Effective Poster Design

Matt Walters
Science Communication and Digital Imaging
School of Biological Sciences, UC

Sustainability of Canterbury Cockle Beds

Adkins, S.C. & Marsden, I.D.
School of Biological Sciences, University of Canterbury
Christchurch, N.Z.

Introduction

The little neck clam *Austrovenus stutchburyi*, a food source for both humans and other species, is in decline throughout New Zealand. Apart from the Avon-Heathcote estuary, little is currently known about cockle populations in the Canterbury area.

This study is part of a PhD project investigating environmental and anthropogenic effects on shellfish beds with the goal of establishing protocols which will allow the sustainable management of these beds.

The poster presents initial population structures (Figures 2 & 3), site characteristics (Table 1) and density information (Table 2) of cockle beds for 8 sites, January through to August 2006. Density statistics for one of these populations which has had a harvesting ban in place for over 10 years is also presented (Table 3).

Conclusions

All these data show the populations to be highly variable both in density (Table 2) and size structure (Figure 2, Figure 3 A-D), suggesting irregular recruitment success. The common factor supporting the hypothesis of populations in decline are the low numbers of small (or juvenile) cockles.

Over harvesting has been broached as a possible reason for population declines, but the bed that has been closed to harvesting for several years shows low but stable population densities (Table 3).


Saltwater Creek Estuary - Sites A and B


Avon-Heathcote Estuary - Bromley


Avon-Heathcote Estuary - Tern St


Akaroa Harbour - Barry's Bay


Port Levy


Akaroa Harbour - Takamatua


Port Levy - Fernlea


Port Levy - Pa

Figure 2. Port Levy Class Sizes.

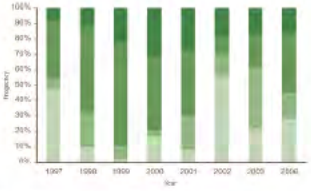

Figure 3. Cockle population age structure over three seasons.

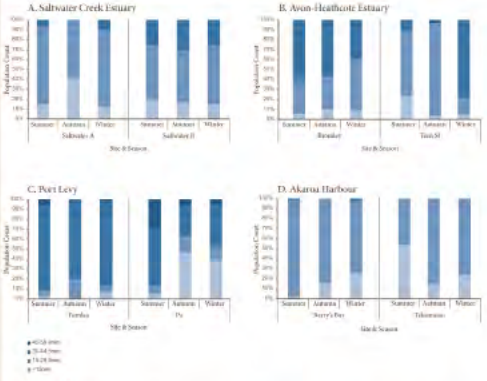

Table 1. Site characteristics

Site	Sediment	Salinity (g/100g)	Intertidal length (m)	Impacts & Land Use
Saltwater Creek (2 sites)	Sand/silt	2.5	60-70	Cropping, cattle & pig farm
Avon-Heathcote Estuary- Bromley	Sand/silt	3.0	500-550	Water discharge from sewage treatment plant; City
Avon-Heathcote Estuary- Tern St	Sand	3.2	600-650	City
Port Levy -Fernlea	Sand/silt over larva flow base	0.2	40-50	Grazing
Port Levy -Pa	Mostly sand	3.4	50	Village, grazing
Akaroa Harbour -Barry's Bay	95% silt/clay*	3.5	300	Stream discharge, plus water input from cheese factory; Grazing
Akaroa Harbour -Takamatua	25% silt clay*	0.3	300-350	Storm water discharge;Village, grazing

* Bolton-Ritchie (2005)

Table 2. Mean cockle density (cockles/0.1m²) for three seasons (2006)

	Saltwater A	Saltwater B	Bromley	Tern St	Fernlea	Pa	Barry's Bay	Takamatua
Summer	14	11	5	12	4	5	20	25
Autumn	17	18	9	20	5	10	20	50
Winter	20	25	8	30	4	6	8	31

Table 3. Mean cockle density (cockles/0.1m²) at Pa site, Port Levy, 1997-2003, and 2006

1997	1998	1999	2000	2001	2002	2003	2006
5	6	5	5	3	9	5	5

After Voller, 2006

Acknowledgements
This project is supported by: Brian Mason Scientific & Technical Trust; ECAN; NZFGW (Harriet Jenkins Award); Port Levy Coastal Marine Soc.

References
Bolton-Ritchie, L. (2005) Sediments and macrobiota of the intertidal flats of Inner Akaroa Harbour. ECAN report U05/64
Voller, R. (2006) Report on Koukourarata cockle bed surveys at Port Levy 1997-2006

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Kaka Beak: Conservation by Cultivation

Jason Song[1,2] Paula E Jameson[1] Garry K Burge[3] John Clemens[1,2]
1. School of Biological Sciences, University of Canterbury, Christchurch. 2. Institute of Molecular BioSciences, Massey University, Palmerston North. 3. New Zealand Institute for Crop & Food Research, Palmerston North

Ngutukaka (*Clianthus*, the Kaka beak) is one of New Zealand's few brilliantly coloured flowering plants. The genera, *Clianthus*, only occurs in New Zealand. The last remaining plant of *C. puniceus* died in 1996 (Site 12, Fig 1). With fewer than 100 plants remaining in the wild, *C. maximus* is now critically endangered and becoming rarer as small populations simply disappear through slips or browsing by deer and possums [Note: *Clianthus* is a legume and its pods and leaves are highly nutritious]. The eleven remaining populations are spread over the East Coast of the North Island (Fig 1).

Cultivation, both privately and commercially, is desperately needed to save the kaka beak. A few seeds were rescued from the last *C. puniceus* plant and these are being grown under supervision. Fortunately, *C. maximus* is a popular ornamental garden plant already, and seven cultivars are widely grown. **BUT:**

(1) Do the cultivated varieties represent the wild populations?

(2) What is the genetic relationship among wild populations and how can this information be used in species conservation?

(3) Is there enough genetic diversity among the remaining populations for kaka beak to survive in the wild?

Figure 1. Distribution of *Clianthus* populations.
Note the different northern site of *C. puniceus*.

Figure 2. DNA finger printing: A sample ISSR gel showing DNA banding patterns of seven kaka beak cultivars (a-g).
Note that the different cultivars show genetic differences.

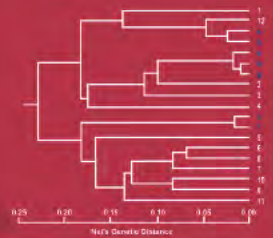

Figure 3. Genetic relationship tree built using DNA markers.
Note that all the wild populations (1-12) and cultivars (a-g) are genetically different. No wild populations are in cultivation!

- DNA marker (AFLP, ISSR and RAPD) analyses revealed that all of the 12 wild populations and seven commercial cultivars are genetically different from each other (Fig 2).
- There is moderate genetic diversity among populations. All wild populations are important contributors to the total genetic diversity, and should be used for species conservation. A genetic relationship tree was built (Fig 3), and this was recently provided to DOC to assist their conservation recovery planning.
- Commercial cultivars originated from only a few sources (Fig 3). New cultivar development from selected wild populations can put more genetic diversity under cultivation and would be beneficial for species conservation.
- Surprisingly, our results do not support the current two species classification. The *C. puniceus* seeds are possibly from a population of *C. maximus* (Fig 1, Fig 3), and *C. puniceus* may have gone extinct many years ago.
- The future of kaka beak looks bleak unless individuals of the wild populations are brought into cultivation to act as founder plants for population re-establishment and/or cultivar development.
- Conservation by cultivation should be successful for kaka beak because it is an attractive ornamental plant.

Warning: CONTAINS INSECT Nudity!

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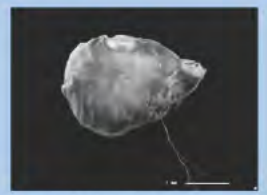
RESTRICTED 18 Restricted to persons 18 Years and Over. Contains close-up images of insects' textures that may offend some people.

Sooty beech scale insects (*Ultracoelostoma* sp.) are vitally important for beech forest ecology, but we know very little about them. These images are the first detailed pictures of the insects' feeding and excreting structures.

