CENTRE FOR BIODIVERSITY & RESTORATION ECOLOGY

Te Tumu Whakaoho Mauri o te Ao Koiora

# In search of super-lures: mammalian communication and pest control

Monday 8th April, 9am to 5pm

Cliftons – Level 28, The Majestic Centre - 100 Willis St, Wellington

# Schedule

| Time | Item |
|---|---|
| 9:00 | Welcome |
| 9:20 | **PLENARY -** Jane Hurst |
| 9:40 | |
| 10:00 | |
| 10:20 | Morning tea |
| 10:40 | 1-Phil Bell |
| 11:00 | 2-Clare Veltman |
| 11:20 | 3-Dave Greenwood |
| 11:40 | 4-Grace Panske & Christine Stockum |
| 12:00 | 5-Max Suckling |
| 12:20 | Lunch |
| 12:40 | Lunch |
| 1:00 | **PLENARY** - Peter Banks |
| 1:20 | |
| 1:40 | |
| 2:00 | 6-Rob Keyzers |
| 2:20 | 7-Janine Duckworth |
| 2:40 | 8-Elaine Murphy |
| 3:00 | 9-Jamie MacKay |
| 3:20 | Afternoon tea |
| 3:40 | Workshop |
| 4:00 | Workshop |
| 4:20 | Workshop |
| 4:40 | Closing |

## PLENARY 1

### Making sense of mammalian scents: implications for the use of scents in pest control

Jane L Hurst and Robert J Beynon,
Institute of Integrative Biology, University of Liverpool UK;
jane.hurst@liv.ac.uk; r.beynon@liv.ac.uk.

While pheromones and other chemosignals have been applied very effectively in invertebrate pest control, among mammals, scent communication is generally much more complex. Mammalian scents typically comprise several hundred components with patterns differing between individuals of the same species. Reception involves a combination of olfactory sub-systems, and responses typically are modulated through learning. In addition to volatile odorants, scents can contain a high concentration of specialized signalling proteins, such as the major urinary proteins (MUPs) excreted by mice and rats, which are detected on nasal contact through the vomeronasal system. MUPs also selectively bind small hydrophobic volatiles, providing a slow release of airborne volatile signals from scent marks. Patterns of highly polymorphic MUPs and their bound volatiles are individual-specific, providing a genetically encoded signal of individual identity and kinship that allows modulation of responses towards different individuals. Sexual attraction in house mice is coordinated by the male sex pheromone darcin, an atypical MUP that induces instinctive female attraction to spend time near male scent. Importantly, mammalian pheromones like darcin can also induce rapid associative learning such that the same attraction is subsequently shown towards the pheromone's remembered location and towards other odour cues associated with the pheromone; the effect of this learning is to provide strong reinforcement of attraction to specific individuals. We have established a collaborative programme (Scents in Mouse and Rat Control, ScentMaRC) to explore how scent cues can be exploited to improve the control of rodent pests.

## PLENARY 2

### Complex interactions in the ecology of olfactory communication

Peter B. Banks, Nelika K. Hughes, Catherine J. Price, Alex J.R. Carthey, Andrew Daly, and Jenna P. Bytheway
School of Biological Sciences, University of Sydney Australia
http://sydney.edu.au/science/biology/becr/people

Olfaction is a primary means of communication amongst mammals that is used to maintain social bonds and signal to conspecifics about an individual's reproductive status, territoriality and even identity. However, these long-lasting olfactory cues are an open form of signal that are vulnerable to interception by a range of unintended "eavesdroppers", including predators, competitors and potential prey. In this talk I provide an overview of how such eavesdropping creates a complex web of potential interactions at scent marks to shape the nature of responses by the intended receivers of scent marks. From our studies on small rodents, I will demonstrate that the traditional view of olfactory communication, as a dyadic interaction with just one signaller and one receiver, is unlikely to hold in natural, multi species systems. I will explore how signallers and receivers manage the costs of social communication that arise when other species eavesdrop and what this means for our understanding of animal decision making. Finally I will contextualize these results for the aim of exploiting olfactory communication in wildlife management and discuss profitable opportunities for novel approaches in the use of odour to manage alien species impacts.

## CONTRIBUTED PAPERS

### The Future of Predator Control Programme: DOC's approach and where lures fits into it.

Phil Bell, Al Bramley, and Graeme Taylor
Science and Technical Group, Department of Conservation, PO Box 10-420, Wellington

Following on from the Pest Summit, DOC has made a commitment to investigate the technical innovations required to advance predator control at large scale sites (>10,000ha). Our approach, known as the Future of Predator Control programme, will target 3-5 large scale sites around the country for predator control and/or elimination, and focus innovation to solve the technical constraints present at those places. One such area of innovation already identified is in the development of new and improved lures. We require lures, for the full suite of target predators, which can work to pull animals in from large distances (multiple kms) and draw them into our killing devices (the final few cms).

