Pollution, parasites and people

the impacts of urbanisation on tiger snakes (*Notechis scutatus*)

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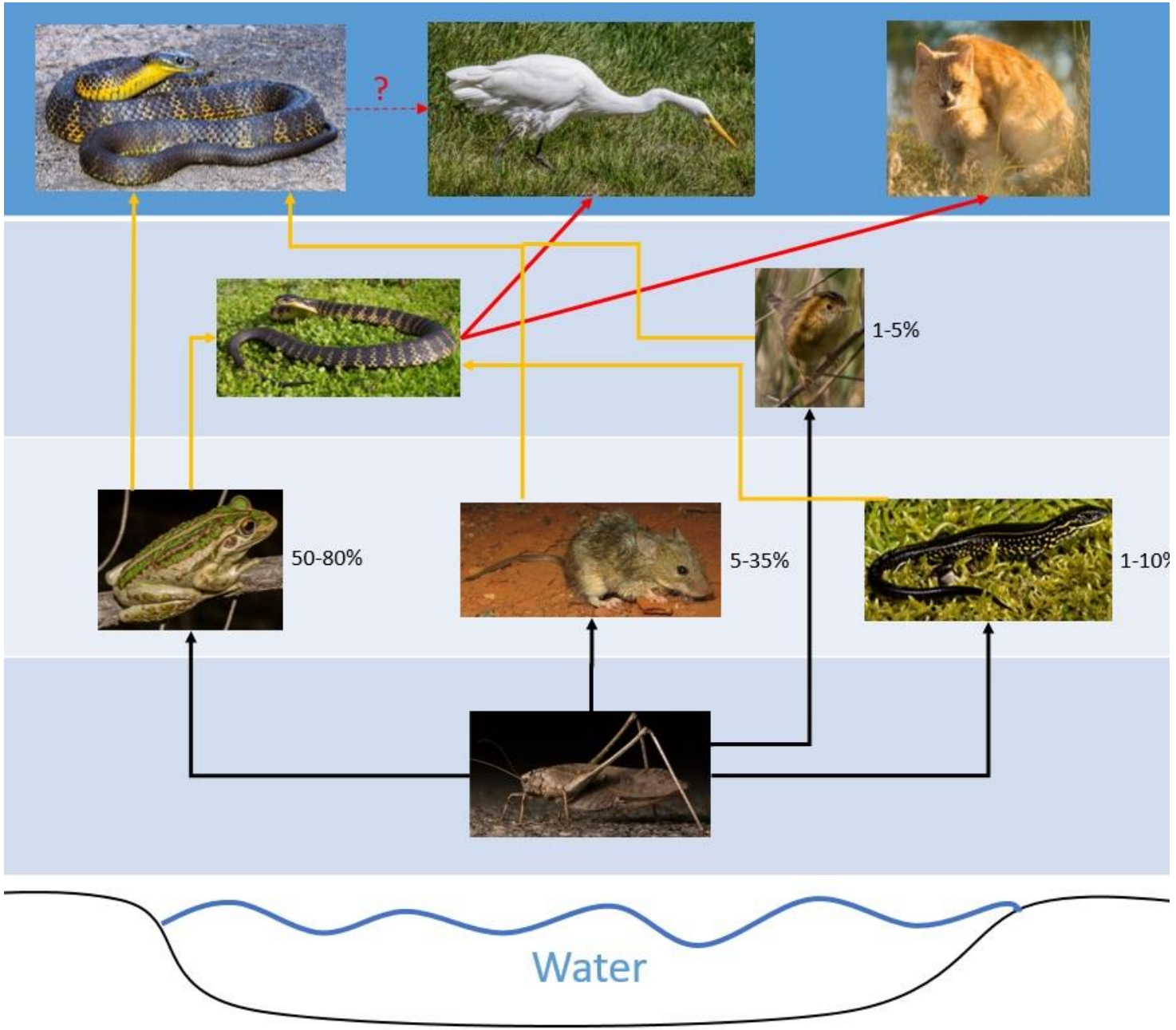
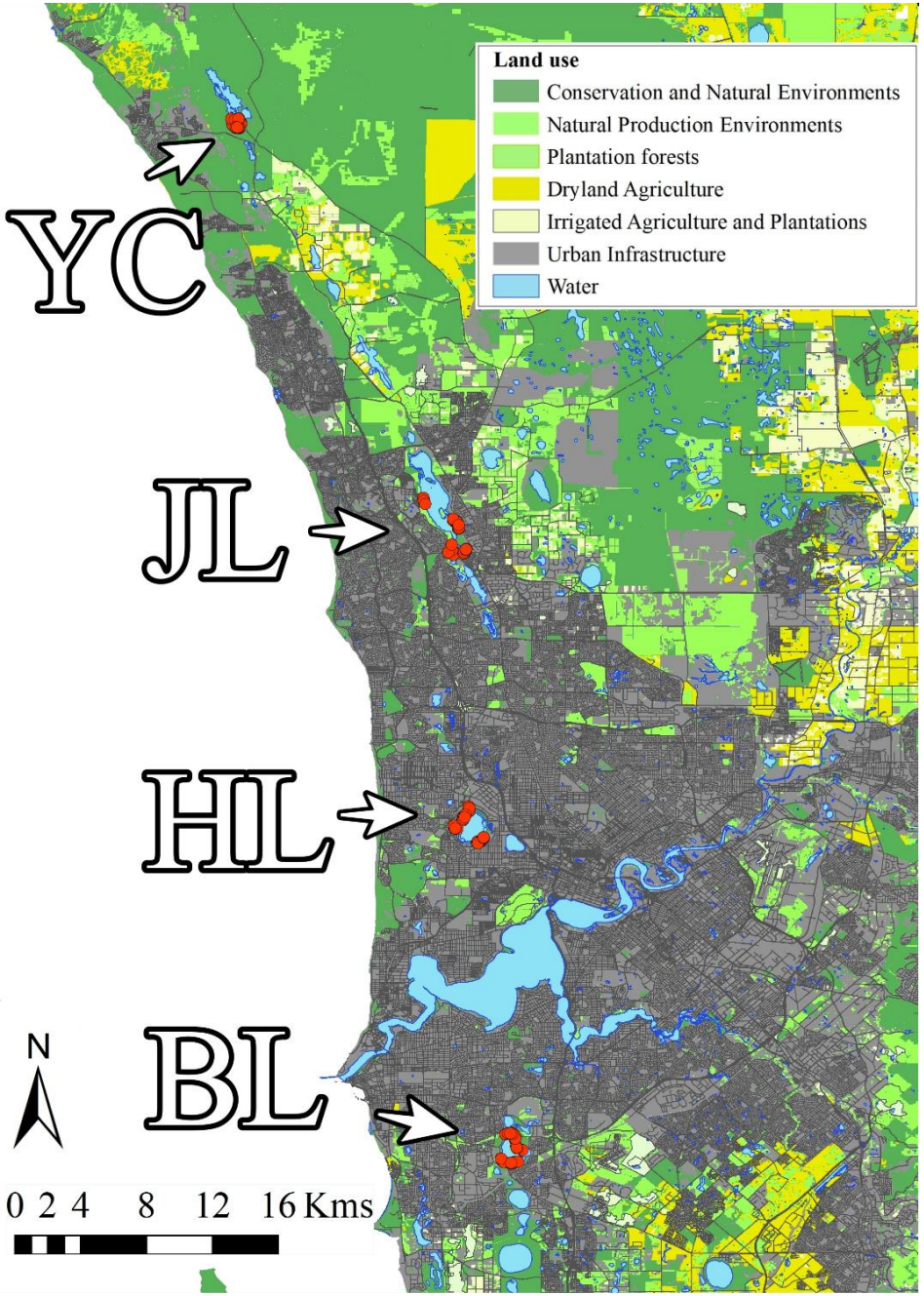
Background: tiger snakes