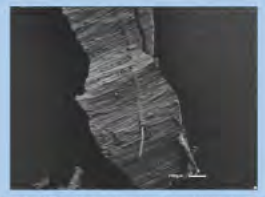
Neil Andrews and Roger Dungan
School of Biological Sciences, University of Canterbury



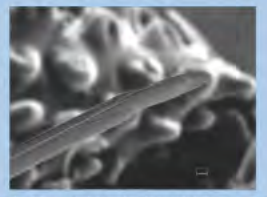
Naked mature female scale insects lack many distinguishing features, and are essentially lipid-filled sacs

They insert their mouthparts into tree phloem, and feed on the sugar-rich sap. Mouthparts consist of four interlinked stylets

The mouthparts are several millimetres long, and penetrate through the bark into the phloem. The insects can closely control the path the mouthparts take. Here, the stylets are stained red.



The stylets follow the nutritious tissue around the circumference of the tree

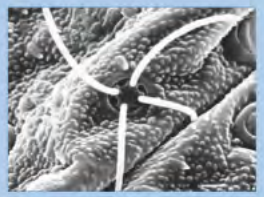


The tips of the stylets has notches that may help in penetrating through the wood

The mouthparts are controlled by muscles attached to a tentorium, which houses a cybarial pump

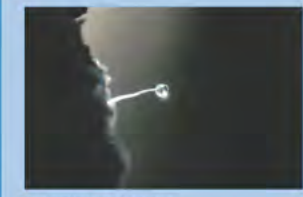
Mouthparts remain embedded in the tree as insects moult, requiring a fresh set to be inserted

Once digested, waste is excreted as honeydew through a long wax anal tube. This tangled pair of tubes, each from a separate insect, is covered in fine wax filigrees, extruded from pores close to the anus



The wax pores extrude wax used to protect the insects from desiccation, and to construct the nodule-like tests that the insects live in

Once they have found a suitable place to settle, female insects stay in the same place for the rest of their lives.
(Photo Matt Walters)



The glistening drops of honeydew ...
(Photo Matt Walters)

... cover the bark of tree trunks and branches.
(Photo Matt Walters)

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Physiological Effects and Biotransformation of **PSP Toxins** in the Greenshell Mussel *Perna canaliculus*

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Andrea M. Contreras[1], **Islay D. Marsden[1]** and Murray H.G. Munro
islay.marsden@canterbury.ac.nz
[1]School of Biological Sciences University of Canterbury Private Bag 4800 Christchurch New Zealand
Department of Chemistry University of Canterbury Private Bag 4800 Christchurch New Zealand

The greenshell mussel *Perna canaliculus* is known to accumulate toxins in its tissues when exposed to PSP causing dinoflagellates. It is the most abundant bivalve in subtidal aquaculture in New Zealand. It is abundant intertidally and is of cultural significance to Maori. Because shellfish closures are based on the levels of toxins in the tissues of this species it is important to investigate the rates of toxification and detoxification and also examine the PSP toxin profile in the mussel tissues compared with the toxic dinoflagellate.

Mussels were provided with the toxic dinoflagellate *Alexandrium tamarense* as a feeding culture with *Tetraselmis* sp. using a non toxic species *Alexandrium margalefi* and *Tetraselmis* sp. as the control.

Mussels were fed a diet containing toxic dinoflagellates for 10 days and then exposed to a detoxification period of 8 days when they were provided with *Tetraselmis* sp. only. Clearance and excretion rates were measured and the tissues analysed by HPLC using post column oxidation and fluorescence detection.

Clearance rate was variable during the exposure, however, at each time interval there was no difference in the clearance rates of mussels that were ingesting toxic dinflagellates compared with the non-toxic control. Excretion rates were also similar for the two groups throughout the experiment.

P. canaliculus readily fed on both *Alexandrium* sp. and in the toxic group the levels of STX in the tissues increased to above 00 µg STX equiv. between day 3 and 6 days of exposure. When the toxic algae were removed from the diet the STX value declined rapidly within 8 days to low levels.

There were considerable differences in the toxic profile of the dinoflagellate *A. tamarense* and the mussels. *Perna canaliculus* had lower proportions of N-sulfocarbamoyl toxins and higher proportions of carbamoyl toxins than the toxic dinoflagellates that had been ingested. Differences were found between the toxin profile of different mussel tissues. The bioconversion of the PSP toxins by epimerization of the ß to α-epimers C-11 took place more actively in the digestive gland than in the other tissues.

Acclimation Period (n 8)
etra alexandri sp (50 x 10 c ls/ind/day) non toxic
A. margalefi (0 15 x 10 c ls/ind/day) non toxic

Intoxication Period
PSP diet (n 5)
etra alexandri sp (50 x 10 c ls/ind/day)
A. tamarense (0 15 x 10 c ls/ind/ day)
Control diet (n 3)
etra alexandri sp (50 x 10 c ls/ind/day)
A. margalefi (0 15 x 10 c ls/ind/day)

Detoxification Period (n 8)
etra alexandri sp (50 x 10 c ls/ind/day) non toxic
A. margalefi (0 15 x 10 c ls/ind/day) non toxic

Clearance rate (CR) d fin d as th volum of wat r cl ar d p r unit tim

Excretion rate (ER) d fin d as th total proportion of absorb d n rgy liminat d as m tabolic r sidu s (ammonia) by xcr tion organs

Mussels had an acclimation period of days to non toxic dinoflagellate cells

Fig 1. Experimental design including acclimation intoxication and detoxification periods

Greenshell mussels *Perna canaliculus*

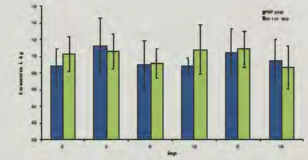

Fig 2. Clearance rates of *P canaliculus* feeding on toxic *A. tamarense* or non toxic *A. margalefi* with *Tetraselmis* sp

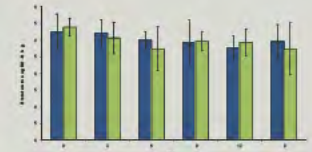

Fig 3. Excretion rates of *P. canaliculus* feeding on toxic *A. tamarense* or non toxic *A. margalefi* with *Tetraselmis* sp

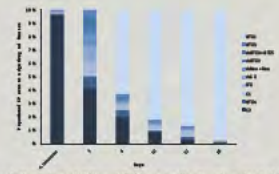

Fig 4. Proportion of different PSP toxins in the digestive gland of *P canaliculus*

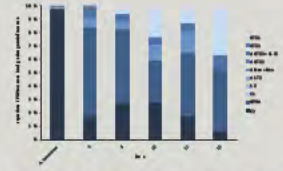

Fig 5. Proportion of PSP different toxins in remaining body tissues of *P canaliculus*

PSP Toxins
Carbamoyl toxins: Saxitoxin (S X) N oxysaxitoxin (N o) Gonyautoxin 2 (G X2)
Gonyautoxin (G X) Gonyautoxin 3 (G X 3) Gonyautoxin 4 (G X4)
N sulfocarbamoyl toxins: Carbamoyl 1 (C1) Carbamoyl (C) Carbamoyl 3 (C3)
Carbamoyl 4 (C4) Gonyautoxin 5 (G X 5) Gonyautoxin 6 (G X6)
Decarbamoyl toxins: D carbamoyl G X1 (dcG X1) D carbamoyl G X (dcG X)
D carbamoyl G X3 (dcG X3) D carbamoyl G X4 (dcG X4) D carbamoyl S X (dcS X)
D carbamoyl N o (dcN o)

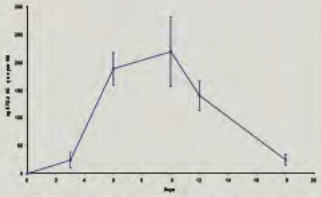

Fig 6. Whole S X body toxin burden of *P canaliculus* feeding on toxic *A. tamarense*

On exposure to PSP toxic causing dinoflagellates the greenshell mussel rapidly accumulates toxins within the tissues. This species is therefore an excellent indicator species for PSP toxins especially at the start of a bloom event. Because the toxins can be eliminated relatively quickly from the tissues there is potential for rapid recovery.

Acknowledgements
hanks to staff at the Cawthron Institute Nelson for supplying the algal cultures and guidance in toxic alanysis echnical staff in the Department of Chemistry are thanked for their assistance in undertaking the HPLC analysis

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Forest in a Petri Dish

Rapid Answers to Wood Quality Questions

Hema Nair and Sandra Jackson
School of Biological Sciences, University of Canterbury, New Zealand.

