Ovis and hydatids, why are they still an issue in cattle sheep and goat production?

What are hydatids and ovis?

It is the infection of sheep with the cystic (intermediate) stages of two species of tapeworm that infect domestic and wild dogs and foxes

- Hydatids = *Echinococcus granulosus*

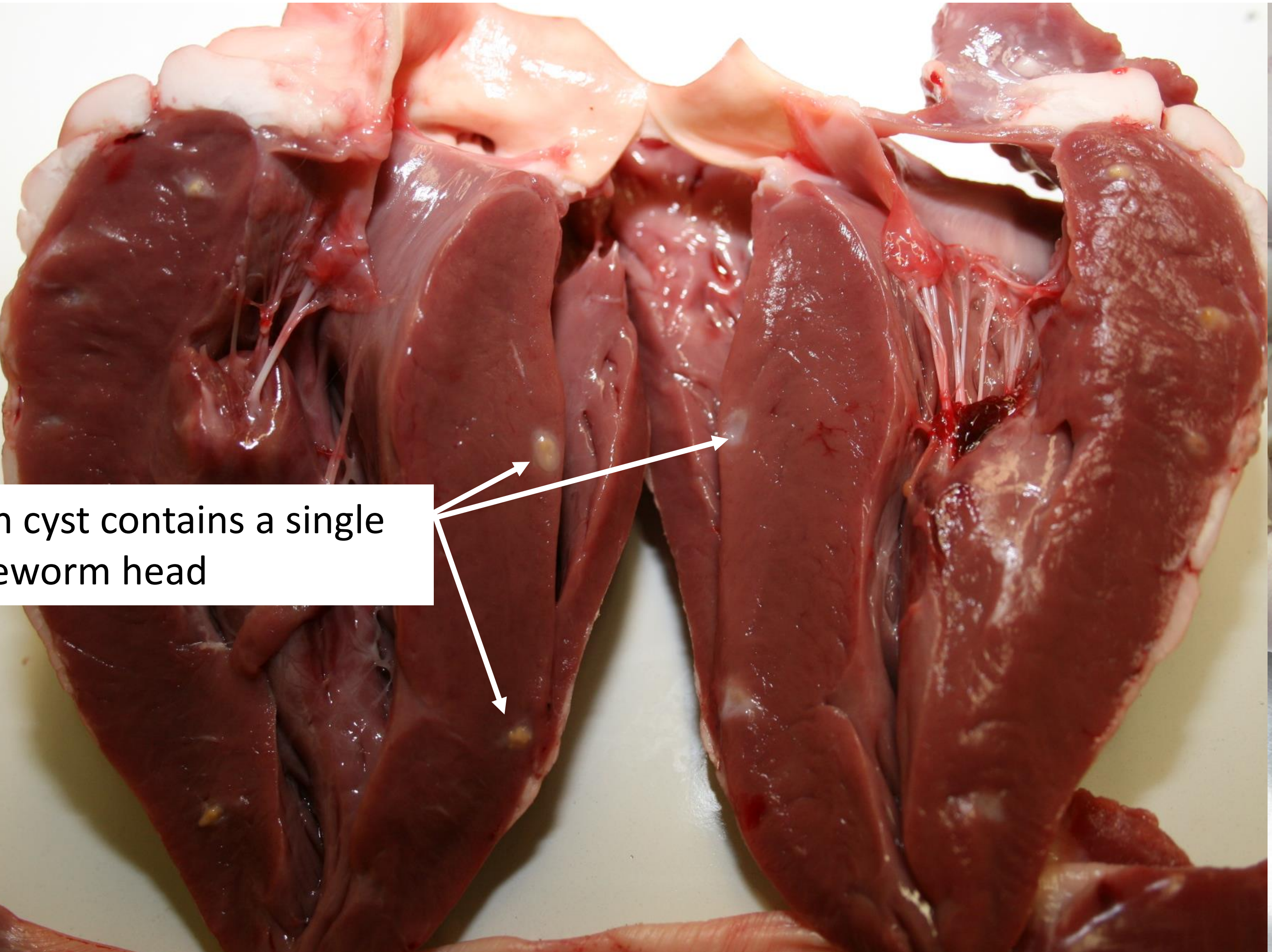
- Ovis (sheep measles) = *Taenia ovis (Cysticercus ovis)*