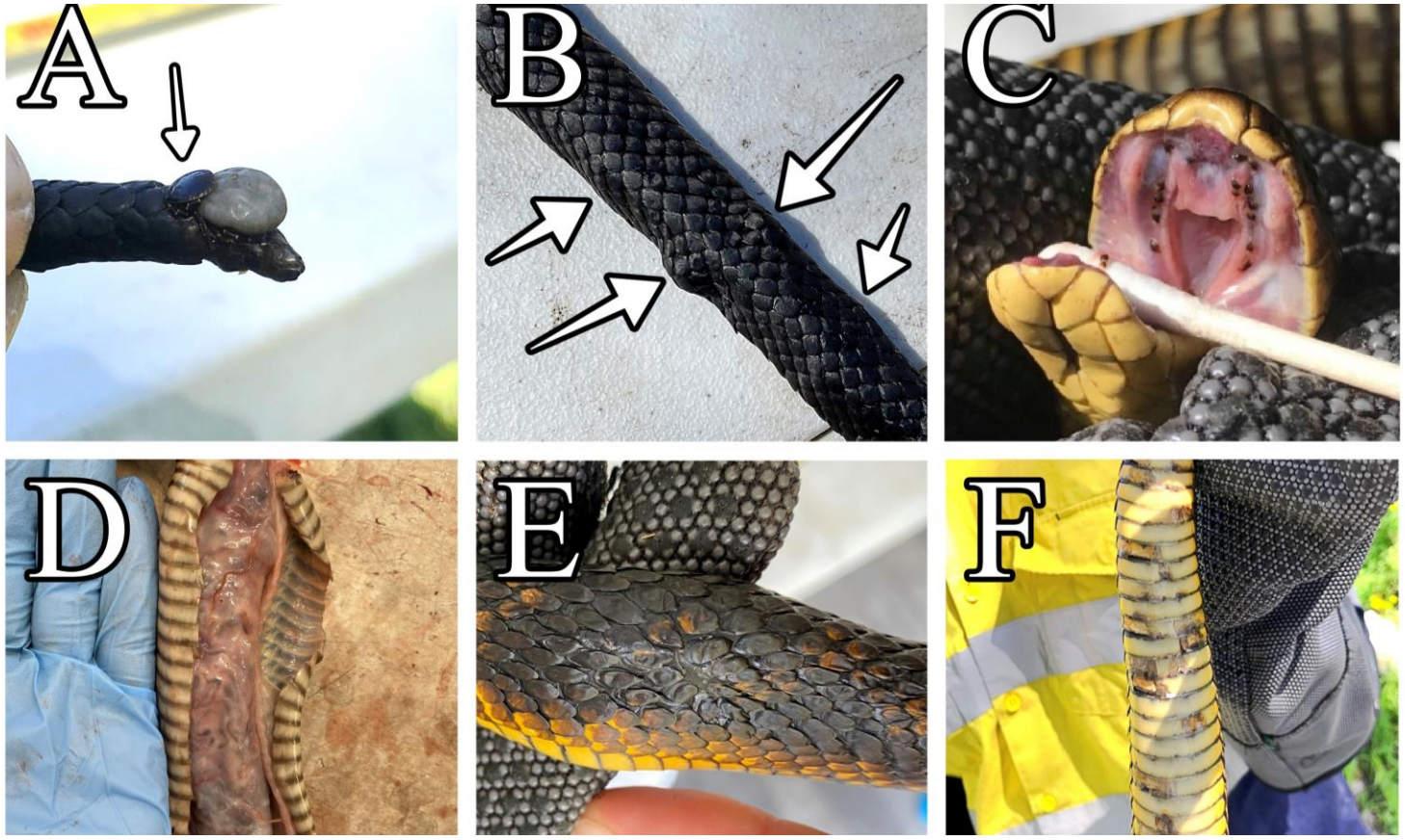
- Tiger snakes are ‘top predator’ of wetlands
- Abundant
- Primarily frog predators (indicator species)
- Potentially live 10-15 years
- Restricted to wetland ‘islands’ within Perth
- Multi-trophic tier life history
- ∴ great bioindicator of wetlands!