In Vitro Wood Formation

We have developed a technique to grow wood outside the tree in the laboratory. This organ culture system enables us to manipulate growth conditions in a controlled manner to a degree that is not possible in an intact tree. In addition, the response of the tissue to the experimental conditions is rapid making it possible to conduct many experiments in a short time.

Organ Culture: A Tool to Improve Wood Quality

Radiata pine accounts for 90% of exotic timber in New Zealand. A small proportion of this wood develops a defect upon kiln drying called intra-ring internal checking. Checking influences the appearance of the wood making it unsuitable for products like furniture. Since this has a negative economic impact, it is desirable to eliminate this wood quality defect.

Manipulating Wood Properties *In Vitro*

Nutrition and plant growth regulators (hormones) can influence the size and shape of plant cells as well as the cell wall composition. We have established that these properties are different in checked wood. By manipulating the nutrients and hormones in culture conditions we are learning which conditions may result in the development of check-prone wood.

Economic Benefits from Rapid Results

Wood cultured in the laboratory allows us to perform many experiments in a short time, thus allowing for rapid advances in our understanding of the complex relationships between growth, genetics, nutrition and wood quality. This knowledge can be applied to silviculture and tree breeding practices, adding value to timber from radiata pine grown in New Zealand.

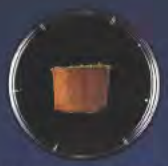

Figure 1: The meristematic cells just under the bark of the tree are cut out under sterile conditions. These cells are placed in a petri dish containing a growth medium with specific nutrients and plant growth regulators.

Figure 2: Organ cultures are grown in 16 hours of light and 8 hours of darkness at a constant temperature of 25 °C. After 12 weeks of growth they are harvested and analysed.

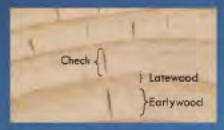

Figure 3: A check spans a single annual growth ring, extending through the earlywood and ending at or in the latewood.

Figure 4: Wood texture, colour, cell size, cell differentiation, growth rate and cell wall composition all changed when the micronutrient boron and the growth regulator auxin (NAA) were varied in the growth medium.

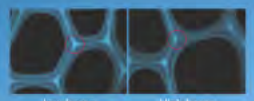

Figure 5: Cell wall composition changed in response to NAA and boron. In general NAA promoted lignin deposition except when boron levels were high. Lignin was visualised with ultra-violet light. The lighter shades of blue indicated higher concentration of lignin.

Acknowledgements
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Poster design by Matt Walters

Miniature Farmers on a Massive SCALE

Do scale insects regulate the productivity of beech forest?

- What regulates ecosystem productivity? In wet ecosystems like streams and oceans, productivity is often regulated from the top down, by large herbivores or predators. In terrestrial ecosystems, control is usually from the bottom up, and is regulated by photosynthesising plants. This is an important question for ecological researchers, because ecosystem productivity underpins the response of forests to global climate change.
- Beech trees in New Zealand are parasitized by scale insects that live in the bark of tree trunks and branches. Insects insert their mouth-parts into the wood, feed on the sugary sap, and excrete the sugar they don't need through waxy tubes. This forms droplets of honeydew, which is a vital food source for native birds and insects (Figure 1).
- This interaction offers the fascinating possibility that productivity of 1 million hectares of forest is controlled by insects' feeding; a rare and exciting example of widespread top-down control in a forest ecosystem.
- Day-to-day tree growth is regulated by the balance between carbon sources (*i.e.* photosynthesis) and sinks (parts of the plant with strong demand for energy). We hypothesise that scale insects alter source-sink balance of beech trees, stimulating extra photosynthesis which enables infested trees to compensate for the sugars lost via insect feeding.

Figure 1. (Clockwise from left). Trees covered with the hair-like wax tubes produced by scale insects are a distinctive part of lowland beech forest. The small apricot-coloured insects settle in cracks in the bark, and produce hard waxy covers for protection. Mature insects have no hard exoskeleton and few distinguishing features.

Photosynthesis: a balance of sources and sinks

- We quantified the size of the carbon source in trees with and without insects using a computer model that scales-up a biochemical model of photosynthesis to the whole canopy. Model parameters were derived from a year of field measurements (Figure 2).
- The size of the extra sink of scale insect feeding was estimated with a newly-developed computer model of honeydew production that accounts for seasonal as well as tree-to-tree variability in honeydew production.
- Trees with and without insects were partially shaded. This increases the demand for sugar production, stimulating extra photosynthesis in unshaded leaves. If our hypothesis is right, we should see less extra production in trees with insects, because the insects had already stimulated photosynthesis

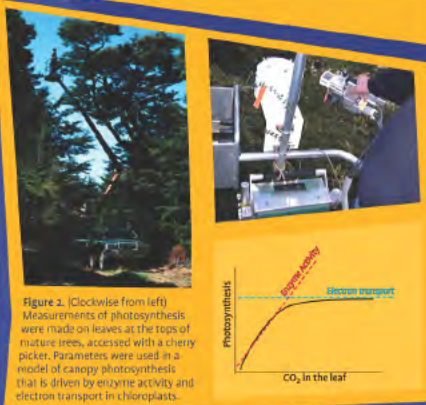

Figure 2. (Clockwise from left) Measurements of photosynthesis were made on leaves at the tops of mature trees, accessed with a cherry picker. Parameters were used in a model of canopy photosynthesis that is driven by enzyme activity and electron transport in chloroplasts.

Insects 'farming' trees for sugar

- The model estimated that trees with insects were losing 520 kg of carbon per hectare to honeydew.
- This carbon loss was balanced by extra photosynthesis. Trees with scale insects had 5% more annual photosynthesis than trees without insects, equivalent to 450 kg carbon per hectare.
- Our shading experiment showed that trees with insects had little extra capacity for photosynthesis, suggesting the insects were already stimulating photosynthesis (Figure 3).
- Our results suggest that scale insects are inducing extra photosynthesis in the trees they feed on. This is a unique example of widespread top-down regulation of forest ecosystem productivity and shows that scale insects are effectively farming sugar from 1 million hectares of beech forest!
- This research is making an important contribution to our understanding of the productivity of native forests. This is improving models of the national carbon budget, which are an important part of New Zealand's Kyoto Protocol response. It is also giving important new insights into a keystone interaction in beech forests that is vitally important for the conservation of threatened native birds and insects that depend on honeydew for food.

Figure 3. Trees with and without insects were partially shaded, and changes in the photosynthetic capacity of the unshaded leaves measured. Trees with insects showed less upregulation than trees without insects. This suggests their production was already increased by the scale insects.

Authors
Roger Dungan, Matthew Turnbull, Dave Kelly
School of Biological Sciences, University of Canterbury

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Understanding the legacy of aged *p,p´*-DDT and *p,p´*-DDE residues in New Zealand horticultural soils

Sally Gaw[1], Grant Northcott[2] and Lucia Ying[2]
1 University of Canterbury, Christchurch, New Zealand. sally.gaw@canterbury.ac.nz
2 Plant and Food Research, Hamilton, New Zealand

Introduction

- *p,p*-DDT was widely used in New Zealand from the 1840s to the 1970s to control horticultural pests.
- Elevated concentrations of *p,p*-DDT and *p,p*-DDE have been measured in NZ horticultural soils.[1]
- Previous studies have shown that a proportion of these residues remain available for uptake by edible plants and earthworms despite four decades of aging.[1,2]
- The size of the bioavailable fraction of the aged *p,p*-DDT and *p,p*-DDE residues had not previously been quantified.
- Tenax TA has been proposed as a surrogate measure of the bioavailability of hydrophobic organic contaminants (HOCs) in soil.[3]
- Persulphate oxidation has been proposed as a surrogate measure of the bioavailability of HOCs for microbial degradation.[4]

Aim: *To estimate the bioavailable fraction of aged p,p-DDT and p,p-DDE residues in orchard soils.*

Methods

Study soils

Five orchard soils with known *p,p*-DDT and *p,p*-DDE concentrations were selected (Table 1.)

Table 1 *p,p*-DDE, *p,p*-DDT and ΣDDT concentrations and selected soil characteristics for study soils.

