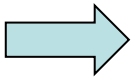
Pied Piper Wanted!
Better Lures for Pest Mammals



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Centre for Biodiversity & Restoration Ecology,
Schools of Biological Sciences, and Chemical & Physical Sciences

Pests abound

POP QUIZ: What are the following?

Rattus rattus

Mustela erminea

Trichosurus vulpecula

What do they all have in common?

- **Only 10% of kiwi-chicks survive to 6 months because of predation by pests**

A bit of background
NZ levels of species endemism

- All reptiles
- All bats
- All native amphibians
- 90% of freshwater fish
- 80% of all vascular plants
- 70% of all native terrestrial birds
- 70% of all native freshwater birds

A bit of background - drivers

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Species loss in NZ

- Over the past 750 years, vertebrate fauna diversity ~halved
- >50 bird species extinct
- Currently >2500 species endangered
- >3000 believed to be endangered but not sufficient data to profile

Where are we now?

- NZ situation
  - Introduced pests
  - Disease vectors
- Current control
  - Poison drops
  - Trapping
- Issues with control
  - Bait shyness
  - Reinvasion of “mainland islands”

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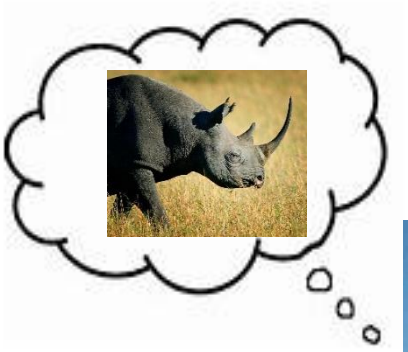
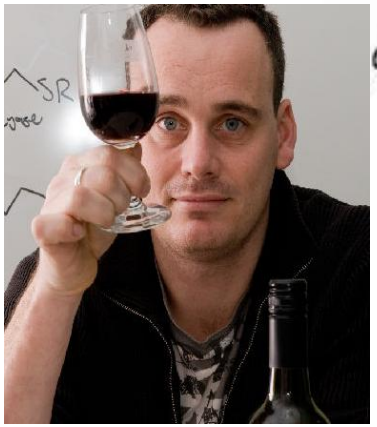
It started with a call…



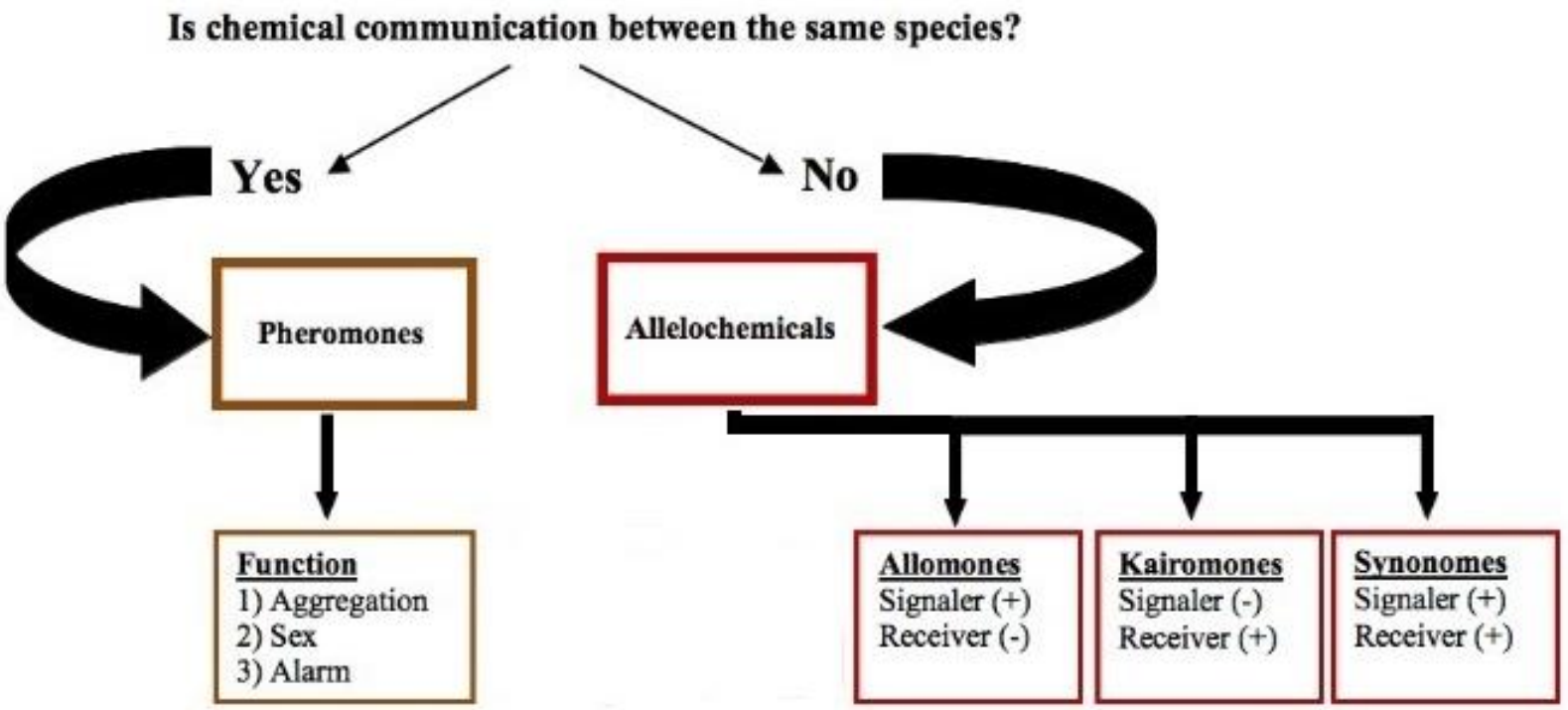


A better option?

- Traps with enhanced properties
  - Lifetime
  - Specificity

- How do we improve trap performance?
  - Improve pest attractiveness with better baits

Semiochemicals – “signalling chemicals



Pheromones

Pheromones mediate intraspecies signalling, e.g. sexual attraction, group hierarchy etc

(From wikipedia): “A pheromone (from Greek ***phero*** “to bear” and ***hormone***, from Greek “impetus”)

Allelochemicals

Produced by one species that modify the behaviour of another species

Allomone
benefits emitter

Synomone
benefits emitter and receiver

Kairomone
benefits receiver

A better option?