Background: urbanisation

- What can impact health in urban areas?
  - Contaminants and bioaccumulation
  - Population genetics and isolation
  - Habitat suitability and resource availability
- Four study sites across the urban matrix



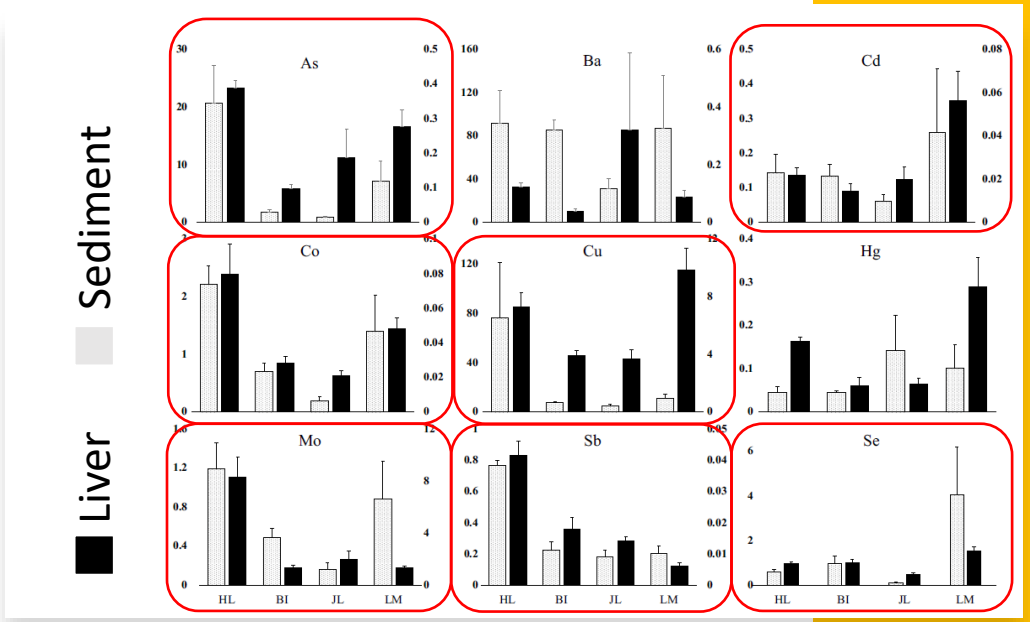


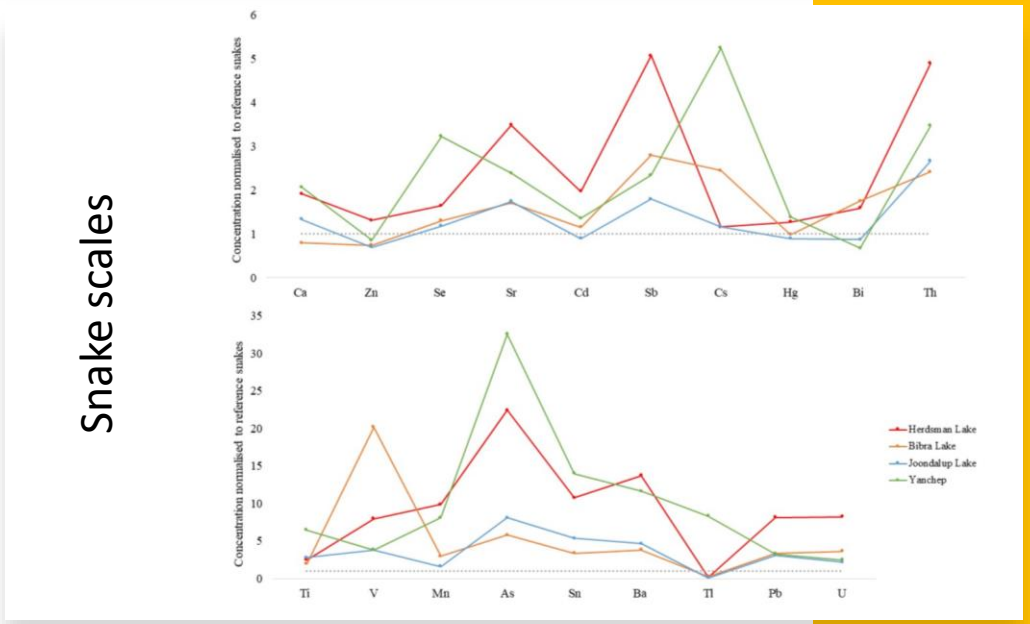
Background: PhD

- Studied the impact of urbanisation on tiger snakes, and their use as a bioindicator of wetland health