**Let’s be clear about the behaviour change we want to cause**

Clare Veltman
Science & Technical Group, Department of Conservation, c/o Landcare Research, Private Bag 11-052, Palmerston North (cveltman@doc.govt.nz)

Fishermen use lures to fool trout, who get hooked when they mistake a small man-made object for a real prey animal. As visual animals ourselves, we are comfortable that an approximation of the true target offers enough information for Gestalt perception. Insects are our friends because, like trout, they can’t help themselves and orient determinedly towards synthetic pheromones. The “truthiness” of fishing and pheromones might let us down in exploring chemical tools for increasing the efficiency of invasive mammal control. My past experience of researching attractants for goats, mate-finding by ladybirds and habitat selection by Drosophila is notable mainly for dead ends, which I now realise arose from not clearly specifying how the putative “lure” was supposed to alter animal behaviour. It might save time and grief if we design “lures” (I will introduce a new terminology) *after* we have clarified what we want them to do.

**Reducing human-elephant conflict – can we use chemosignalling compounds as mammalian deterrents?**

Dave Greenwood
School of Biological Sciences, The University of Auckland

It is estimated that humans and Asian elephants have on average one altercation per day, stemming mainly from a response to the lack of food due to the increasingly diminished natural habitat of these roaming wild animals. Elephants under the cover of darkness will undertake crop raiding missions, in so doing tearing through physical and electrical barriers to gain access to harvested rice and grain crops. This can result in injury to one or both parties as villagers are naturally keen to protect their communally gathered food sources. We have been working on olfactory ways to assist in reducing this marauding activity in Asian elephants. We have extended our previous studies on identifying conspecific compounds eliciting key behavioural responses to working with other chemosignalling compounds. Once again and perhaps surprisingly, such compounds can instigate behavioural manipulation of these large mammals and potentially deter them from entering designated areas.

**The development of chemical lures to improve management of invading rat and possum populations**

Grace Paske[1], Christine Stockum[1], D Eckery[3], R Keyzers[2], KP McNatty[3], S Hartley[1], TW Jordan[3], GS Le Gros[4], W Linklater[1]
[1] Centre for Biodiversity and Ecological Restoration, School of Biological Sciences, Victoria University of Wellington, NZ
[2] Centre for Biodiscovery, School of Chemical and Physical Sciences, Victoria University of Wellington, NZ
[3] Cell and Molecular Biology, School of Biological Sciences, Victoria University of Wellington, NZ
[4] Malaghan Institute of Medical Research, Wellington, NZ

Introduced species have contributed to the extinction of many native species in New Zealand. Current strategies exist to control pest species but eradication remains a challenge. Chemical attractants (lures) might be used to improve pest detection and kill rates at low and invading densities. A major urinary protein (MUP) has been shown in male mice to act as a sexual attractant. MUPs modulate the release of volatile attractants and have potential to act as attractants themselves. Our aim is to determine if similar MUPs and volatiles are present in the olfactory signals of rats (*Rattus norvegicus, R. rattus*) and Australian brushtail possum (*Trichosurus vulpecula*). Preliminary results of *R. norvegicus* MUP identification and recombinant expression will be presented. The same strategy, including testing proteins on animals, will be used for *R. rattus* and possum.

**Coupling Chromatography to Electrophysiology and Behavioural Assays in Insects: Can Sniffer Bees Help Us to Find Mammal Pheromones ?**

DM Suckling, KC Park, F. Mas and AM El-Sayed
NZ Institute for Plant and Food Research, Lincoln

Insect pheromone identifications were revolutionized in the 1970s using couple GC-electroantennogram techniques whereby peaks on the flame ionization detector can be cross referenced to the ability of an excised insect antenna to detect the compounds. This type bioassay is widely used for the detection of volatiles perceived by the antennal olfactory apparatus of insects in the field (Suckling et al. 1994) or laboratory (El-Sayed et al. 2009) but animal ethical requirements prevent its direct application to mammalian pheromone identification. Today, there are more than 1,500 moth pheromones alone, and more than 3,500 semiochemicals are listed on the worlds' largest database of behaviour modifying chemicals, which was developed locally (El-Sayed 2013). We are currently training restrained honey bees to a range of odours using their proboscis extension reflex (PER) after as few as four training bouts, for example to the odours of human or bovine tuberculosis (Suckling and Sagar 2011).The coupled gas chromatograph or GC-PERs method of Le Metayer et al. (1997) offers a further opportunity to harvest the eavesdropping potential of honeybees. The capacity of bees to detect and learn even anthropogenic compounds from explosives illustrates their wide-ranging olfactory abilities. Clever use of sniffer bees as intermediaries could help to expedite chemical identification of mammalian semiochemicals.