Soil	p,p'-DDE (µg kg⁻¹)	p,p'-DDT (µg kg⁻¹)	ΣDDT* (µg kg⁻¹)	%clay	%silt	%sand	pH	CEC	% TOC
Orchard 1	6065	6137	14160	42	53	4	5.3	23	4.4
Orchard 2	478	255	940	35	53	12	5.5	18	2.7
Orchard 3	388	139	560	30	63	7	6	17	4.5
Orchard 4	4389	1907	6576	26	65	8	6	19	5.5
Orchard 5	11850	16720	32460	19	63	18	6	21	6.9

*sum of the *o,p* and *p,p* isomers of DDE, DDT and DDD

Total soil p,p-DDT and p,p-DDE concentrations

Total *p,p*-DDT and *p,p*-DDE were extracted using 2 3 acetone hexane, purified by adsorption chromatography and analysed by GC-ECD.

Persulphate oxidation

Duplicates of the field moist soils were heated (3 h at 80°C) with a solution of $K_2S_2O_8$ at a $S_2O_8^{2-}$ organic matter ratio of 12g/g and a final solution $S_2O_8^{2-}$ concentration of 0.04 g/mL.[4] The oxidised soils were extracted with 2 3 acetone hexane and analysed by GC-ECD.

Tenax TA Desorption Experiments

Short term

The field moist soils (1g) were extracted for 24 hours by shaking with 0.25 g tenax and 50 mL of 0.005M $CaCl_2$/0.01 M NaN_3. The tenax was recovered by vacuum and extracted with acetone hexane and hexane. The extracts were purified by adsorption chromatography and analysed by GC-ECD.

Long term

Triplicates of field moist soil were extracted with tenax as described for the short-term experiments. At each sampling time the tenax was replaced with fresh tenax and additional 0.005M $CaCl_2$/0.01 M NaN_3 added. The recovered tenax was extracted as described previously. There were 26 sampling periods in total over 162 days.

The results were modelled using a three compartment kinetic model that describes the rapid (r), slow (sl) and very slow (vs) desorbing fractions of HOCs.

$$F_{des} = 1-(F_r(e^{-k_r t})+F_{sl}(e^{-k_{sl} t})+F_{vs}(e^{-k_{vs} t}))$$

F values and rate constants were determined using nonlinear regression in the statistical package R.

Table 2 Percentage of *p,p*-DDE, *p,p*-DDT and ΣDDT desorbed by tenax.

Soil	24 hours		162 days	
	p,p'-DDE	p,p'-DDT	p,p'-DDE	p,p'-DDT
Orchard 1	16	16	43	49
Orchard 2	28	15	40	41
Orchard 3	15	7	28	26
Orchard 4	13	10	32	37
Orchard 5	9	8	37	43

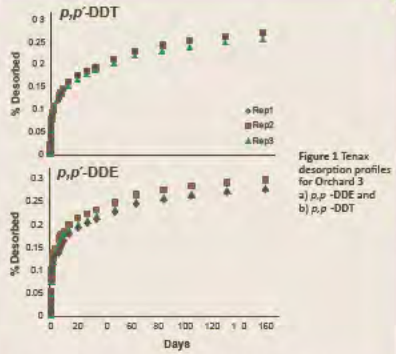


Figure 1 Tenax desorption profiles for Orchard 3 a) *p,p*-DDE and b) *p,p*-DDT

Table 3 Rapid desorbing fractions (Fr) of *p,p*-DDE and *p,p*-DDT and % *p,p*-DDT oxidised by persulphate.

Soil	F p,p'-DDE (%)	F p,p'-DDT (%)	% p,p'-DDT oxidised
Orchard 1	21	19	37
Orchard 2	18	15	13
Orchard 3	12	8	4
Orchard 4	13	13	16
Orchard 5	10	12	19

Results and discussion

- Up to 16% of *p,p*-DDT and 28% of *p,p*-DDE were released from the orchard soils in 24 hours in the short-term release experiment (Table 2).
- Up to 53% of *p,p*-DDT and 43% of *p,p*-DDE were released from the orchard soils over the 162 day experiment (Table 2 and Figure 1).
- The rapidly released fraction F_r represents the bioavailable fraction. Values for F_r ranged from 8 to 19% for *p,p*-DDT and 10 to 21% for *p,p*-DDE (Table 3).
- F_r for *p,p*-DDT was significantly correlated ($p<0.05$) with the fraction desorbed over 24 hours.
- Up to 37% of *p,p*-DDT was oxidised by persulphate.
- The magnitude of the persulphate oxidisable fractions were comparable to the bioavailable fractions (F_r) estimated from the tenax long-term release experiments.

Conclusions

- Aged residues of *p,p*-DDT and *p,p*-DDE remain bioavailable despite four decades of aging.
- Bioremediation potential of these soils is limited as F_r is less than 20% for *p,p*-DDT and *p,p*-DDE and less than 40% of *p,p*-DDT was oxidised.

References

1 Gaw SK, K m ND, No thcott GL, W k ns AL, Rob nson G. (2008) Uptake of ΣDDT, a sen c, cadm um, coppe , and lead by lettuce and ad sh g own n contam nated ho ticultu al so ls. *J Ag c Food Chem* 56 6584-6593
2 Gaw S, No thcott G, K m N, W k ns A, Jensen J (2012) Compa son of ea thwo m and chem cal assays of the b oava lab l ty of aged 1 1-d chlo o-2,2-b s(p-chlo ophenyl)ethylene, 1,1,1-t chlo o-2,2-b s(p-chlo ophenyl) ethane, and heavy metals n o cha d so ls. *Env on Tox col Chem* DOI 10.1002/etc.181
3 B and E, Pe nenbu g W, B. G, V nk J, L jzen J, Ten Hulsche D, Jonke C, Romkens P, Roex E. (2009) Towa ds mplementation of b oava lab l ty measu ements n the Dutch egulato y f amewo k. RIVM Repo t 711701084/2009. RIVM, B lthoven, The Nethe lands.
4 Cuype s C., G otenhu s T., Joz asse J. and Rulkens W. (2000) Rap d pe sulfate ox dation p ed cts PAH ava lab l ty n so ls and sed ments. *Env on Sc Technol.* 34 2057–2063.

Acknowledgements

D. Crittenden (University of Canterbury) for assistance with the kinetic modelling.
M. Walters for assistance with poster preparation.

Trace element concentrations in the Avon River and Avon-Heathcote Estuary following post-earthquake sewage discharges

Sally Gaw*[1], Lauren Raffensperger[1], Marlese Fairgray[1], Grant Northcott[2] and Louis Tremblay[3]
1 University of Canterbury Private Bag 4800 Christchurch NZ
2 Plant & Food Research Private Bag 3123 Hamilton NZ
3 Cawthron Institute 98 Halifax East St Nelson NZ

Introduction

The 6.3 magnitude earthquake in Christchurch on 22nd February 2011 and subsequent aftershocks had devastating effects on the city. Key infrastructure including wastewater pipes was badly damaged. The extent of land damage in the central city and surrounding suburbs is shown in Figure 1. Raw sewage was discharged into the Avon and Heathcote Rivers and the Avon-Heathcote Estuary from February until October 2011. These sewage discharges were the result of numerous broken waste water pipes and pumping of raw sewage into the rivers as a disposal mechanism (Figure 2). The effects of discharging large volumes of untreated sewage into the rivers and estuary on contaminant concentrations were unknown. This study is part of a wider study investigating micropollutant concentrations including sewage organic contaminants in the Avon River and Avon-Heathcote Estuary as a result of the raw sewage discharges.

The Avon River is approximately 26 km in length and flows through a highly urbanised catchment of 90 km² prior to discharging into the Avon-Heathcote Estuary. The Avon River and Avon-Heathcote Estuary both provide important wildlife habitats.[1] Total daily overflow volumes of sewage discharged into the Avon River ranged between 3,000 and 40,000 cubic metres.[2]

Study objective

To determine if the discharge of untreated sewage increased the levels of trace elements in water and sediments of the Avon River and the Avon- Heathcote Estuary.

Methods

Sampling commenced in September 2011 after the majority of the sewage overflows had ceased. Water samples were collected from the Avon River at Antigua Boatsheds, Kerrs Reach and Owles Terrace and sediment samples were collected from the river sites and an additional two sites in the Avon Heathcote Estuary, Humphrey's Drive and Penguin St (Figure 3). The Antigua Boatsheds site was chosen as a control site as it was located upstream of the known sewer overflows.

The water samples were collected from the shore using an acid washed HDPE container attached to a pole. Samples for analysis of acid-soluble trace elements were acidified to pH<2 with quartz distilled HNO_3. Samples for analysis of dissolved trace elements were filtered (<0.45 µm) and acidified to pH<2.