- Measured pollutants, parasites and parameters of health
- Population genetics

Contaminants in Tiger Snakes

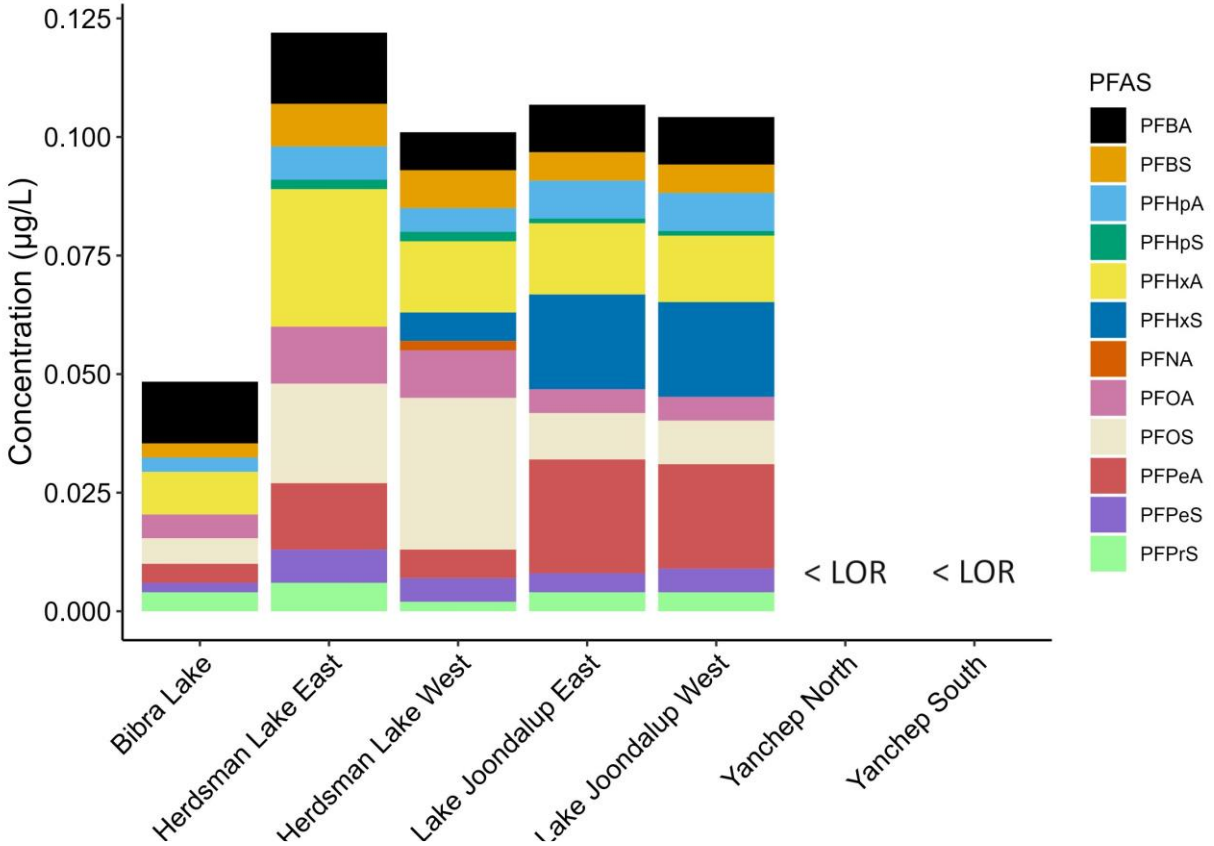
- In these wetlands, tiger snakes accumulate a suite of metal(loid)s
- Sediment, liver and snake scales show similar patterns of contamination
- Herdsman Lake was generally the ‘most contaminated’ with metals
- Oddly, Yanchep was second ‘most contaminated’ with metals
- Tiger snakes have trace amount of rat poisons in them