Hydatids in ovine liver

Cyst contains fluid and thousands of tiny tapeworm heads

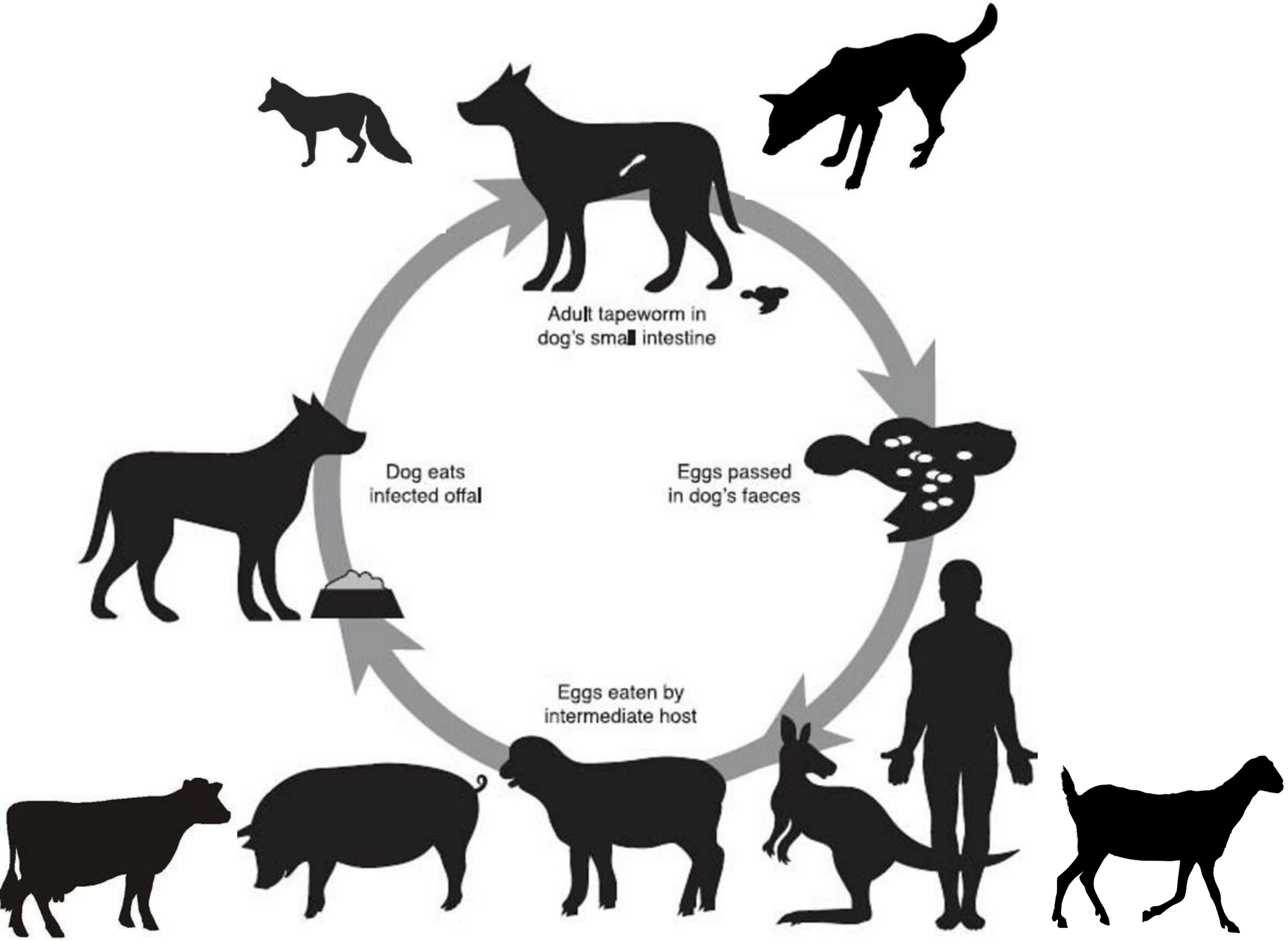
Sheep measles cysts

Viable

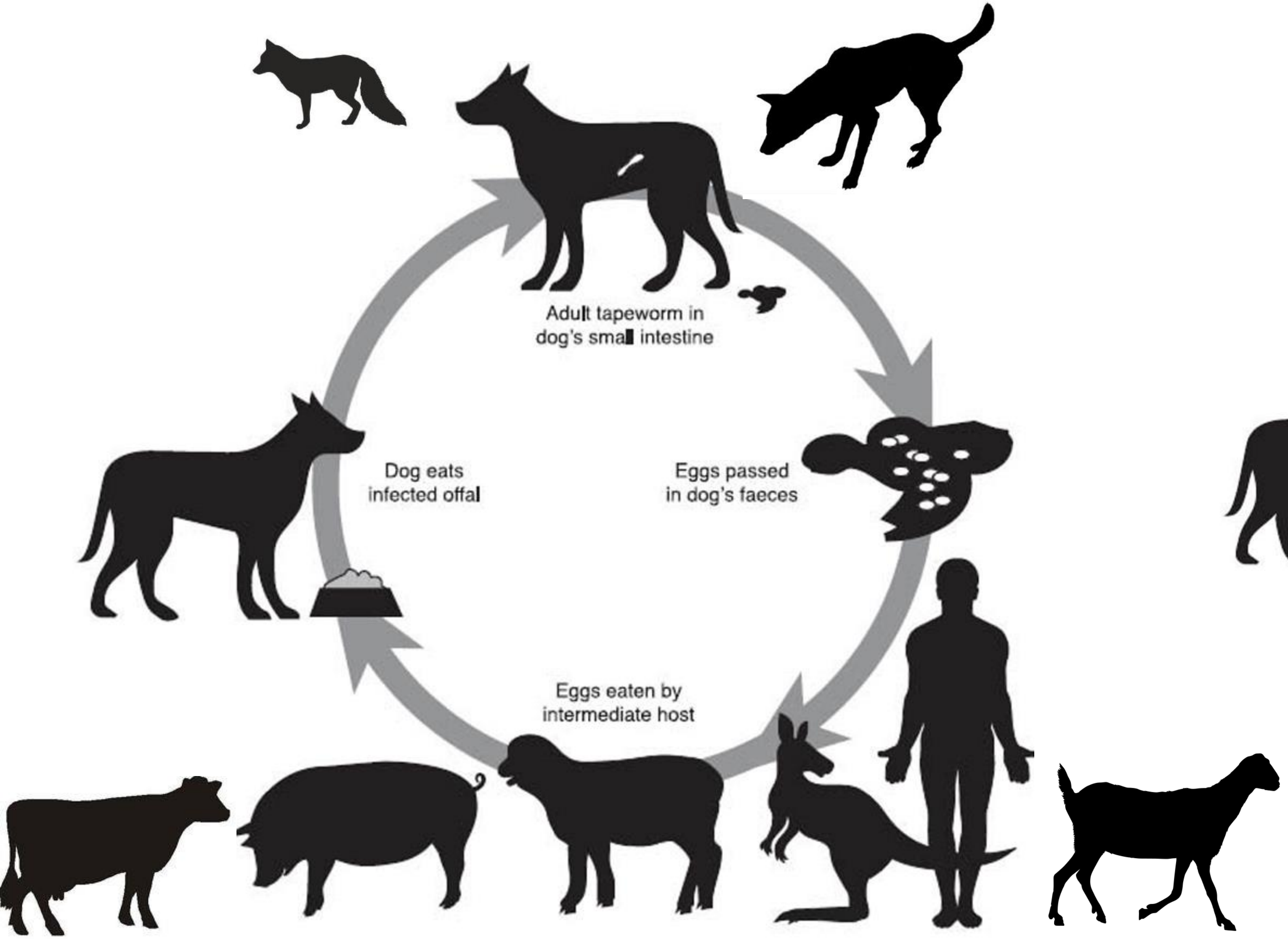


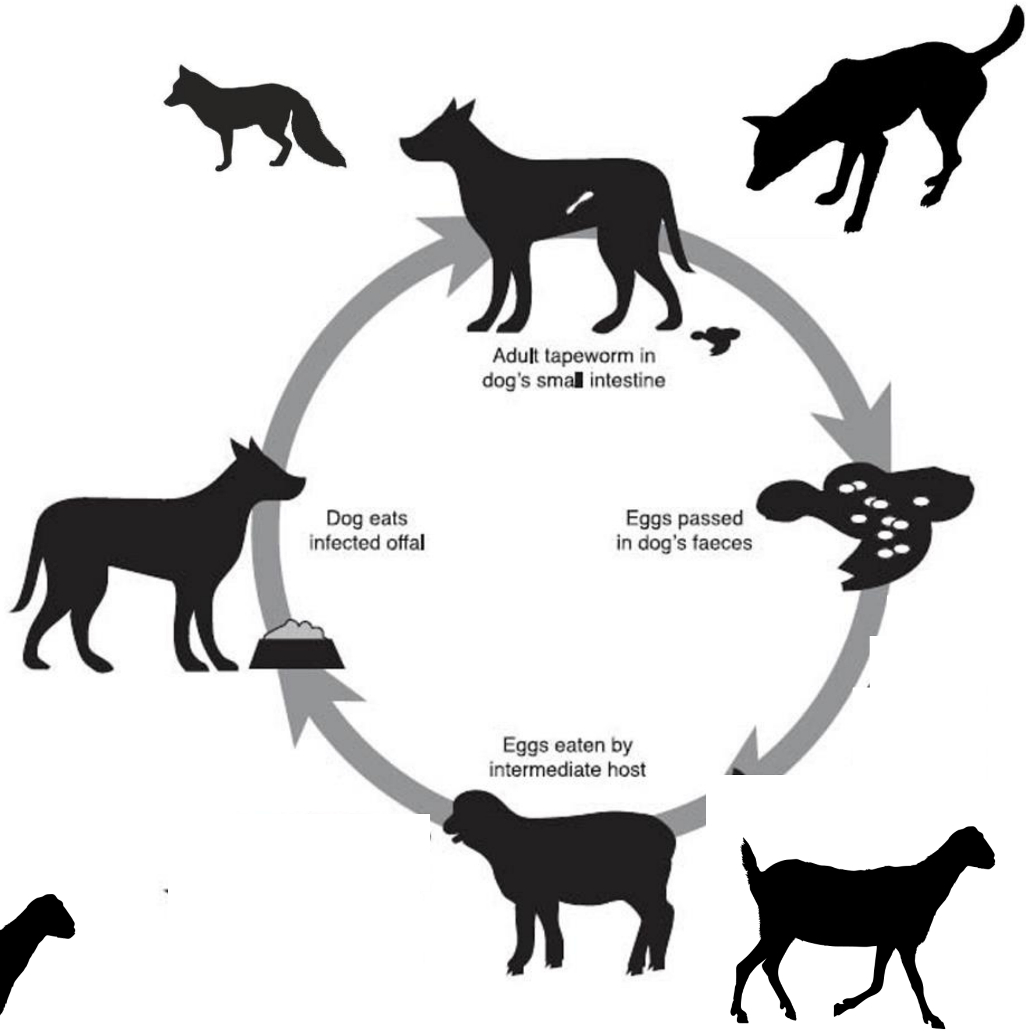
Non-viable

Hydatids lifecycle



Hydatids & ovis lifecycles





Controlling hydatid/ovis transmission

- Do not allow dogs access to livers/lungs (domestic & wild animals) raw sheep meat/hearts
- Confine dogs; offal pits
- Regular treatment of dogs with de-worming products containing praziquantel
- Feed dry/tinned or cooked/frozen (10days) raw meat/offal
- Public education

If they are so easy to control in dogs, why are they still an issue in livestock?

Wild canids!............