- For invertebrates (insects), pheromone lures dominate
    - e.g. methyl eugenol – fruit fly attractant




- Such semiochemical lures could provide advantages such as:
    - ease of handling, species/sex specificity, controlled release, long life etc.

A better option?

- For mammals, such chemical based lures are far less common.
- In fact, food based lures are the current industry standards:
  - Peanut butter (rats)
  - Cinnamon paste (possums)
  - Rabbit meat (stoats)
- Can we do better?
  - We should be able to!

Lure chemistry

- Lure (bait) requirements:
  - Lifetime & stability (related to an individual chemical entity)
  - Specificity
  - Ability to transport (volatility)

- What lures are we targeting?
  - Lures that encourage attraction AND interaction (traps may require action)
  - Pheromones (Sexual signalling molecules should be VERY attractive)
  - Food (Based upon anecdotal evidence from trappers etc. Should promote interaction)

How do we do this?

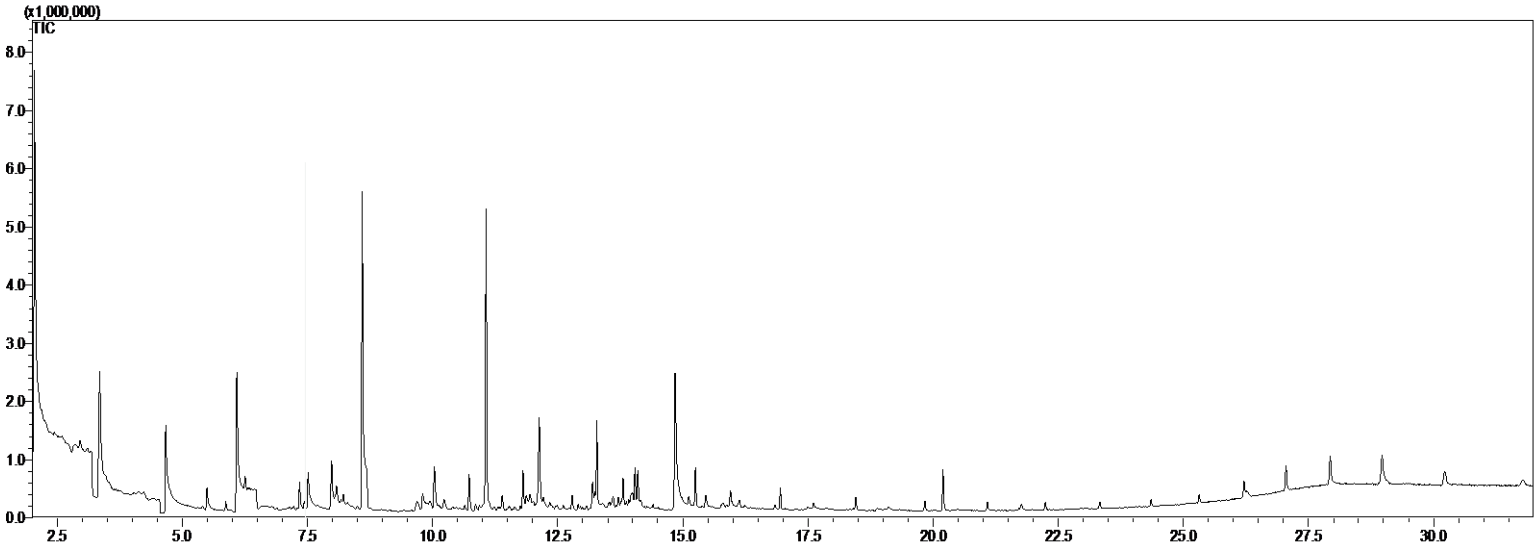
- Test a variety of matrices (food, excreta etc)
- Check to see if pests are attracted to them
- Select those matrices that the pests are both attracted to (brought in from distance) but also interact with (ability to add poisons etc at a later date)
- Then, analyse chemical composition of the matrix

Volatile analysis

State of the art technique for volatile analysis is Gas Chromatography (GC)

Shimadzu QP-2010 Plus GCMS

Volatile analysis



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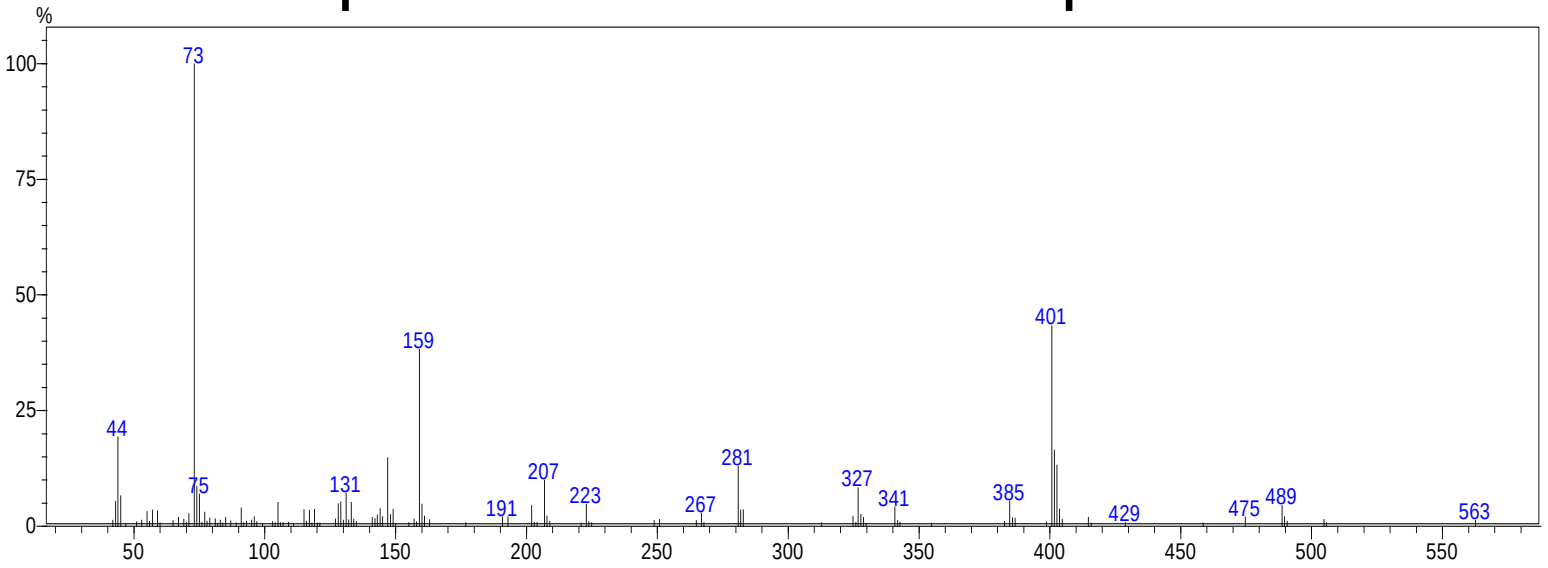
Mass spectra