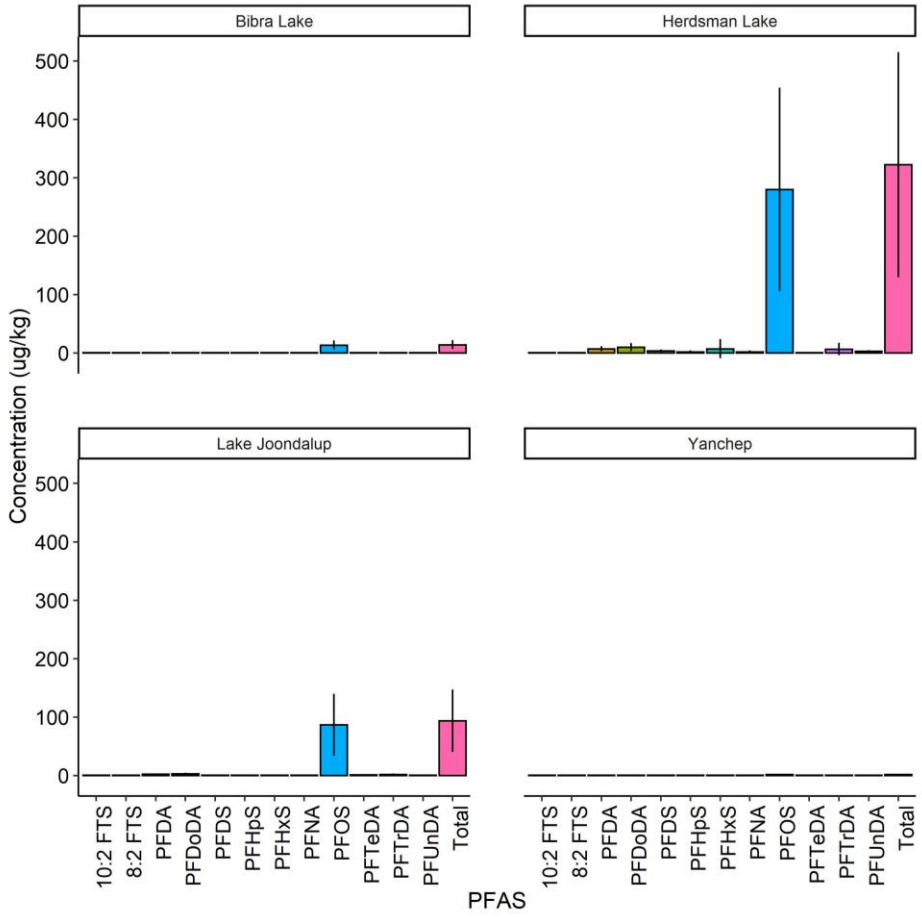


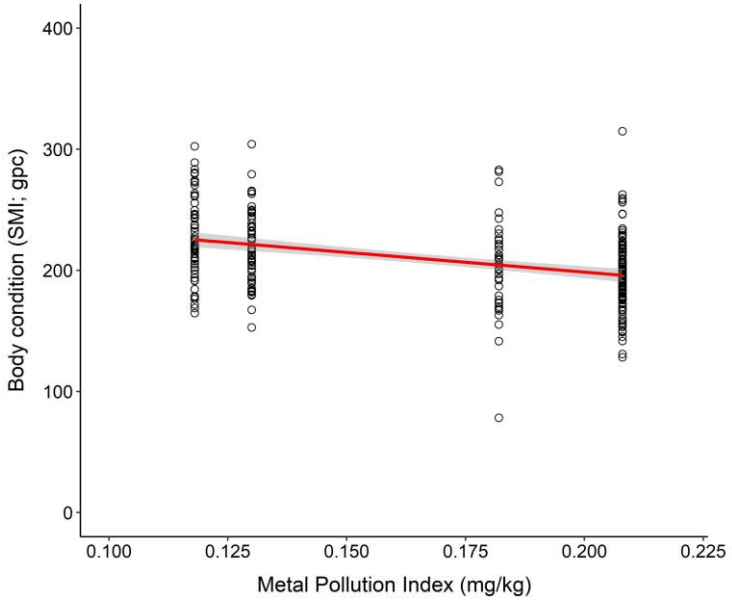


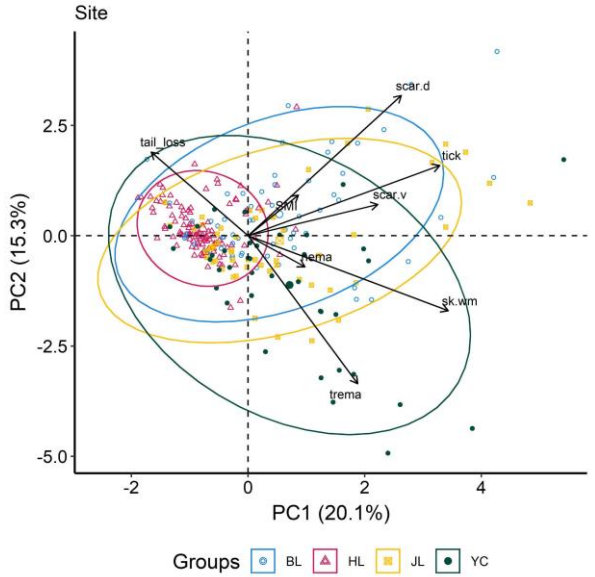
Contaminants in Tiger Snakes

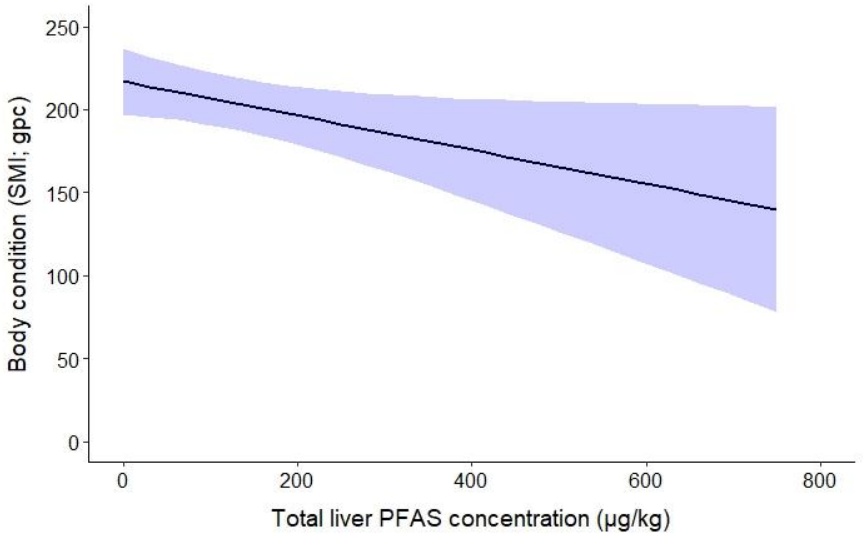
- PFAS mixtures were highest in Herdsman Lake and Joondalup waters but not detected in Yanchep
- PFOS is the dominant PFAS ending up in tiger snakes
  - Highest in Herdsman Lake