References: El-Sayed 2013. http://www.pherobase.com; El-Sayed et al. 2009. Pest Manag. Sci. 65: 975-981; Le Metayer et al. 1997. Chem. Sens. 22: 391-398; Suckling & Sagar 2011. Tuberculosis 91: 327-328; Suckling et al. 1994. J. Econ. Entomol. 87: 1477-1487.

**Volatile analysis of mouse and rat urine: Identification of sex specific pheromones**

Grace Paske,[1] Wayne Linklater,[1] Doug Eckery,[1] Christine Stockum[1] & Rob Keyzers[2]
[1] Centre for Biodiversity and Ecological Restoration, School of Biological Sciences, Victoria University of Wellington, NZ
[2] Centre for Biodiscovery, School of Chemical and Physical Sciences, Victoria University of Wellington, NZ

Introduced pest mammal species such as rats, cats, stoats etc have had an irrevocable effect on NZ's unique fauna, leading to the extinction of many native bird and mammal species. Trapping of pest species is one approach to try and curtail such extinction events, however effective trapping and pest monitoring at low population densities is particularly difficult. One route to improve the effectiveness of trapping and monitoring programmes is to use species specific lures to attract the pest of interest. The use of a specific sexual pheromone molecule as a lure is therefore an attractive option. We are using Gas-Chromatography Mass-Spectrometry (GC-MS), the state of the art technique for qualitative and quantitative aroma analysis, to examine the volatile constituents of rat and mouse urine to identify potential pheromone compounds to target as prospective lures. An overview of GC-MS, sampling techniques and possible pitfalls in their use will be presented using our results as examples.

**Lures to monitor and control vertebrate pests at low densities: sex pheromone attractants**

Janine Duckworth, Sam Brown, Jane Arrow, Bruce Warburton
Wildlife Ecology and Management, Landcare Research, New Zealand
duckworthj@landcareresearch.co.nz

Solitary species, such as possums and stoats, are highly effective at finding suitable mates at low population densities presumably using sex pheromone cues. However, no one has isolated or identified sex attractant components secreted by possums and stoats, nor looked at their ability to act as lures. In captive male and female possums, we compared the attractiveness of secretions collected from female possums during oestrus (period of sexual attractiveness) with samples from male possums, non-breeding females and control preparations. The most promising of the lures was then assessed in the field using possums collared with active RFID (radio frequency identification) tags to measure their encounters and interactions with traps. RFID scanners and PIR (passive infrared) movement sensors monitored encounters, and motion-activated cameras recorded possum behaviour at trap sites. Volatile components of secretions from possums of varying reproductive states are being identified so that synthetic versions of sex attractants can be incorporated into lures to improve the efficacy of future monitoring and control operations.

## Development of long-life lures for stoats and rats

Elaine Murphy[1, 2], Tim Sjoberg[1, 2], Shona Sam[1], Des Smith[1], Jenn Bothwell[1], Brent Barrett[1], Nick Tucker[3], Hussam Razzaq[3] & Janine Duckworth[4].
[1]Department of Ecology, Lincoln University, [2]Department of Conservation, Christchurch, [3]Plant & Food, Christchurch, [4]Landcare Research, Christchurch
emurphy@doc.govt.nz

Stoats and rats continue to have a major impact on biodiversity, and improved control techniques are required to avoid further extinctions. Re-setting traps and toxin delivery devices will become an increasingly important part of pest control in New Zealand. Resetting devices that work for long periods without being serviced, also require long life lures - we are investigating pheromone, prey and sound lures. Urine and scats from both male and oestrous female stoats have been collected, as well as urine and droppings from ship rats. These potential lures are being trialled in outdoor enclosures with captive stoats and rats at Lincoln University. Rabbit components eg. muscle, pelt and fat are also being trialled for attractiveness. The volatile components of the most attractive lures will then be analysed using headspace sampling and gas chromatographic analysis. The sustained control of stoats and rats requires a range of different control techniques and the development of long-life lures is integral to their effectiveness.