MS gives unique finger-print fragmentation patterns for each compound



Matches to commercially available libraries of compounds

NIST 2011 library (220,460 patterns of 192,108 unique molecules)

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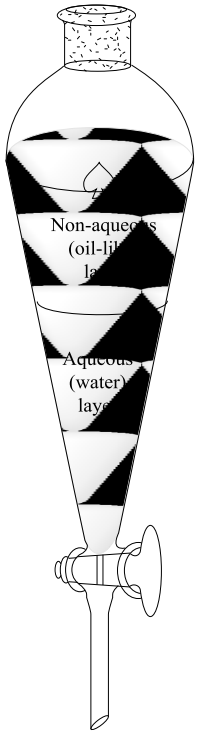
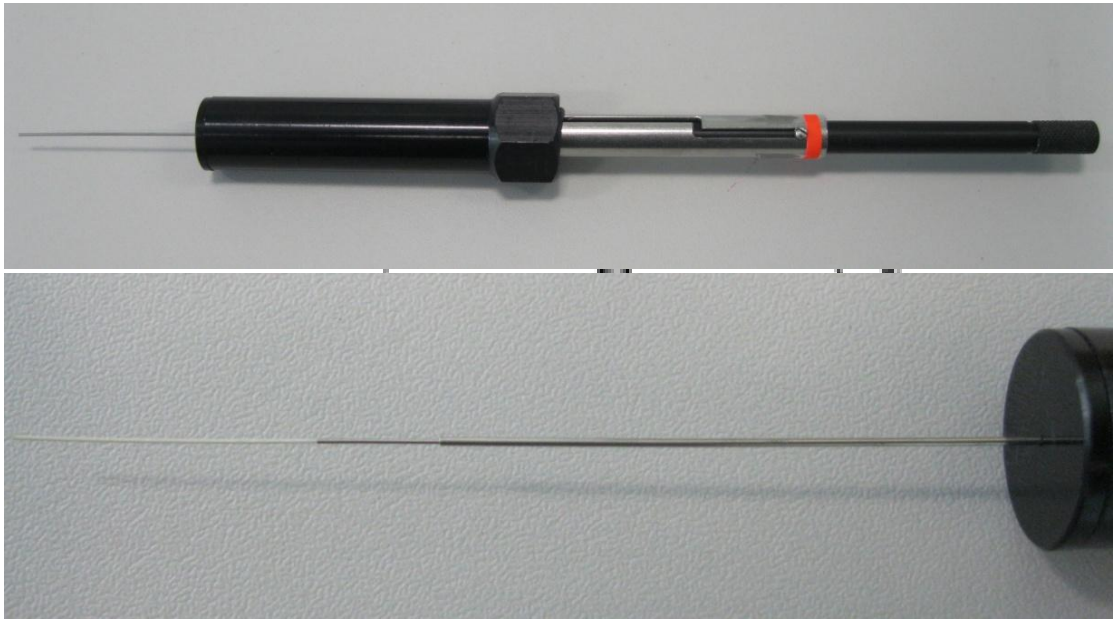
Sample introduction

- Two main methods for sampling & introduction
    1. Solvent extraction & injection
    2. Solid Phase Micro-Extraction





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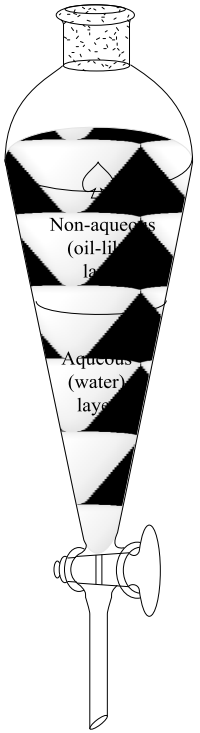
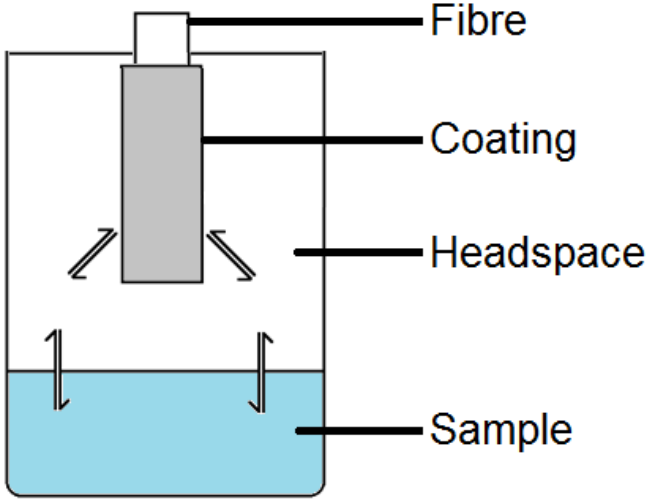
Sample introduction