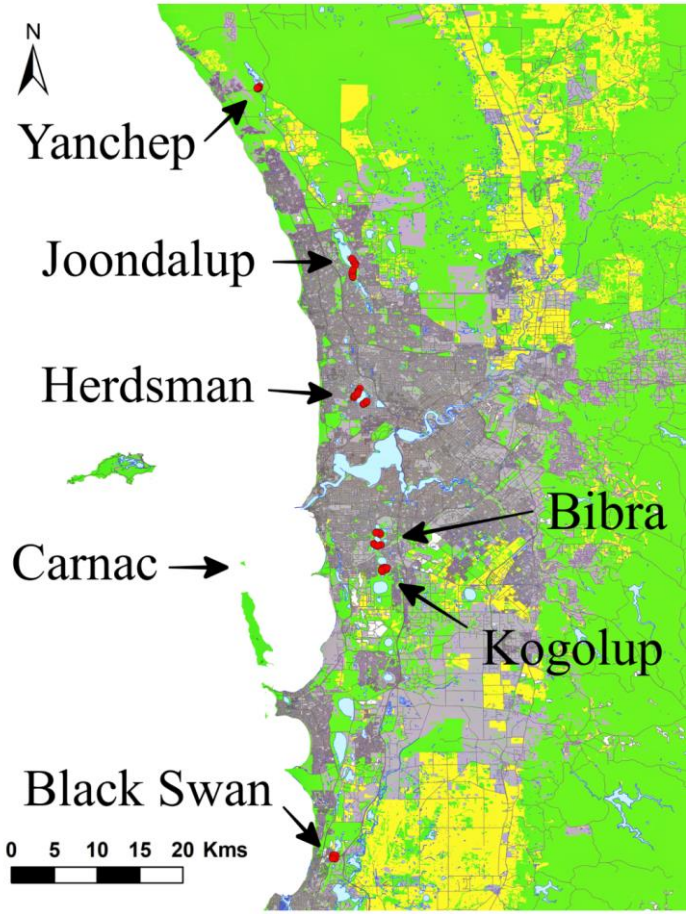


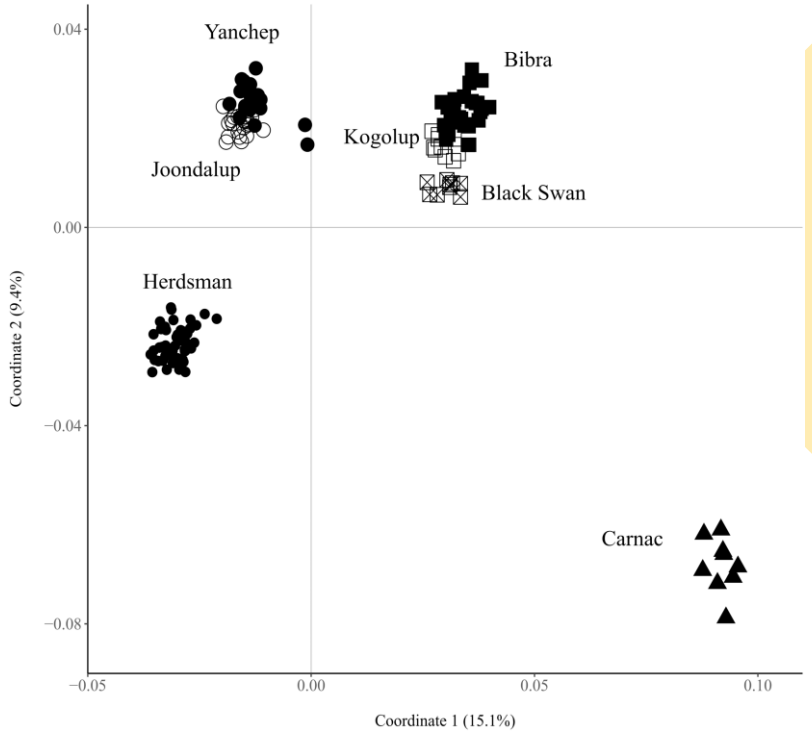
Impacts on Tiger Snakes

- Not a large enough sample size to disentangle the impact of each contaminant
- No association between pollution index and any parasite, infection or wound
- Urbanisation was NOT associated with any health parameter
- No sig. difference between feeding frequency among sites
- No sig. difference between growth rates among sites
- Lower body condition associated with population metal pollution index
  - Plenty of frogs and good feeding frequency > energy spent on detoxifying, ↑ metabolism
- Lower body condition associated with total PFAS concentration
  - Strong metabolomic signals of changes in energy production and cellular maintenance pathways in the muscle
- HL snakes have very homogenous ‘health profiles’

Genetics

- Population relatedness reflected historic isolation
- Populations north of the rivers had lower diversity
- Inbreeding signal was low but reflected isolation





Site	N_A	A_E	*I*	*Ho*	*He*	F_{IS}	Private alleles