River surface sediments were collected in 250 mL polystyrene containers using a "Mighty Gripper". Estuary surface sediments were collected using stainless steel spoons. The sediments were dried at 70 °C and sieved to <2mm. Duplicates of each sample were digested using USEPA method 200.8. Water samples and sediment digests were analysed for Cu, Fe, Pb, Ni and Zn by ICP-MS.

Figure 1: Map of observed liquefaction in central Christchurch and surrounding suburbs. Map produced by the Canterbury Earthquake Recovery Authority and Tonkin and Taylor. Reproduced with permission.

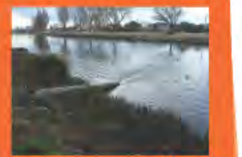


Figure 2: Pipe discharging raw sewage into the Avon River.

Figure 3: Map of sampling sites in the Avon River and Avon-Heathcote Estuary. A) Antigua Boatsheds, B) Kerrs Reach, C) Owles Terrace, D) Humphreys Drive and E) Penguin Street.

Results and discussion

Water

Trace element concentrations in the river water samples followed the general order Fe>Zn>Cu>Pb>Ni (Figure 4) and were consistent with Christchurch City Council monitoring data (2007-2010) for other sites on the river.

Fe and Pb were predominantly associated with particulates and Cu, Ni, and Zn were predominantly present in the dissolved phase (<0.45 µm).

Concentrations of Cu and Zn exceeded the ANZECC water quality trigger values for 95% level of protection[3] at all sites for some sampling dates.

There was no overall temporal trend for trace metal concentrations in river water over the sampling period.

Sediments

Trace metal concentrations in the river and estuary sediments followed the general order Zn>Pb>Cu>Ni (Figure 5).

Concentrations of Zn in sediments from the Kerrs Reach and Antigua Boatsheds sampling sites and concentrations of Pb in Kerrs Reach sediments exceeded the ANZECC ISQG-Low guidelines for sediment[3] on some sampling dates.

Trace metal concentrations were lowest in the Penguin St sediments.

The lack of recent pre-earthquake data for trace element concentrations in sediments the Avon River and Avon-Heathcoate Estuary makes data interpretation problematic. The measured sediment trace metal concentrations are likely to be lower than prior to the earthquake sequence occurring as it has been estimated that up to 40% of the estuary was covered by liquefaction and significant quantities of liquefaction silt entered the river systems. Liquefaction has been found to contain low concentrations of trace elements.[4]

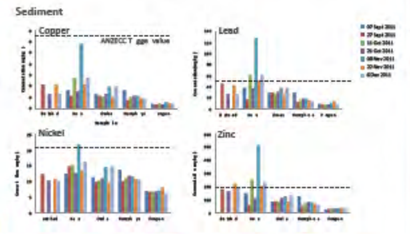


Figure 5. Trace element concentrations in sediments collected from the Avon River and Avon-Heathcote Estuary. Dashed line = ANZECC Trigger value for 95% Level of Protection.

Conclusions

Trace metal concentrations in the Avon River and sediment Avon River and Avon-Heathcote Estuary sediments can exceed the ANZECC water quality trigger values and the ANZECC ISQG-Low guidelines for sediment.

Sediment trace element concentrations may have been reduced as a result of liquefaction silt diluting historically contaminated sediment.

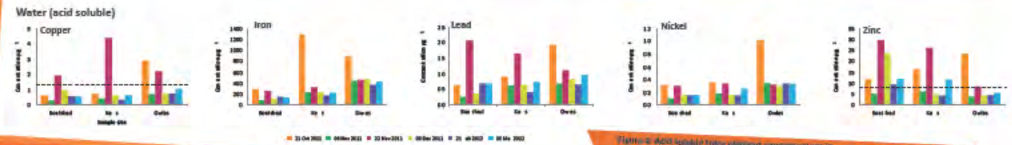


Figure 4: Acid soluble trace element concentrations in water samples collected from the Avon River. Line is ANZECC Trigger value for 95% Level of Protection.

References

[illegible]

Acknowledgements

We would like to thank ESR for assistance with sampling and Rob Stainthorpe (University of Canterbury) for the ICP-MS analyses.

Poster design by Matt Walters

Summary

- Key messages, not every message
- Less is more
- Just because you can doesn't mean you should
- Be consistent, bold and clear
- Use logical navigation to lead your audience
- Explain the 'why' of your research

Purpose

Why are you making a poster?

- **Who** are you presenting to?
  your audience

- **What** are you presenting to them?
  your key messages

- **Why** should they care?
  relevance to them

The number one problem

is too much text.

Text first

- **First write the text** before designing the layout.
- **Word count** should not exceed **800**. Posters are visual – show don't tell.
- The time taken to make a poster will expand to fill the time available to make a poster.
- **Front load sentences** with important content first. People scan the first 3–5 words of a paragraph looking for keywords.
- **Keep paragraphs short.** Text appears less dense and front loading is more effective.

Title

Short, relevant, quirky

- Your audience is mobile and easily distracted
- You need to attract attention and create interest
- Make it readable from 5 metres
- Choose the typeface carefully, avoid large blocks of UPPERCASE
- Use your first name and surname - makes you more approachable.

Framework

- Identify your **key messages** – short statements - Build your poster around these.
- **Sub-headings** help your audience navigate through your poster.
- Develop a **one sentence overview** of your project, this will also be useful when presenting your poster.
- Edit out excess. If its not adding its subtracting.
- Inverted pyramid - put the most important information at the start. Put your conclusion in your title.

Word count 800

- No abstract, unless forced to 50
- Introduction, short and interesting **200**
- Materials and Methods, tables and figs **200**
- Results, get to the point, figures, images **200**
- Conclusions, remind, discuss, relevance, future **200**
- References, maximum of 10
- Acknowledgements, support, advice, funding 40

Look at me

Posters are easy to ignore

- Many posters are presented at one time, why should someone stop at yours?
- You first need to attract their attention- bold, clean, professional, interesting, quirky.
- What will your audience respond to?

Software

Learn how to use page layout software.

- Powerpoint® is designed for on screen viewing of files, not print output. It may look good on screen and is easy to use, but there are often tears at print time. **General rule is to avoid Powerpoint®**.
- Software such as Adobe InDesign® and Coral Draw® are recommended for posters. They have better controls for layout and are not hard to learn.

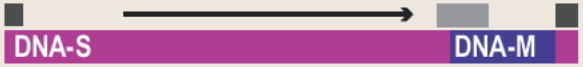
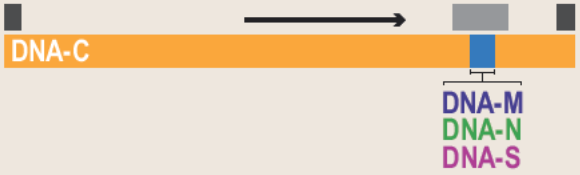
Tables

- Use **space** and **lines** to organize tables, draw the readers' eyes across the data.
- Make the most **important information stand out** by using bold type, colour and highlights.
- Make the information easier to navigate by sorting/ordering.
- Remove excess information.

Table 1: Correlation results for cockle size, trace metals and environmental variables

	Mean size	Largest size	N	P	As (mg/Kg)	Cu	Zn	Silt	Salinity	Human impacts	Agricultural impacts
Largest size	**0.7547**	1									
N	-0.1877	**-0.6678**	1								
P	0.1049	-0.2714	0.3663	1							
As	0.3221	0.0501	0.19464	**0.93538**	1						
Cu	0.4049	-0.076	0.38681	**0.83905**	**0.82795**	1					
Zn	0.5206	0.156	0.04001	0.56513	0.58135	**0.84145**	1				
Silt	-0.1169	-0.494	**0.93866**	-0.3444	0.26979	0.41831	0.09422	1			
Salinity	-0.1267	0.3422	-0.6119	-0.2885	-0.15743	-0.5004	-0.19692	-0.46479	1		
Human impacts	-0.057	-0.066	.32859	0.22722	0.29167	0.30546	-0.10728	0.40570	-0.061505	1	
Agricultural impacts	-0.125	-0.138	-0.0730	**-0.6612**	-079782	-0.6452	-0.53111	-0.31087	-0.1207	-0.3333	1

Correlations in **bold** are significant(P=0.5)