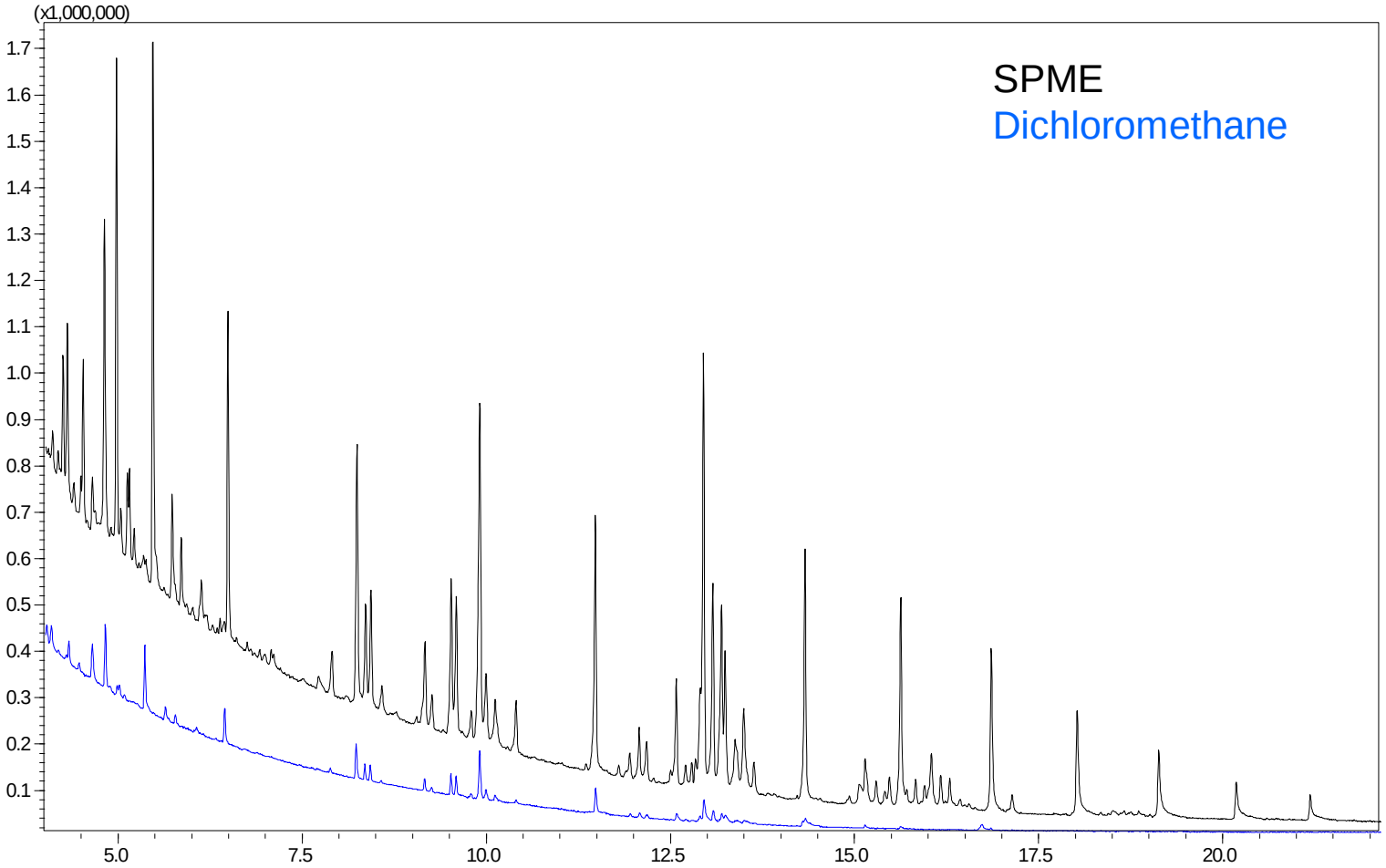


- Pro's and con's with each
  - Solvent extraction
    - Wide analyte selection (all relevant?)
    - Physiological relevance
  - SPME
    - Physiological relevance
    - Matrix sensitivity