Wild dogs (dingoes and dingo domestic dog hybrids) and foxes

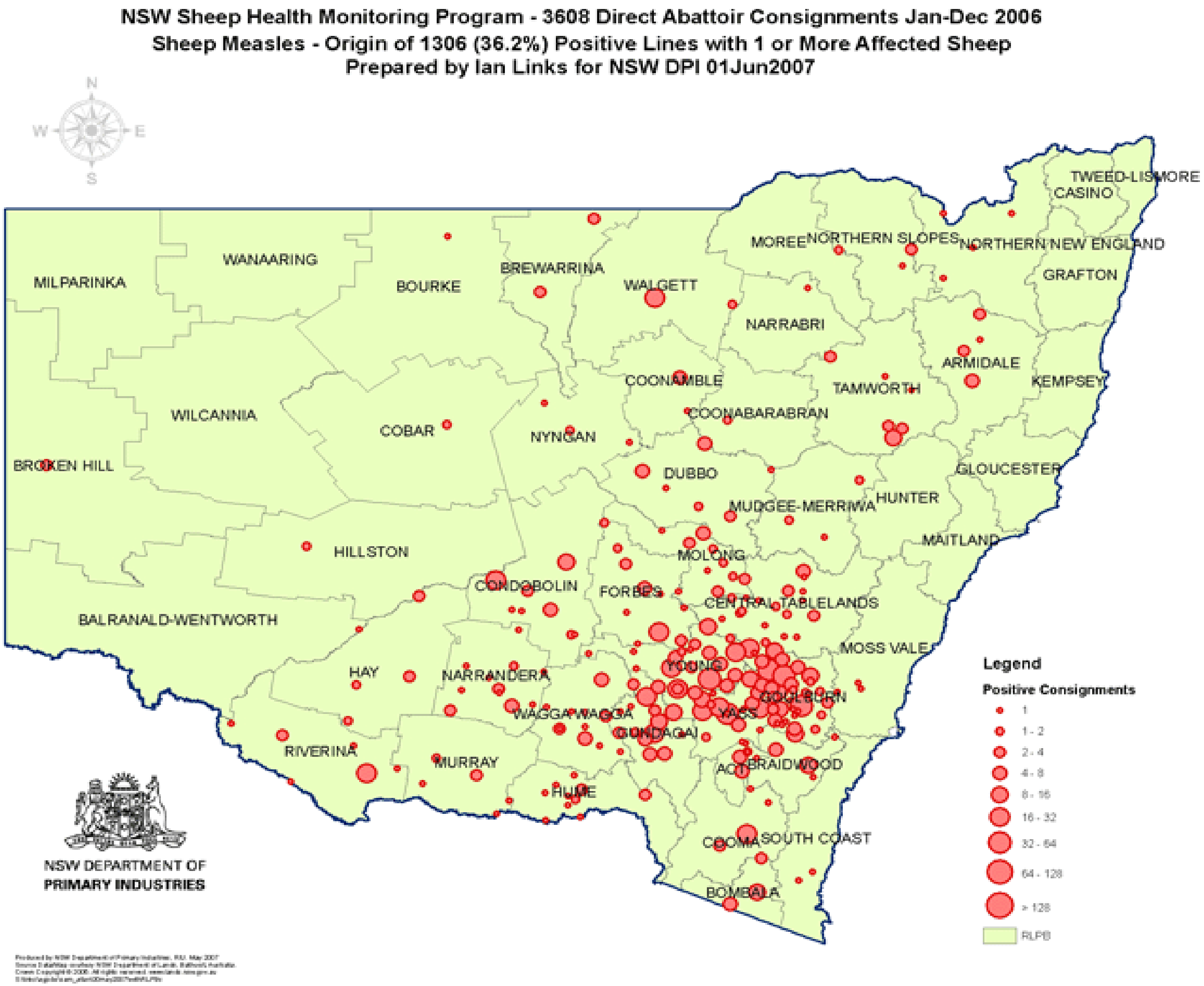
Why are hydatids and sheep measles important?

Financial losses to the Australian meat industry

- Hydatids – condemnation/downgrading of offal (sheep/cattle/goats*)
- Sheep measles – condemnation/downgrading of carcasses and hearts (sheep /goats*)
- Additional time for inspection/trimming

*There are recent records of sheep measles and hydatids in slaughtered feral goats (Brookes & Jenkins unpublished data). There are very few infected (probably reflecting goats are mainly browsers and live in more arid areas) the financial losses associated with infection in goats are likely to be minimal.

T.ovis distribution/occurrence



T.ovis present in 36% (1306 lines) of 3,608 lines of sheep examined…….

…….an ongoing production problem for the sheep meat industry?