Event	DNA Organiziation	Recombinant(s)	Sequence used to infer major parent(s)	Sequence used to infer minor parent(s)	Breakpoint Begin-End	Methods	P - value
1		All Asian Group DNA-S	All South Pacific Group DNA-S	All Asian Group DNA-M	791–974	RGMCST	2.14×10^{-35}
2		All South Pacific Group DNA-M	All Asian Group DNA-M	All South Pacific Group DNA-S	764–1029	RGMCST	1.03×10^{-26}
3		All CN DNA-C	All South Pacific Group DNA-C	All CN DNA-N, All VN DNA-S, All TW DNA-S, All CN DNA-S, All Asian Group DNA-M	827–872	RGT	2.16×10^{-11}

→ ORF Common region major Common region stem loop

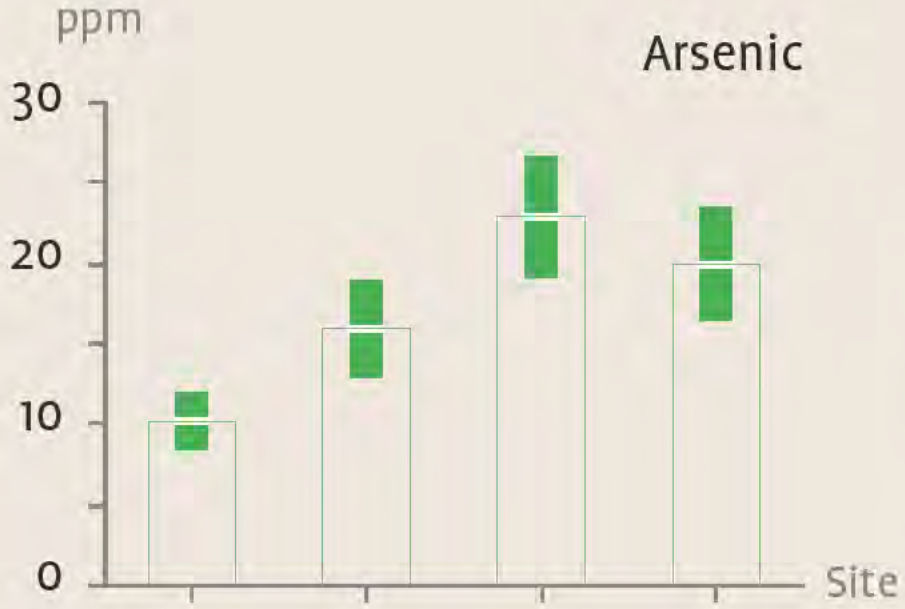
DNA-C DNA-M DNA-N DNA-S

Methods R – RDP G – GENECONV M – Maxchi C – Chimaera S – SiSscan T – 3Seq B – Bootscan

Subject	Room	Day	1	2	3	4	5	6	7	8
432 Cell Biology (am)	275	MON	27 Feb	12 Mar	26 Mar	30 April	14 May	28 May	16 Jul	30 Jul
491 Plant Biotechnology (am)	423	TUES	28 Feb	13 Mar	27 Mar	1 May	15 May	29 May	17 Jul	31 Jul
470 Behaviour (pm)	423	WED	29 Feb	14 Mar	28 Mar	2 May	16 May	30 May	18 Jul	1 Aug
430/406 Genomics (am) ❶	275	THUR	1 Mar	15 Mar	29 Mar	3 May	17 May	31 May	19 Jul	2 Aug
478 Evolutionary Ecol. (am)	275	FRI	2 Mar	16 Mar	30 Mar	4 May	18 May	1 Jun	20 Jul	3 Aug

Graphs

- Remove excess - lines, colour, shading, text.
- Can graphs be merged to show the information better?
- Design the graph at the size you will use it to avoid ugly resizing.
- Consider reducing the contrast of low value information such as the axis.
- Avoid frames around graphs.


ppm
Arsenic
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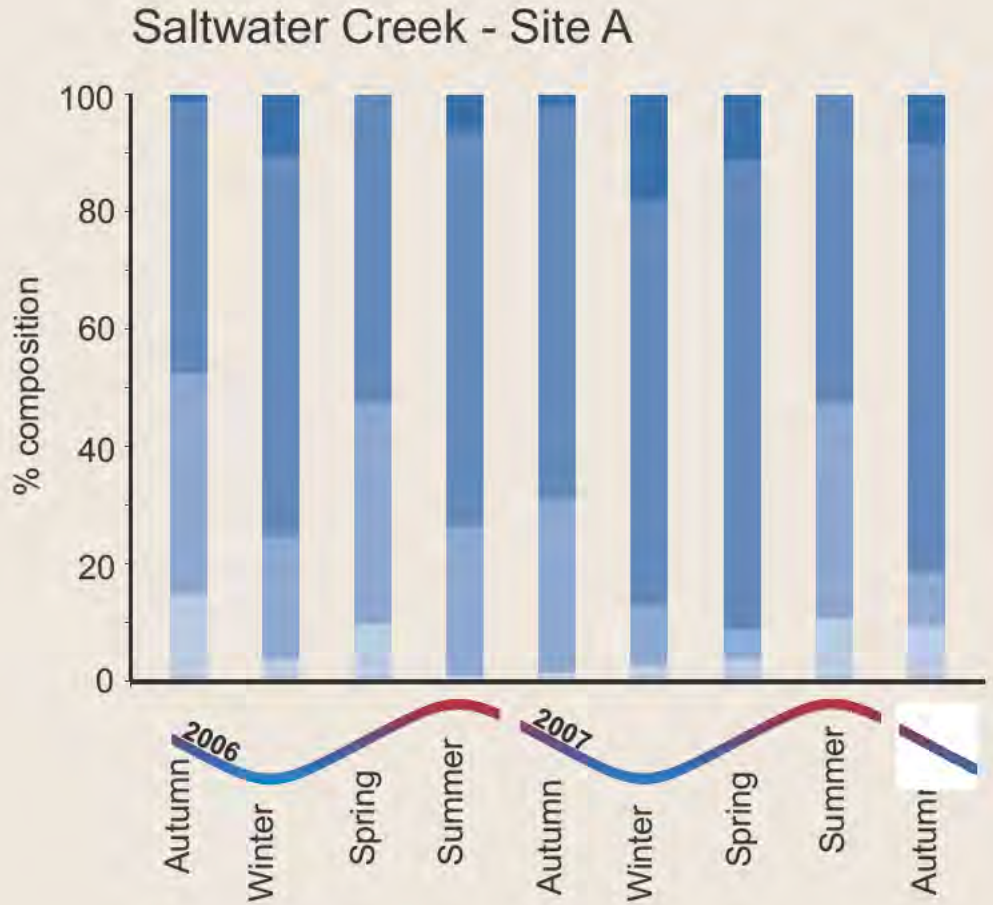
Site