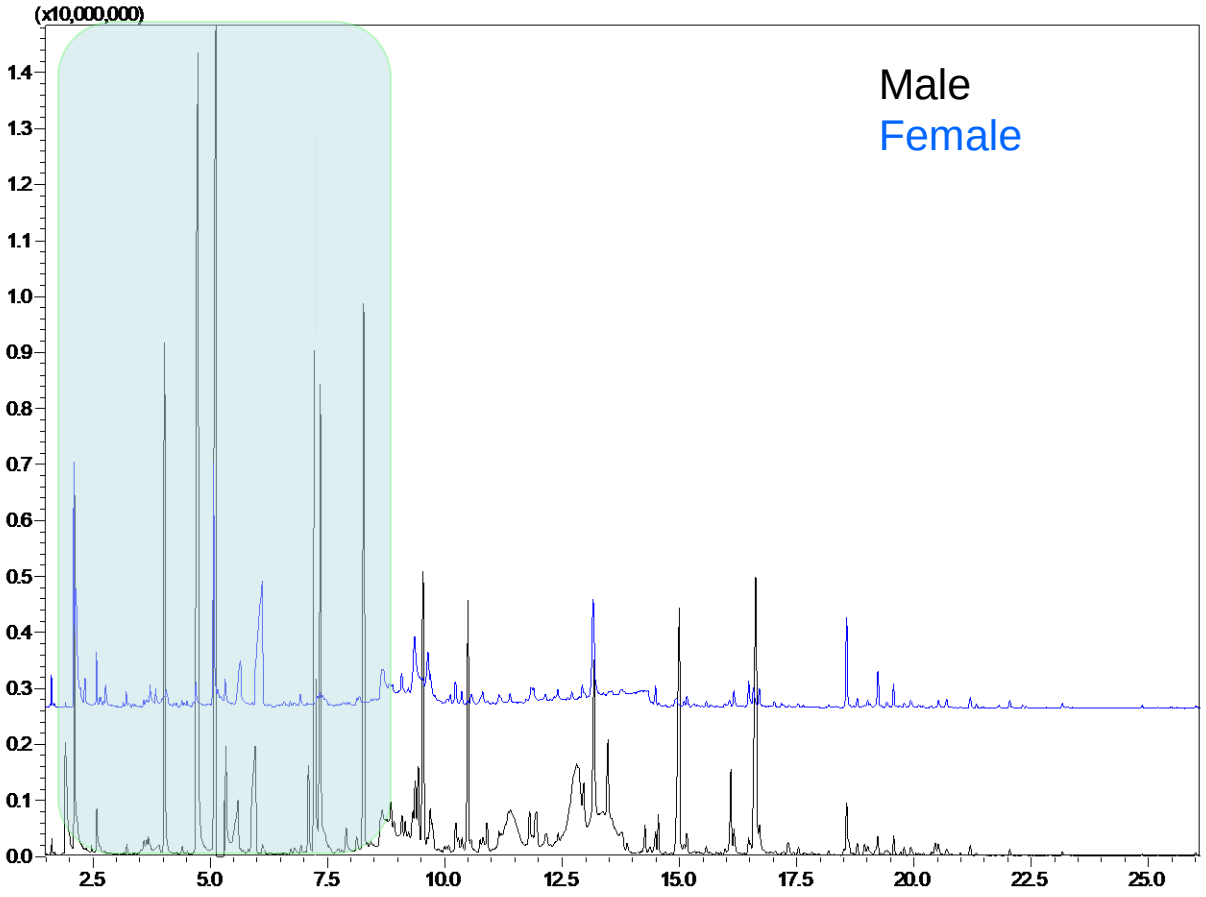
Headspace extraction

SPME vs. solvent extraction

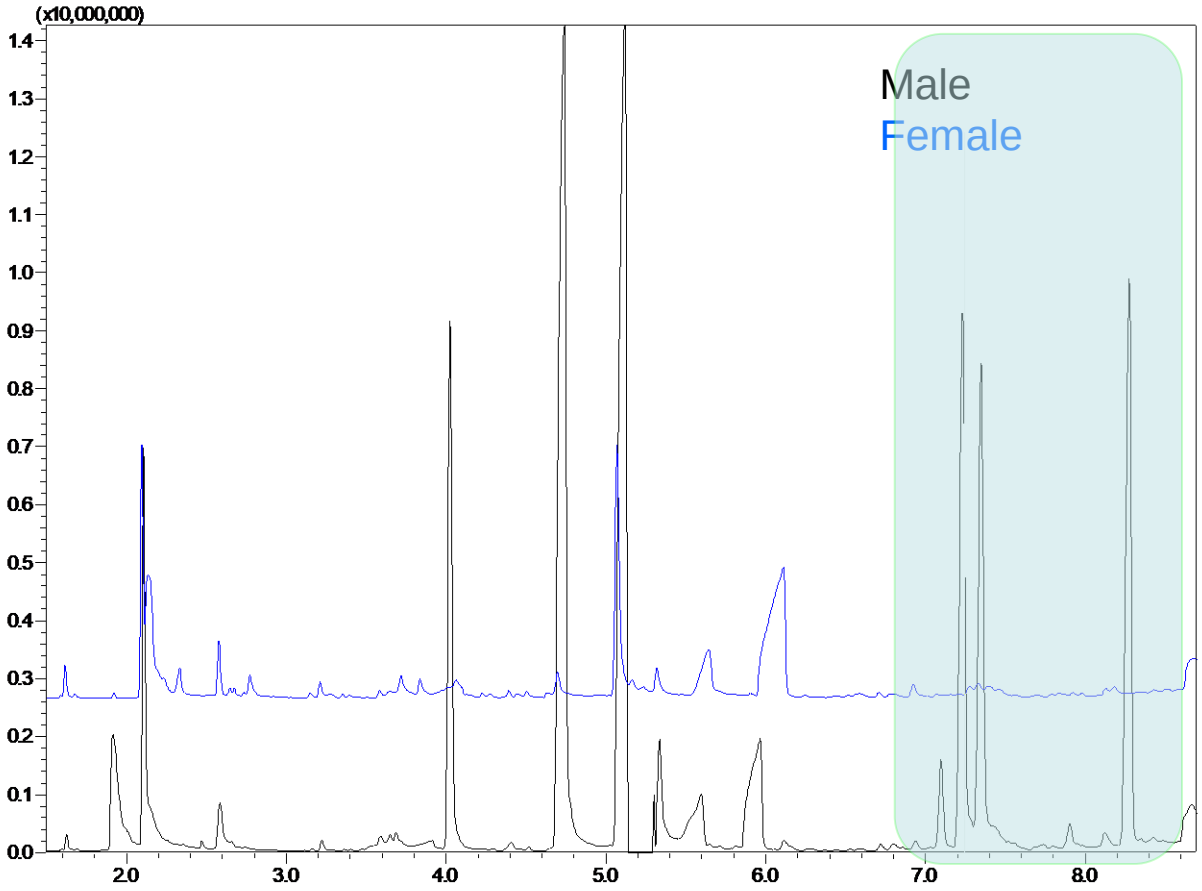


Comparison of GCMS traces of Sauvignon blanc wine using SPME vs solvent extraction

Urine analysis: Male vs. Female



Urine analysis: Male vs. Female



- Questions:
  1. What are the compounds?
  2. Which are important? (limits of detection)