Red foxes (*Vulpes vulpes*) and wild dogs (dingoes (*Canis lupus dingo*) and dingo/domestic dog hybrids), as sylvatic hosts for Australian *Taenia hydatigena* and *Taenia ovis*

David J. Jenkins, Nigel A.R. Urwin , Thomas M. Williams , Kate L. Mitchell , Jan J. Lievaart ,Maria Teresa Armua-Fernandez

International Journal for Parasitology: Parasites and Wildlife 3 (2014) 75–80

Sheep measles

Losses to sheep abattoirs, anything from a few hundred dollars/day to several thousand per day (approx. \$1,500 - \$2,500) with bad days up to \$4,500/day (Jenkins –MLA report 2014)

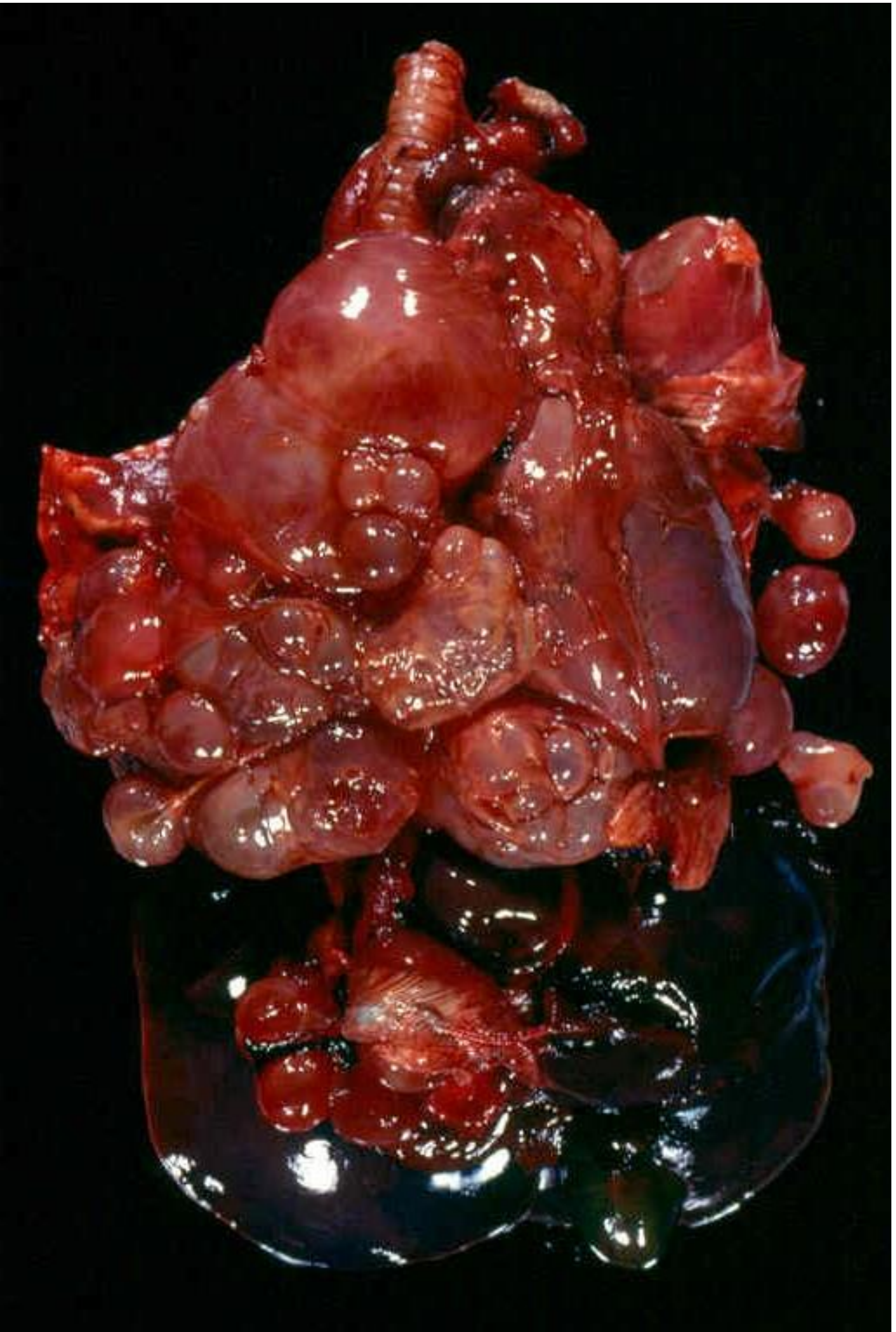
…..also public health impacts of hydatid disease

