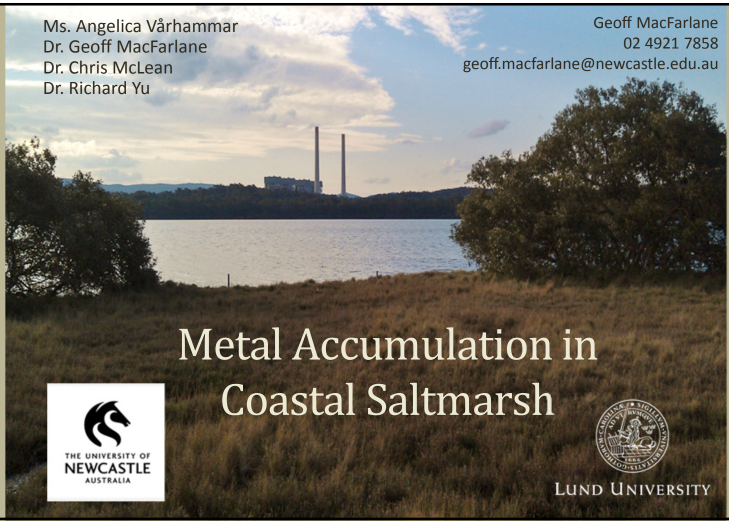

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Metal Accumulation in Coastal Saltmarsh

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Coastal saltmarsh

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Coastal saltmarsh

Services

- Prevent erosion
- Habitat
- Carbon storage

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Coastal saltmarsh

Threats

- Construction
- Agriculture
- Waste disposal
- Industrial development
  - ➢ Biodiversity legislation

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Metal accumulation in sediment

Petrol	Coal fired power
Mining	Metal fabrication
Industrial effluents	Municipal waste
Sewage effluent	Urban storm water
Agricultural runoff	Boating activities

(Pacyna and Pacyna, 2001; MacFarlane et al., 2007
Morrison and Gulson, 2007; Jennett et al., 1980)

Cd: 8 µg/g
Cu: 138 µg/g
Pb: 1497 µg/g
Zn: 694 µg/g

(Suh et al., 2004;
MacFarlane et al., 2006)

ANZECC Sediment Quality Guidelines	Low (µg/g)	High (µg/g)
Cadmium (Cd)	1.5	10
Copper (Cu)	65	270
Lead (Pb)	50	220
Zinc (Zn)	200	410

Metal accumulation in plants

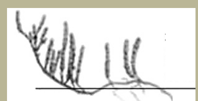
Low uptake	Hyperaccumulators
Shrubby samphire *(Sarcocornia fruticosa)*	Cordgrass *(Spartina alterniflora)* Cu, Pb, Zn
Pickleweed *(Sarcocornia perennis)*	Sea rush *(Juncus maritimus)* Cd


Photo: Doug Beckers

Samphire (*Sarcocornia quinqueflora*)

Plants as bioindicators

1. Contamination load
   - Three estuaries in NSW
2. Bioconcentration and translocation
   - Roots, stems, photosynthetic stems
3. Contamination gradient
   - Physiochemical properties


Duarte et al. 2010,
Environmental Pollution 158:1661-1668.

Photosynthetic stem
⇧
Stem
⇧
Root
⇧
Soil

Results

Analyses

- 3 Estuaries, 10 locations, 50 plants
- 15 x 15 x 10 cm of soil
- Subsamples analysed using ICP-AES and ICP-MS

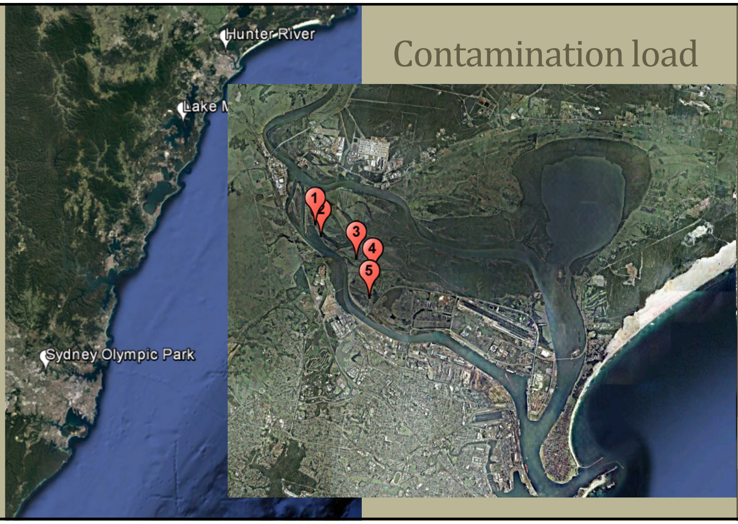
ANZECC	Low (µg/g)	High (µg/g)
Cd	1.5	10
Cu	65	270
Pb	50	220
Zn	200	410