Food-based lures

Food lures - aims

Quantify attractiveness of foods and characterise their volatile profiles

Associate compounds to attraction

Assess single compounds on wild rats

Create blends

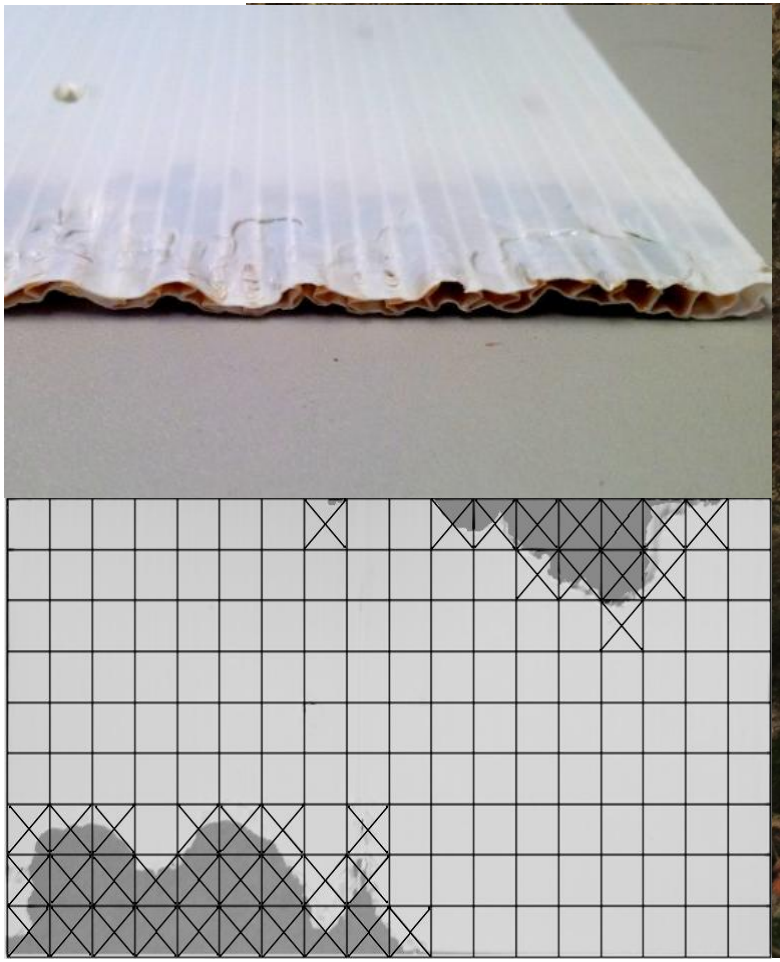
Make a product

Attractiveness of foods

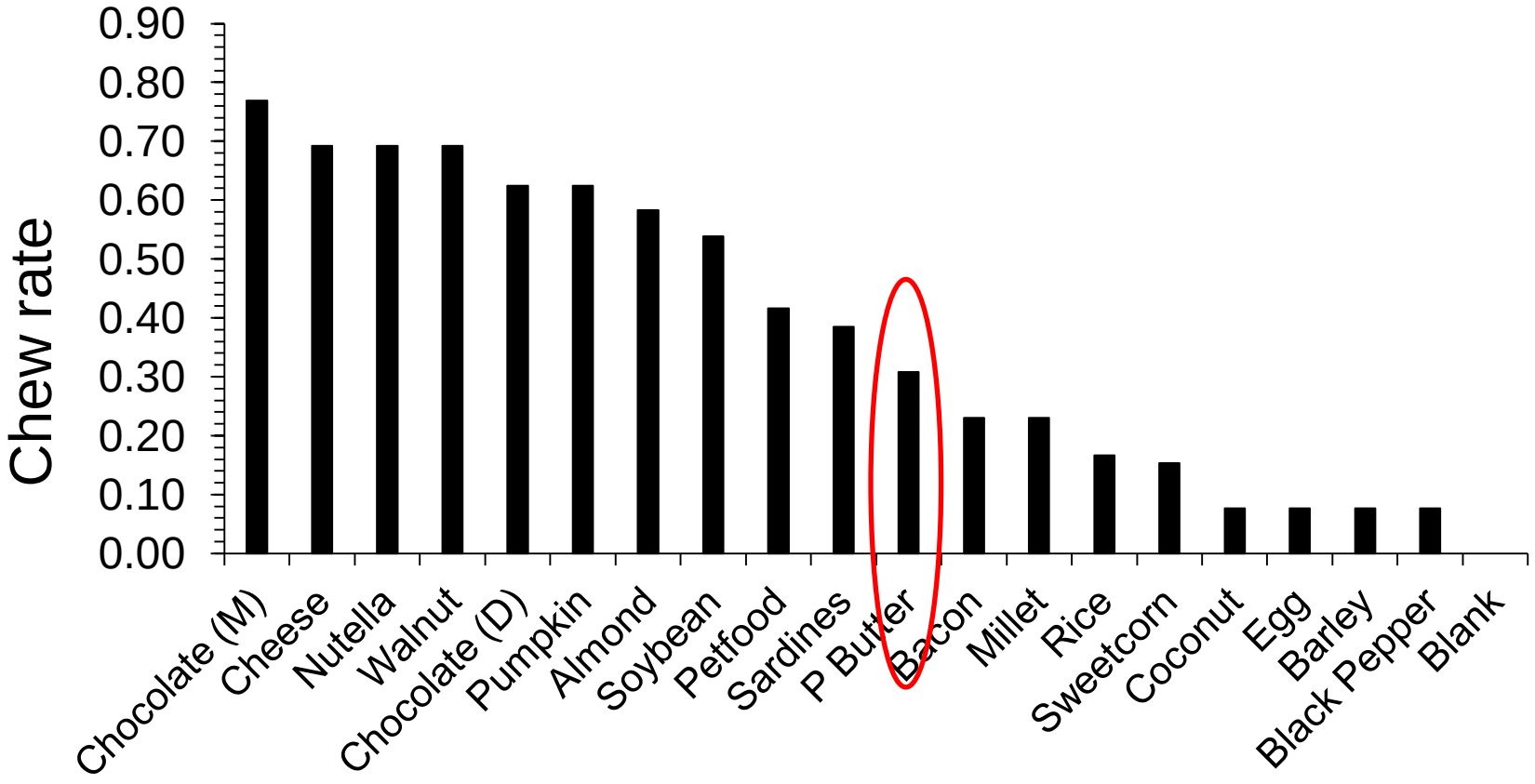
Tested 24 foods for attractiveness to rats

Almond
Bacon
Barley
Black pepper
Blank coreflute card
Cheese (mature cheddar)
Chocolate (milk)
Chocolate (dark)
Coconut
Coffee
Egg
Ginger
Millet
Nutella
Pasta
Peanut butter (standard)
Pet food (dried)
Rice
Sardines
Soap
Soybean
Sweetcorn
Walnut
Yeast

