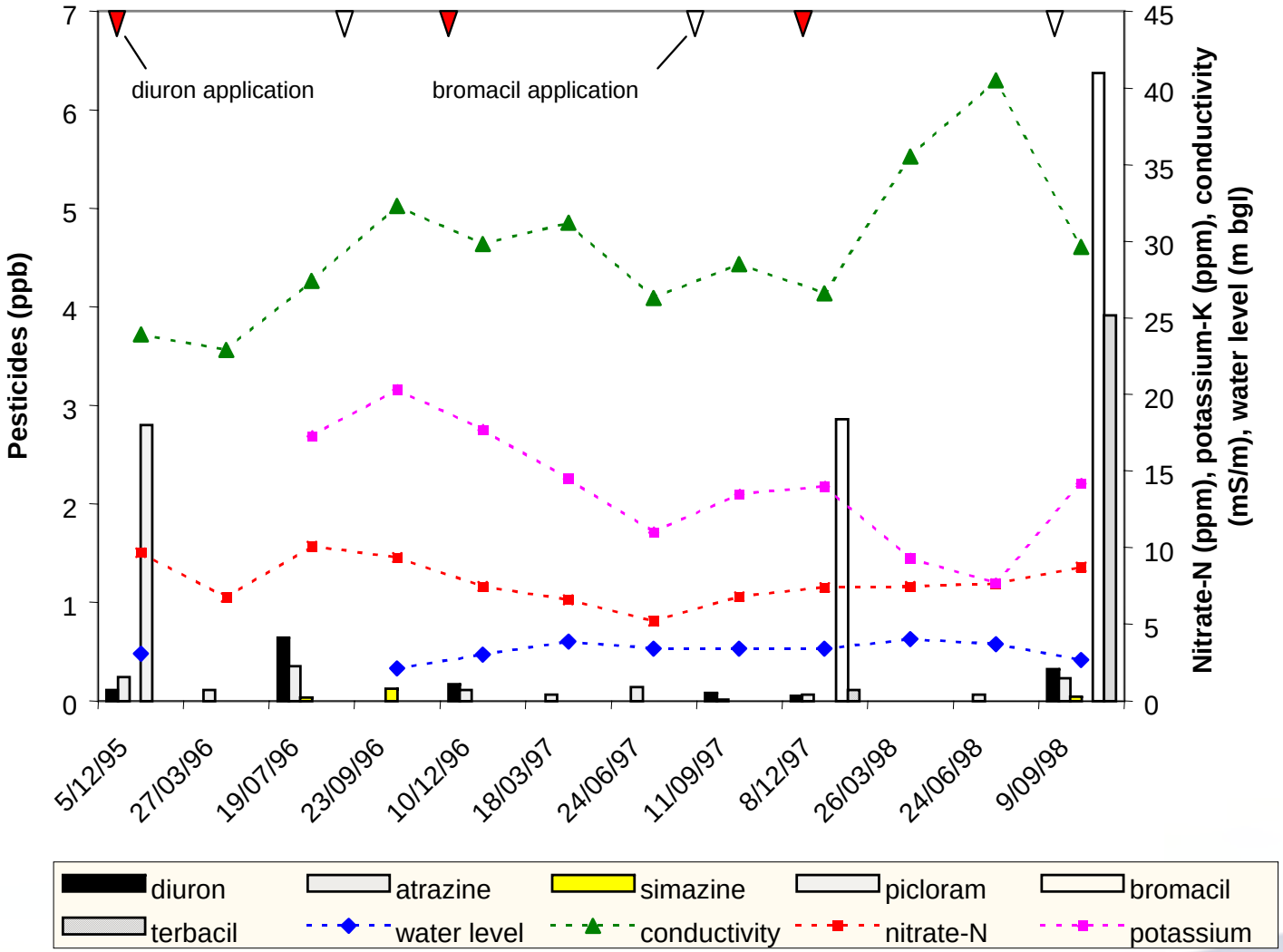
- More intensive regional surveys have been undertaken by several councils
- Mixture of targeted high risk & general resource surveys
- Wide range of results
- Little contamination in areas like Taranaki
- More contamination in areas like Waikato and Canterbury (targeted high risk)
- A general resource survey in Canterbury found 12-14%, only 1 > MAV (dieldrin)