Saltwater Creek - Site A
% composition
100
80
60
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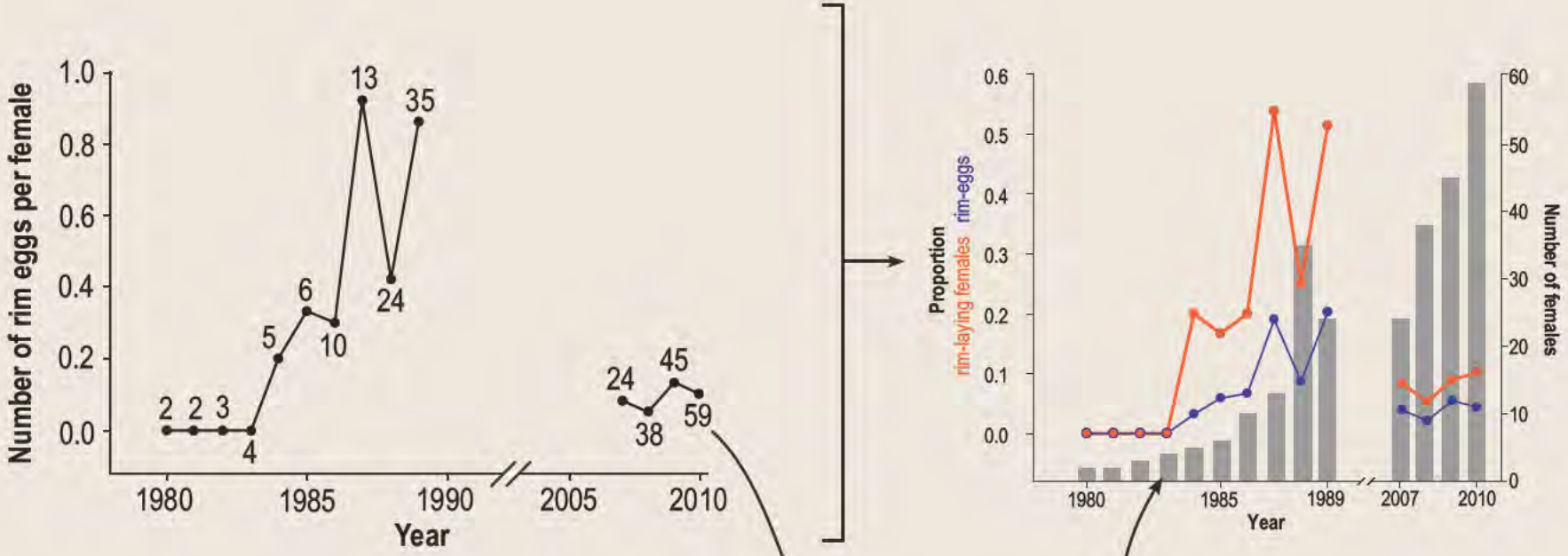
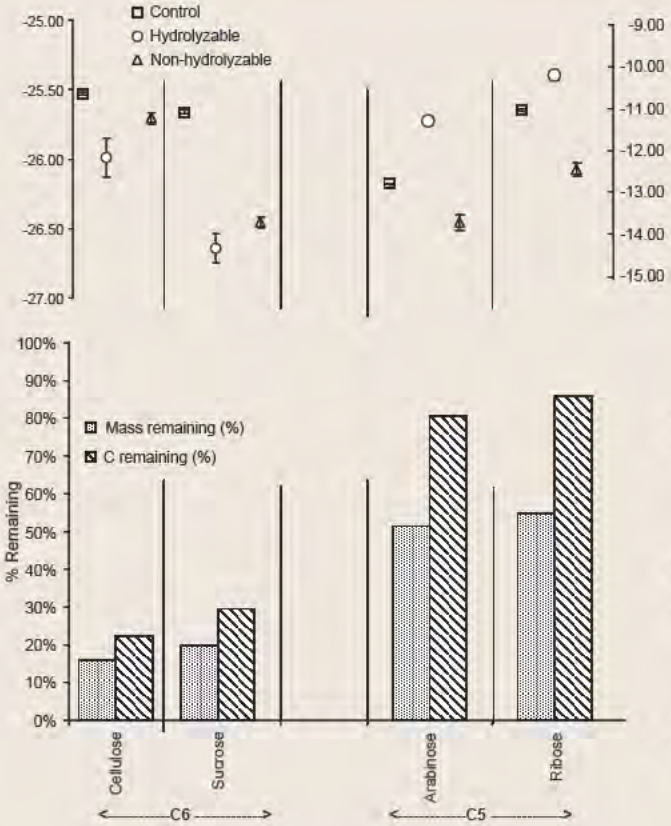
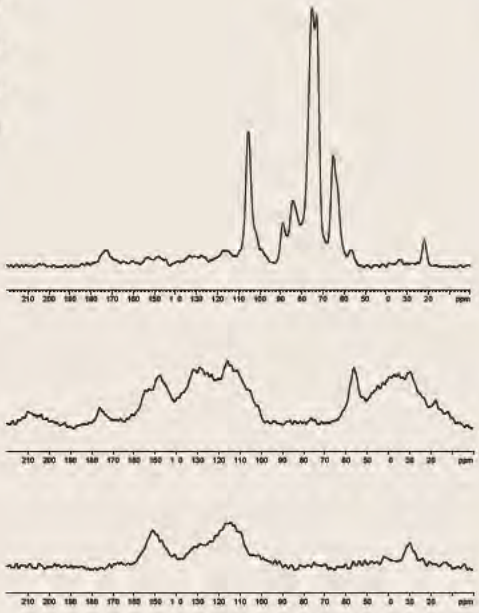
20
0
2006
2007
Autumn
Winter
Spring
Summer
Autumn
Winter
Spring
Summer
Autumn

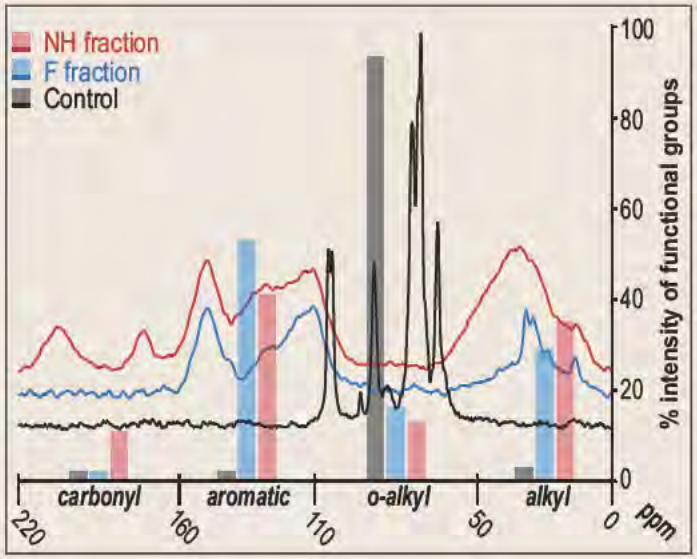


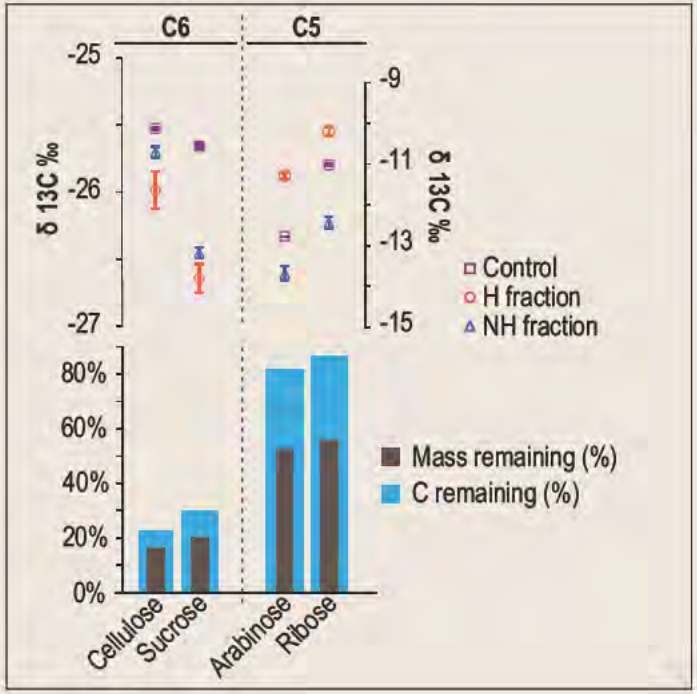
numbers replaced with bars

Sample	Hydrolysis temp °C	Fraction	Carbonyl (220–160 ppm)	Aromatic (160–110 ppm)	O-alkyl (110–50 ppm)	Alkyl (50–0 ppm)
Arabinose		control				
	95	NH				
	120	NH				
	120	F				
Glucose		control				
	95	NH				
	120	NH				
Cellulose		control	2	2	93	3
	95	NH	7	53	21	19
	110	NH	11	39	19	32
	120	NH	11	41	13	35
Maize		control	4	10	85	3
	120	NH	9	43	19	29
	120	F	5	56	19	20









Design not decoration

AIDA *Attention > Interest > Desire > Action*

Think of a poster as an advert for your topic.

You need to:

- Attract attention to the poster
- Generate interest in the topic
- Convince the audience to read the poster
- Lead the audience to take some action, such as ask a question

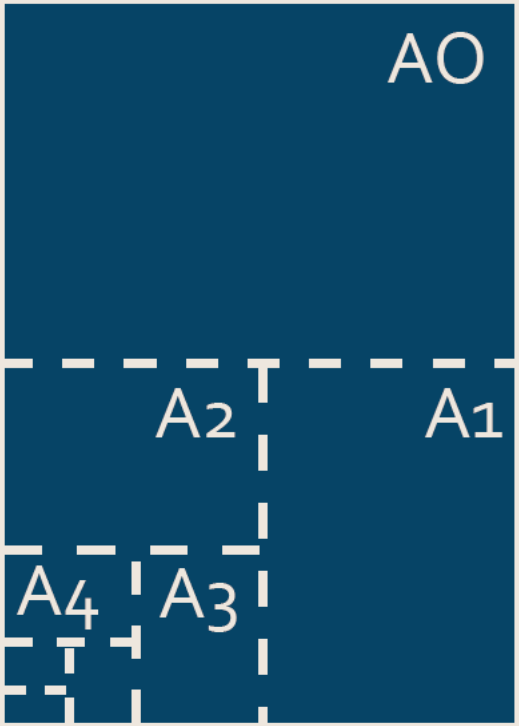
Layout

Understand the rules before you break them.