Attractiveness of foods



Attractiveness of foods



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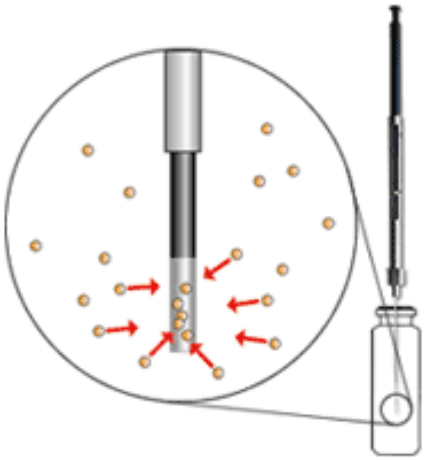
Identify compounds

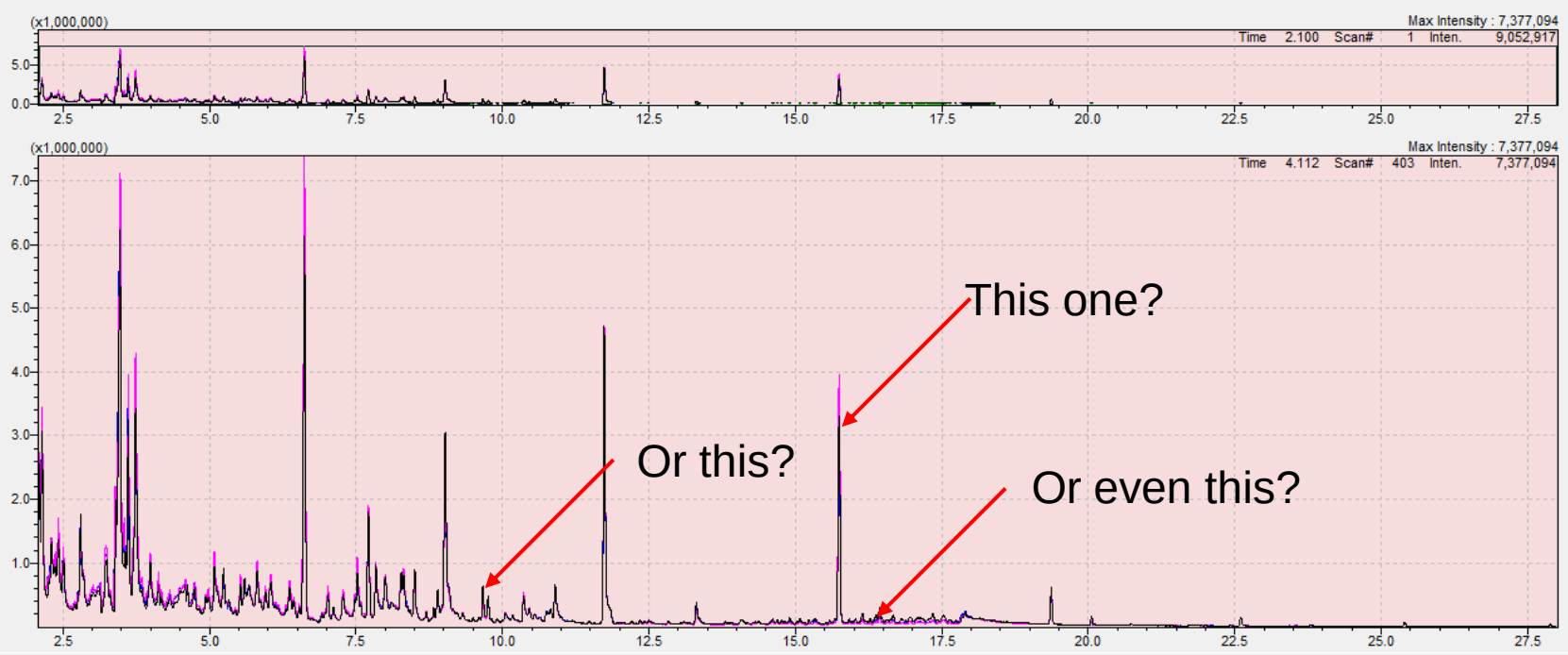


Identify compounds

- Identified 375 compounds across all foods
  - Data is “noisy”, with numerous zeros

Food product	4 Carene	Alpha Phellandrene	Alpha Pinene	Beta Bisabolene	Beta Pinene	Gamma Terpinene
Almond	0	0	331675	0	5383582	140175
Bacon	0	0	940113	0	1246114	0
Barley	0	0	9099014	0	13650113	0
Black Pepper	45340644	99182931	44930481	42810051	52740068	26760437
Control (corflute)	0	0	0	0	0	0
Cheese	0	0	0	0	1241482	0
Coconut	427491	0	882484	0	1088700	428623.00
Dark Chocolate	0	0	22622229	0	7144486	0
Egg	0	0	0	0	0	0
Milk Chocolate	0	0	6059744	0	5330207	0
Millet	0	0	185906	0	0	0
Nutella	0	0	18312773	0	0	745831
Peanut butter	450778	2247948	1773311	0	0	623041
Petfood	0	0	793796	0	0	0
Pumpkin seed	0	0	0	0	0	0
Rice	0	0	386899	0	411034	0
Sardines	0	0	0	0	0	0
Soybean	0	0	428005	0	0	0
Sweetcorn	0	0	0	0	0	0
Walnut	0	0	3763579	0	0	0