Temporal variation of pesticides

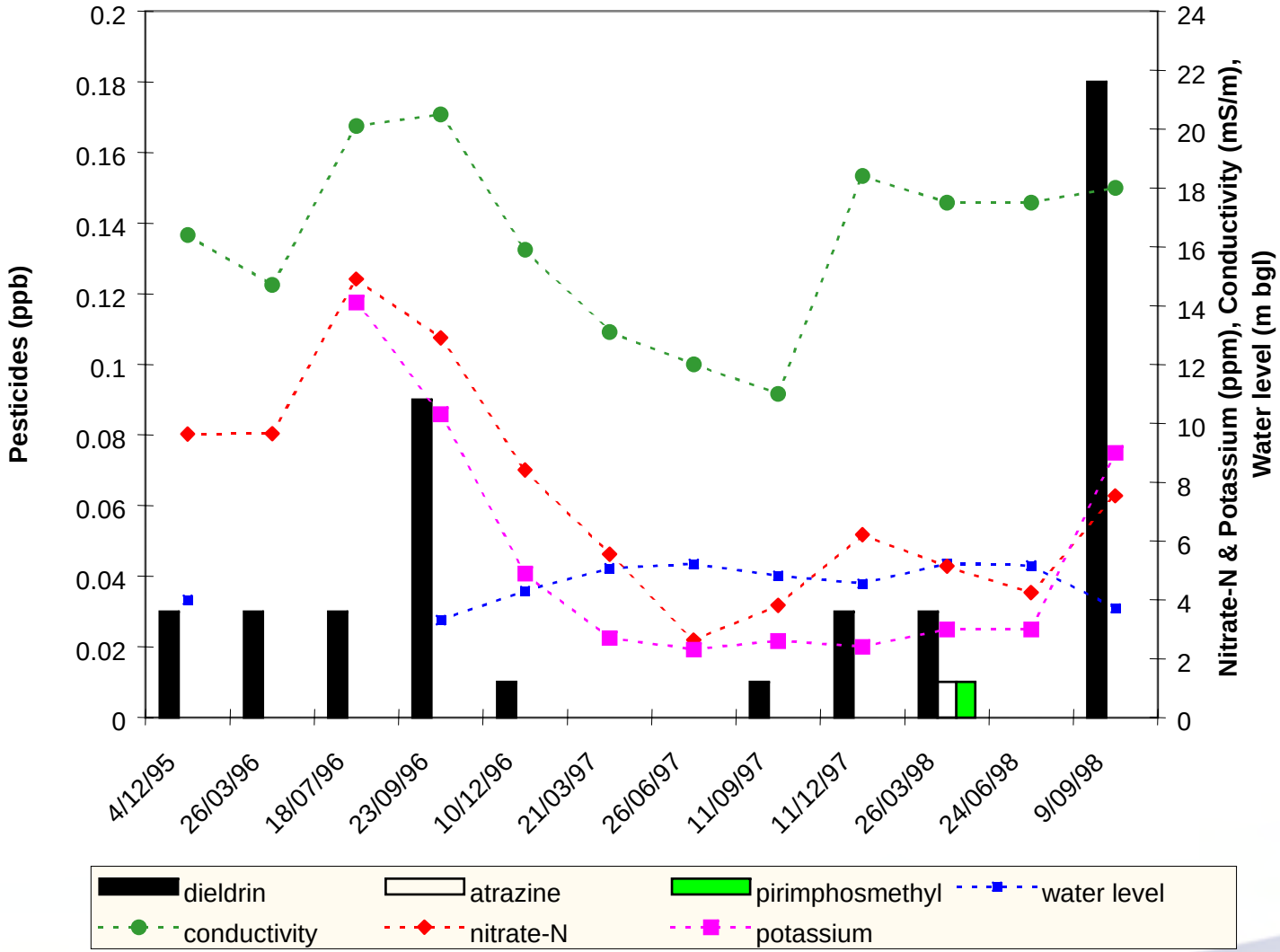
- Temporal monitoring carried out by Environments Waikato & Canterbury
- Variation in temporal patterns
  - some sites pesticide levels consistent
  - some sites sporadic detections
- Some relationship with other parameters such as nitrate & conductivity at some sites but not others



Site 61.113 Waikato (Hadfield & Smith, 1999)



Site 61.357 Waikato (Hadfield & Smith, 1999)



Site 70.69 Waikato (Hadfield & Smith, 1999)

Temporal variation of pesticides

- Variability affected by many factors:
  - recharge patterns - timing wrt pesticide application
  - amounts & timing of pesticide application
  - crop rotations
  - different pesticide characteristics
- Example of atrazine monitoring in Iowa
  - increased for 4 years
  - fluctuated for next 10 years
- Assessment of long-term trends is difficult

Point Sources - Landfills or dumps

- **Landfills or dumps**
  - unused pesticides can be dumped in formulation strength
  - containers can be punctured or corrode
  - pesticides may not have to travel through soil
- **Landfill near Blenheim**
  - mecoprop on 2 occasions @ 2.4 & 3.2 μg/L
  - would not normally expect this pesticide in groundwater
- **South Canterbury point source - 1998 survey**
  - mecoprop, MCPA, MCPB @ 420, 61 and 2.1 μg/L

Point Sources - Mapua site

- **Fruitgrowers Chemical Site, Mapua,Nelson**
  - **Chemicals manufactured between 1955 - 88**
  - **Organochlorines still persist in soil at medium - high levels**
  - **DDT, DDE, DDD, aldrin, lindane**
  - **detected in the groundwater at variable levels**
- **Options considered include thermal desorption, bioremediation and sealing in a permanent landfill**
- **Orphan site - TDC working with government**

Point sources - Sheep dip sites

- Arsenic used from mid 1800's to 1950's, then lindane
- Dieldrin (organochlorine) used 1950's - 1966
- Hadfield & Smith have looked at sheep dips in Waikato
  - estimated 10,000 old dip sites in Waikato region
- Investigated one site in detail
  - groundwater plume extending 40 m from site - levels up to 2.2 μg/L - MAV = 0.03 μg/L
  - significant levels still in soil - problem for many years

Interpretation of results

- Check against Drinking Water Standards
- Look up likely leaching properties of pesticide detected
  - good site = http://waffle.nal.usda.gov/agdb/arsppdb.html
- Check for local uses of the pesticide
  - talk to farmer & neighbours
  - look up Novachem manual or similar
- Talk to an “expert”
- Resample well to confirm result

Interpretation of results

- Be aware of temporal variability issues
- Talk to landowner
  - sometimes they will change pesticide use to avoid repeat contamination
- Link results in with other studies
- Be aware of political issues