- Leave a good size margin around the edge to prevent your presentation appearing cramped. **General rule is 20 mm margin.**
- Lines of text should not exceed 15 words as they become hard to read. **General rule is 12-15 words per column width**.
- People are trained to read top to bottom, left to right, starting in the top left. Going against this standard can cause confusion. Proceed with caution. **General rule is 3 columns**.

Use a grid

- Use a grid to align elements.
- Make your columns strong by aligning as many elements to the left as possible.
- Avoid underlining, use **bold** for emphasis.
- Use bullet points where appropriate.
- More space, less text.



Standard page sizes

AO	841 x 1189 mm
A1	594 x 841 mm
A2	420 x 594 mm

You can trim your poster be a different size within these limits.

Writing style

- Short sentences are easier to read
- Use plain english, remove jargon
- Break text into small chunks
- Front load sentences - important information first

Mosquitoes must have water to complete their life cycle (Fig. 1). This water can range from very high quality to sewage water and can be in almost any container imaginable (Fig. 2). Adults may carry dangerous diseases to both people and animals. Dengue Fever, Western Nile Virus, Ross River fever and numerous forms of encephalitis are a few of the diseases that are carried by mosquitoes in Tonga. The feeding habits of mosquitoes are quite unique in that it is the female that requires protein from blood for egg production, males feed predominantly on plant juices.

96 words

Adult mosquitoes can transmit deadly diseases to humans and animals. In Tonga these diseases include Dengue Fever, Western Nile Virus, Ross River fever and numerous forms of encephalitis.

To complete their life cycle mosquitoes must have water.

The water can be in almost any container and range from pure water to sewerage.

The feeding habits of mosquitoes are unique. The males feed predominantly on plant juices, but to produce eggs the female requires protein from blood.

76 words

Type

Use a maximum of 2 typefaces, but only one from each of the type families:

- serif (Times, Garamond, Bookman)
- sans serif (Arial, Corbel, Tahoma)

150+ pt	title
40 pt	sub heading
26 pt	body text

150

40

26

Naviagation

- Your poster must be easy to navigate
- Most people will not read a whole poster, they will jump between sections
- Use large, informative headings to help your audience find their way.

Images

Colour

Greyscale

Lineart

Resolution

Dots per inch

Screen quality

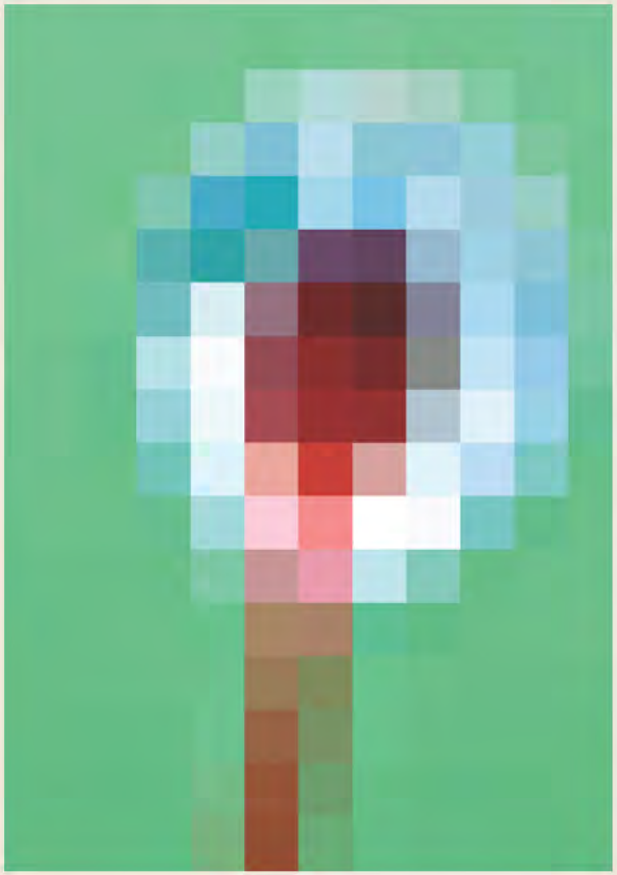
Intermediate quality

Print quality

Lineart

High resolution

Low resolution



Web – low resolution, do not print clearly, number of pixels in image important

Copyright – be aware, acknowledge source, ask permission

pTaxuskever.jpg
200 x 200 pixels - 18k
207.5.71.37/biobest/nl/plagen/taxuskever.htm

dvic384.jpg
768 x 512 pixels - 64k
www.au.af.mil/au/awc/systems/dvic384.jpg

clamp.JPG
640 x 480 pixels - 104k
www.a1sew.com/biological.htm

butterfly-sm.jpg
175 x 175 pixels - 9k
www.rainforestweb.org/.../Biodiversity/

1024 x 768 pixels = 10cm x 6cm print (300 dpi)

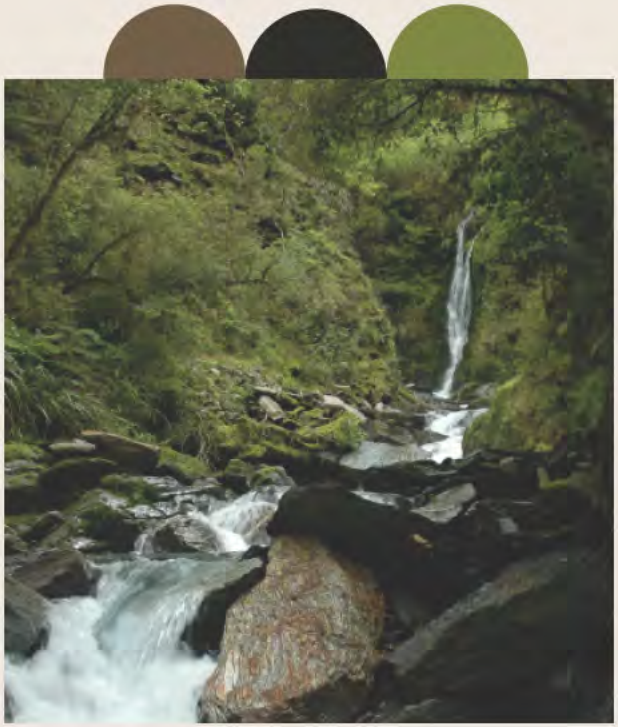
Graphics

- Table, graph or text?
- One message in each graphic, image or graph
- Remove anything that is not necessary, such as lines, colours, legends, 3D shading.
- Make figures bold and simple, they must be able to stand alone.
- Captions and titles should be short and clear.
- Use resolution independent vector files (eps,emf, pdf) over bitmap (jpg, png, bmp).

Colour

Overuse of colour is distracting

- Less is more
- Be consistent
- Use logical colours



Printing

Convert to pdf to reduce issues

- Portable document format (PDF) - the name says it all.
- Different computers have different settings and fonts, pdf files are designed to look the same across different platforms.
- Ensure the quality setting is for ***print*** not standard, otherwise image quality is reduced.

Less = more

Remove unnecessary content

- Improve the signal to noise ratio by removing frames around objects and fill colours where possible.
- If required keep the stroke weight on frames as light as possible. Minimum of 0.25 pt
- Avoid images behind text - it is very distracting.
- A contrast of 70%+ is required to easily read text.

Steps to follow

1. Identify key messages
2. Identify audience
3. Write text in a separate file
4. You wrote too much, edit text to remove excess
5. Gather or generate high quality image and graphics files

6. Import all text and images into layout software
7. Design rough layout to get an idea of how it all fits
8. Refine design
9. Check for errors
10. Produce print-ready file

Less text

Remember

- ***Less is more***
- ***Just because you can, doesn't mean you should***
- Key point not every point
- Consistent, logical, navigation
- Bold and clear