Yanchep (*n* = 22)	1.32 (0.01)	1.14 (<)	0.13 (<)	0.08 (<)	0.08 (<)	0.00 (<)	55.79 (0.89)
Lake Joondalup (*n* = 23)	1.33 (0.01)	1.15 (<)	0.14 (<)	0.09 (<)	0.09 (<)	0.02 (<)	56.27 (0.53)
Herdsman Lake (*n* = 57)	1.39 (0.01)	1.15 (<)	0.14 (<)	0.09 (<)	0.09 (<)	0.04 (<)	69.49 (0.73)
Bibra Lake (*n* = 29)	1.45 (0.01)	1.20 (<)	0.19 (<)	0.12 (<)	0.12 (<)	0.03 (<)	81.73 (0.86)
Kogolup Lake (*n* = 10)	1.39 (0.01)	1.19 (<)	0.18 (<)	0.12 (<)	0.12 (<)	-0.02 (<)	68.17 (0.59)
Black Swan Lake (*n* = 9)	1.38 (0.01)	1.19 (<)	0.18 (<)	0.12 (<)	0.12 (<)	-0.02 (<)	111.30 (0.46)
Carnac Island (*n* = 9)	1.41 (0.01)	1.25 (0.01)	0.21 (<)	0.13 (<)	0.14 (<)	0.05 (0.01)	328.03 (0.97)

Presented as mean values across all SNPs; (<), standard error < 0.01; *Na*, no. of alleles; A_E, effective number of alleles; *I*, information index; *Ho*, observed heterozygosity; *He*, expected heterozygosity; F_{IS}, fixation index (Wright's inbreeding coefficient).

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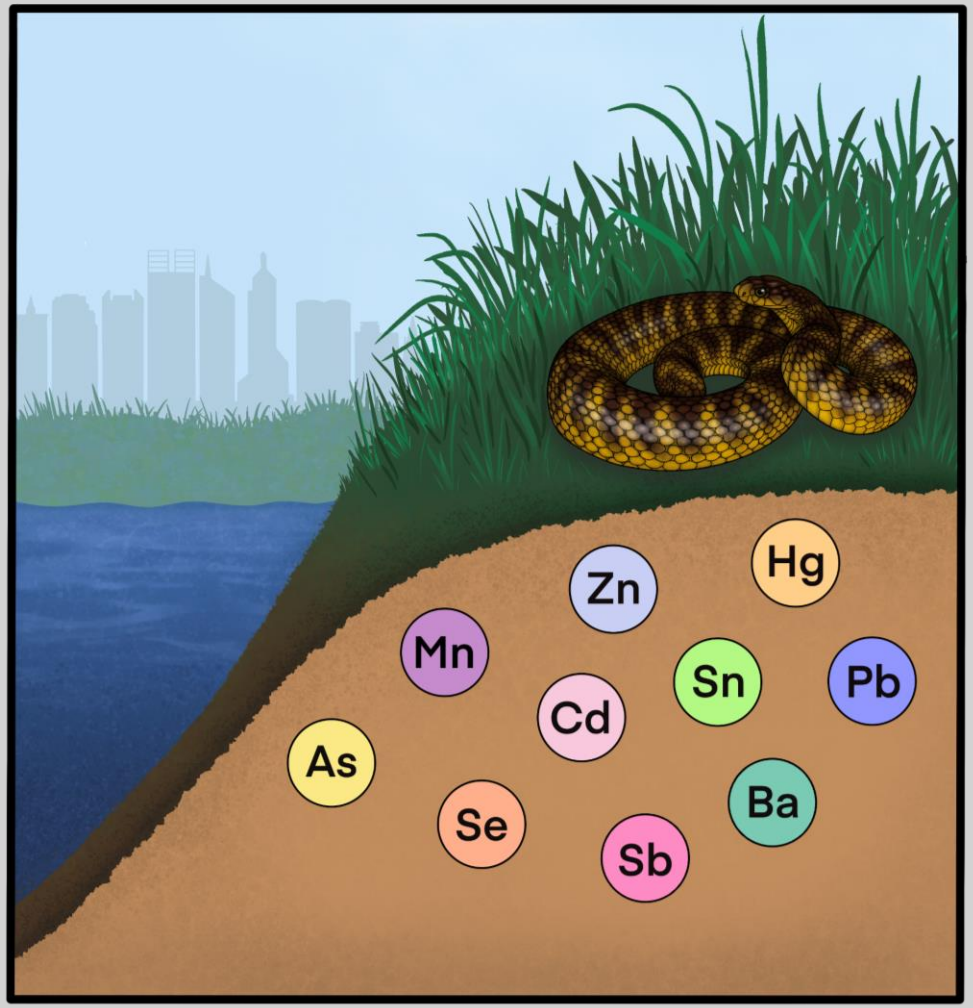
Opportunistic discoveries