**Lures and lure delivery systems for possum control**

Jamie MacKay[1], Duncan MacMorran[2], Helen Blackie[2, 3]
[1]University of Auckland
[2] Connovation Ltd.
[3] Lincoln University

As part of the development process for a new long-life control tool for possums we have been investigating the effectiveness of different lure formulations and delivery methods. Initial field trials of an aerosol delivery system were so successful that the product is now commercially available from Connovation Ltd. To better quantify interaction rates between possums and lure devices we have developed a new proximity logger system specifically for this project. Trials of olfactory, visual and audio lures are currently underway using this system and preliminary results will be discussed.

# List of Attendees and Contributors:

| Name | Affilation |
|---|---|
| Prof Jane Hurst<br>(via video conference) | Mammalian Behaviour & Evolution Group<br>Institute of Integrative Biology, University of Liverpool: jane.hurst@liv.ac.uk |
| Assoc Prof Peter Banks | School of Biological Sciences \|Behavioural Ecology and Conservation Research Group<br>The University of Sydney<br>peter.banks@sydney.edu.au |
| Dr Elaine Murphy | Principal scientist, Science & Technical<br>Department of Conservation—*Te Papa Atawhai*<br>Programme Manager Pest Control for the 21st Century<br>Department of Ecology, Lincoln University: emurphy@doc.govt.nz |
| Dr Graeme Taylor | Principal Science Advisor<br>Science and Technical Group<br>Department of Conservation: gtaylor@doc.govt.nz |
| Dr Janine Duckworth | Researcher<br>Wildlife Ecology and Management Team<br>Landcare Research New Zealand Ltd: duckworthj@landcareresearch.co.nz |
| Dr Max Suckling | Science Group Leader<br>The New Zealand Institute for Plant & Food Research Limited: max.suckling@plantandfood.co.nz |
| Stuart Cockburn | Stuart Cockburn<br>Electronics Engineer<br>Department of Conservation: scockburn@doc.govt.nz |
| Dr Bill Jordan | Director<br>Centre for Biodiscovery<br>Victoria University of Wellington: bill.jordan@vuw.ac.nz |
| Robbie van Dam | Director at Goodnature: robbie@goodnature.co.nz |

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|---|---|
| Dr Clare Veltman | Science & Technical Group, Department of Conservation: cveltman@doc.govt.nz |
| Dr Jamie MacKay | Postdoctoral Fellow<br>Centre for Biodiversity and Biosecurity, School of Biological Sciences<br>University of Auckland: j.mackay@auckland.ac.nz |
| Dr Phil Bell | Programme Manager (Predator Free New Zealand)<br>Science and Technical Group<br>Department of Conservation—*Te Papa Atawhai:* pbell@doc.govt.nz |
| Dr Erik Van Eyndhoven | Principal Adviser Conservation<br>Preparedness and Partnerships \| Compliance and Response<br>Ministry for Primary Industries: Erik.VanEyndhoven@mpi.govt.nz |
| Dr Ben Bell | School of Biological Sciences, Victoria University of Wellington:<br>ben.bell@vuw.ac.nz |
| Dr Christine Stockum | Postdoctoral Fellow<br>Centre for Biodiversity and Restoration Ecology, Victoria University of Wellington:<br>christine.stockum@vuw.ac.nz |
| Grace Paske | Masters student<br>School of Biological Sciences, Victoria University of Wellington: gracepaske@gmail.com |
| Harry Thomas | Masters student<br>School of Biological Sciences, Victoria University of Wellington: harry.thomas@vuw.ac.nz |
| Alison Smeaton | Masters student<br>School of Biological Sciences, Victoria University of Wellington: smeatonali@gmail.com |
| Andrew Digby | PhD candidate<br>School of Biological Sciences, Victoria University of Wellington: andrew.digby@vuw.ac.nz |
| Chris Cosslett | DOC volunteer<br>cosslett.hunter@paradise.net.nz |

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|---|---|
| Dr Wayne Linklater | Director<br>Centre for Biodiversity and Restoration Ecology,<br>Victoria University of Wellington<br>wayne.linklater@vuw.ac.nz |
| Dr Stephen Hartley | Deputy Director<br>Centre for Biodiversity and Restoration Ecology,<br>Victoria University of Wellington<br>stephen.harley@vuw.ac.nz |
| Dr Robert Keyzers | Senior Lecturer in Organic Chemistry<br>School of Chemical and Physical Sciences<br>Victoria University of Wellington<br>robert.keyzers@vuw.ac.nz |
| Dr Dave Greenwood | Dave Greenwood<br>Senior Scientist<br>The New Zealand Institute for Plant & Food Research Limited<br>dave.greenwood@plantandfood.co.nz |
| Dr Geoff Hicks | Chief Scientist<br>Department of Conservation<br>ghicks@doc.govt.nz |
| Dr Al Bramley | Department of Conservation<br>abramley@doc.govt.nz |