Soil properties

- Cd: 0.5–2 µg/g (4x)
- Cu: 20–60 µg/g (3x)
- Pb: 30–310 µg/g (10x)
- Zn: 60 to 760 µg/g (12x)

- Soil Organic Matter: 8 - 49 %
- Salinity: 2.5 – 56 mS/cm (1:5 w/v)
- pH: 5.8 – 7.4 (1:5 w/v)
- Particle size distribution

Contamination load



Bioconcentration and Translocation

	Soil to root	Root to stem	Stem to PS stem
Cd	2.1	0.5	0.6
Cu	0.7	0.7	1
Pb	1	0.3	0.7
Zn	2	0.8	1.1

Photosynthetic stem

Translocation

Stem

Translocation

Root

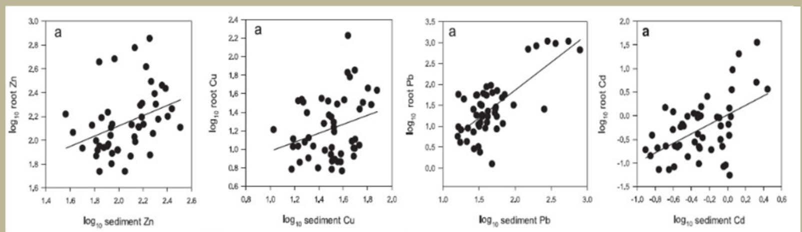
Bioconcentration

Soil

Contamination gradients

- Soil vs. roots

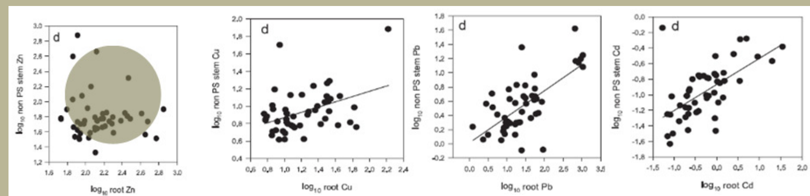
Root concentration



Soil Zn | Soil Cu | Soil Pb | Soil Cd

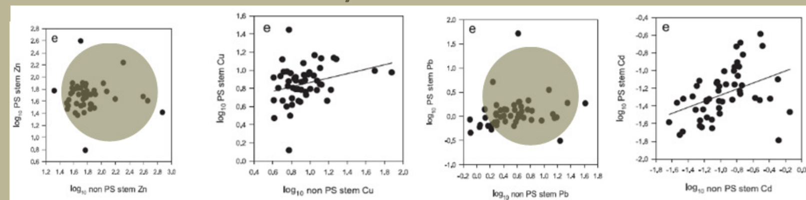
Translocation root to stem

Stem concentration



Translocation stem vs. Photosynthetic stem

PS stem concentration



Zn | Cu | Pb | Cd

Conclusions

1. **Contamination load**
   - Several sites exceeded the sediment quality guidelines
2. **Bioconcentration and translocation**
   - Roots accumulated metals generally 1-2x that of the soil
   - Barriers at the root:stem interface (Cd, Cu, Pb and Zn)
   - Barriers to the stem:photosynthetic stem interface (Cd, Pb)
3. **Contamination gradient**
   - Metals accumulate with root exposure
   - Regulated translocation of Zn and Pb
4. **Bioindicator**
   - Linear correlations but a lot of variation left unexplained

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Next steps

- **Explore the uptake of other dominant Australian native saltmarsh plants**
  - *Juncus kraussii*
  - *Sporobolous virginicus*
- **Explore impacts on physiology and performance**
  - Photosynthesis
  - Oxidative damage
- **Impacts on other parts of the lifecycle**
  - Germination trials and early seedling survival

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Thank you

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