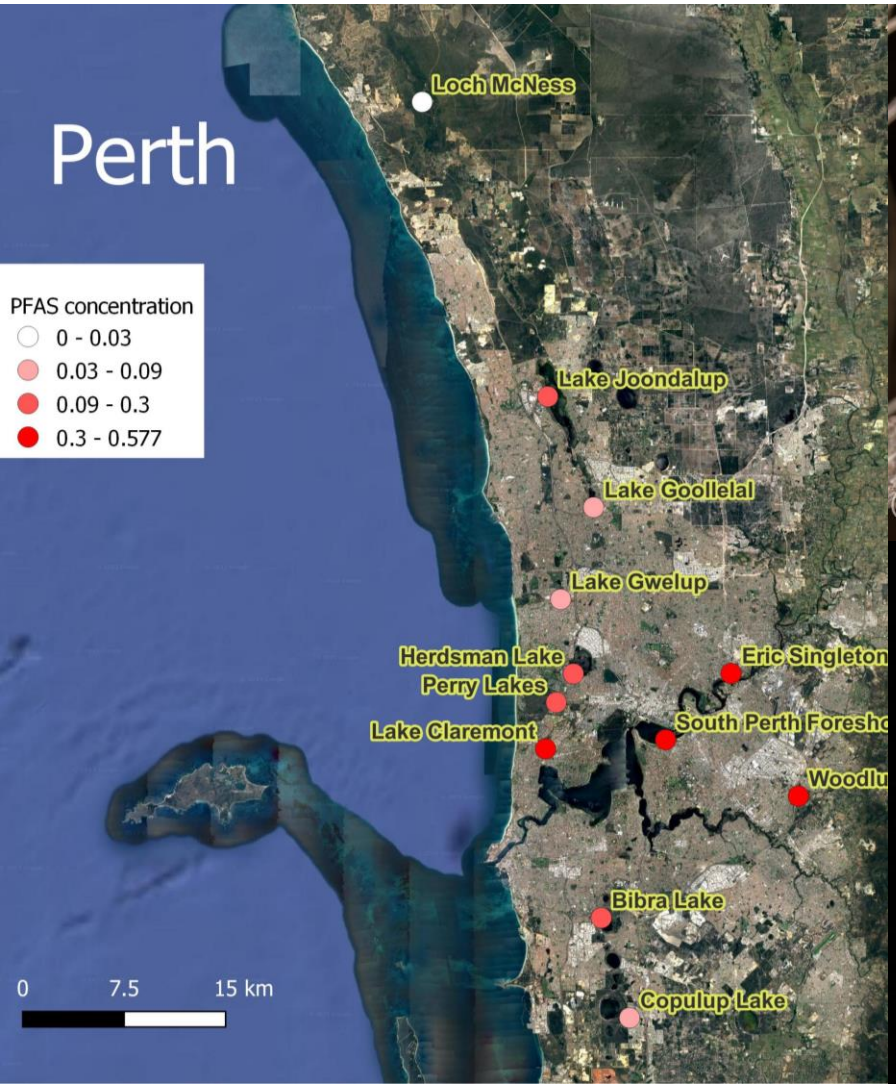
- Mother tiger snakes can transfer Mn, Mo, Sb, As, Hg, Zn
- Bibra lake tiger snakes can eat baby bandicoots & turtles
- Tiger snakes can eat bottle caps and die
- Tiger snakes can hold their breath for at least 18 mins

Take home message

- Tiger snakes are showing an impact on health from contaminants
- Tiger snake contamination reflects greater food web contamination
- More sensitive species need to be assessed
- Terrestrial vertebrate ecotox research is understudied in Australia (Death et al., 2019)



Future research



- Assessing frogs around Perth and Brisbane
  - PFAS and metals
  - Detailed assessment of their biochemical and genetic health

Acknowledgements

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