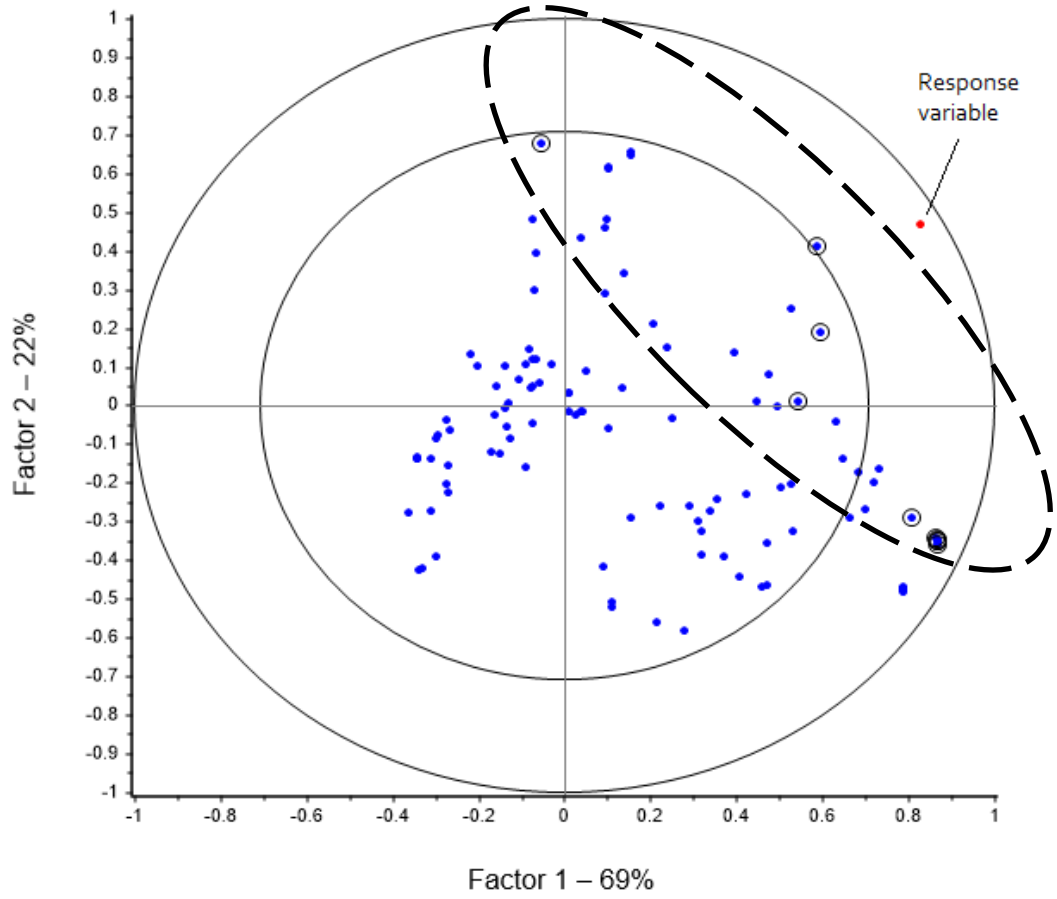
Identify compounds



Link rat response to the chemical profile of the foods

Associate compounds to attraction

10 statistically significant



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Trial single compounds

AIMS

- Trial compounds for attractiveness on wild animals
  - Identify optimal concentration

Trial single compounds

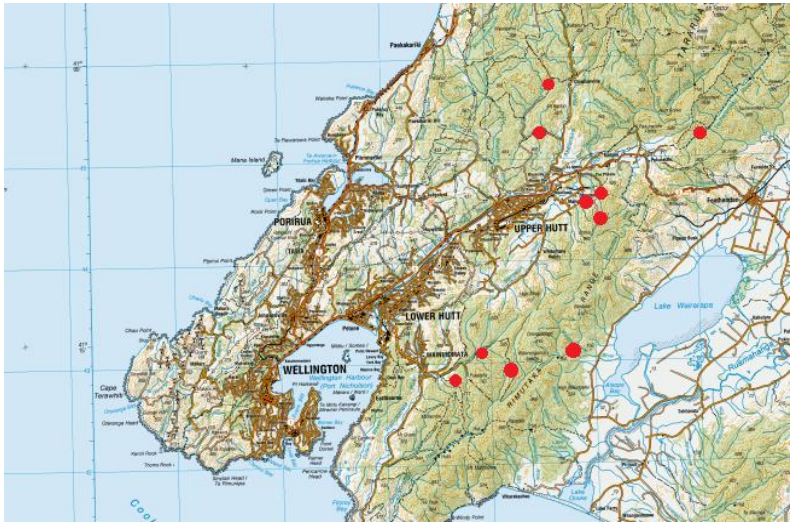
- Trialled seven different concentrations

  0.01 – 10,000 ppm - in microtubes tubes in tracking tunnels.

- Left in the field for one night at ten sites

- Peanut butter used as a control

Trial single compounds



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Trial single compounds


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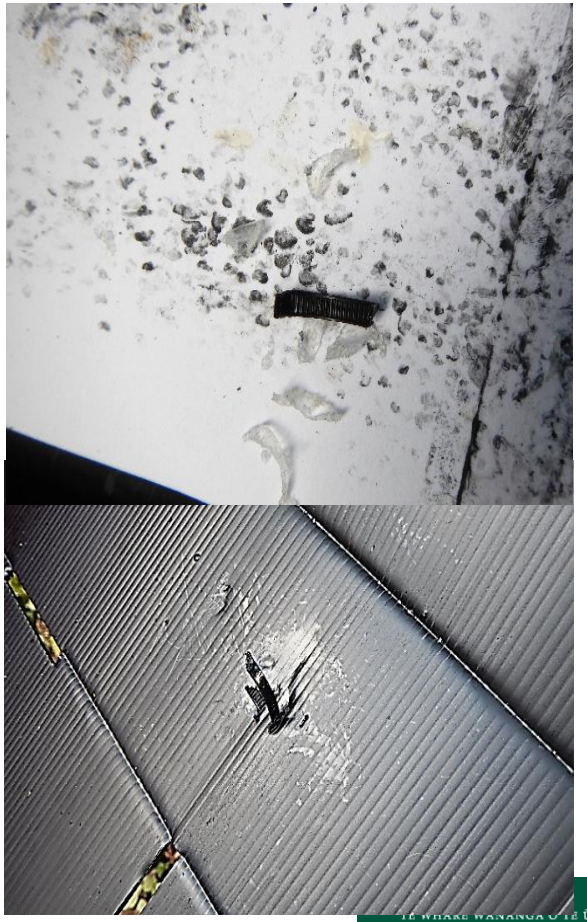
Trial single compounds

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Trial blends

Trial blends

Pilot study

Prototype products

Summary

Currently available traps are heavily dependent upon trappers to visit and reset/replenish.

Better lures have the potential to reduce this cost, and improve trap efficacy.

Next step – get a commercial partner to license the technology and make it available

Acknowledgments

SBS

- Christine Stockum
- Stephen Hartley
- Bill Jordan
- Doug Eckery

$$$

- DOC
- MBIE
- ZIP
- KiwiNet
- VUW
- External commercial partners

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QUESTIONS?!?