- Humans can act as a host for the cystic stage. Infection can lead to major health impacts and in some cases death

…..veterinary impacts of hydatid disease on native wildlife

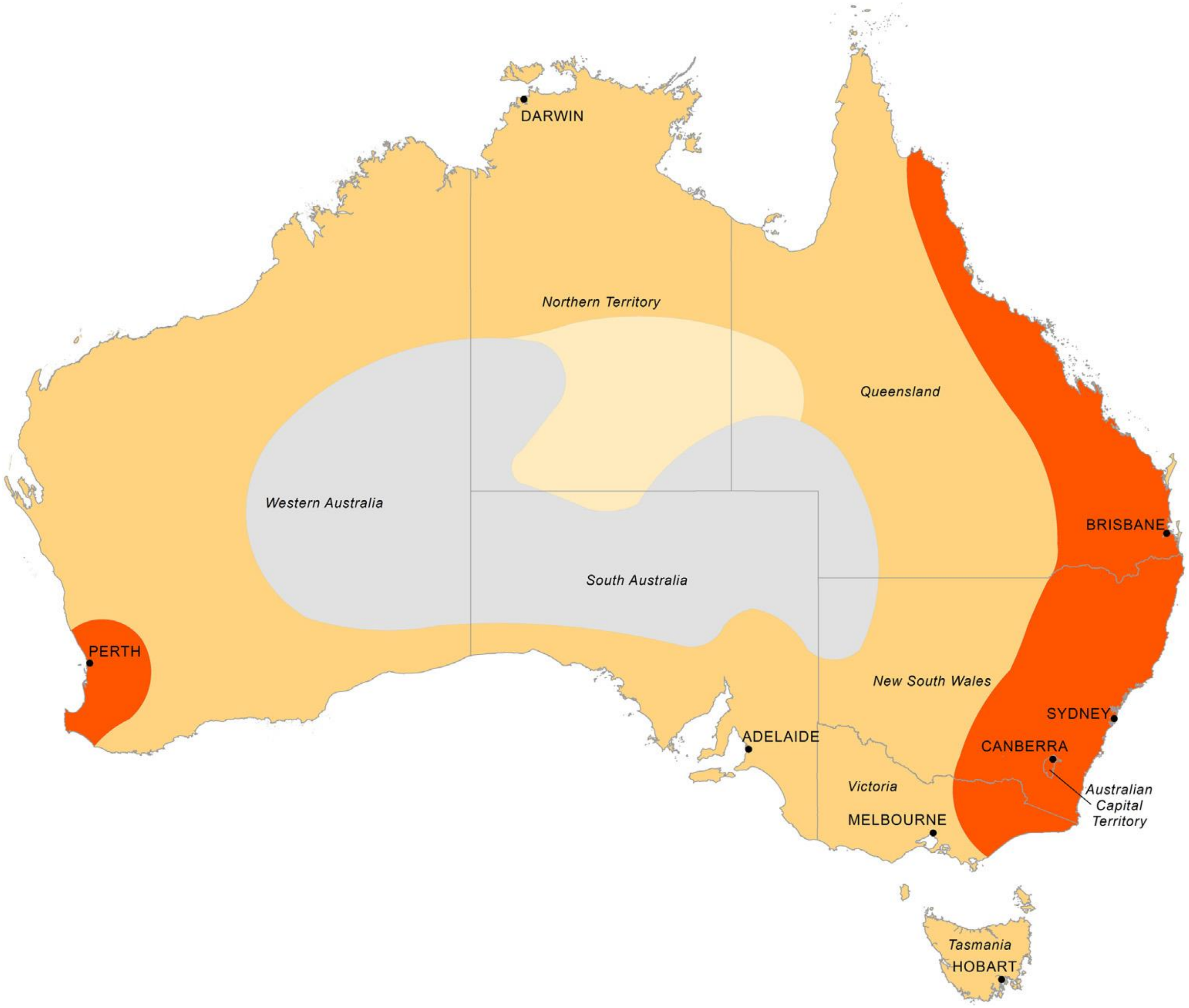
- In native wildlife (macropods) infection commonly leads to severe health impacts and death

Hydatids in humans



Hydatid disease in a wallaby

Where does hydatid disease occur in Australia?



Thompson and Jenkins - International Journal for Parasitology 44 (2014) 865–877

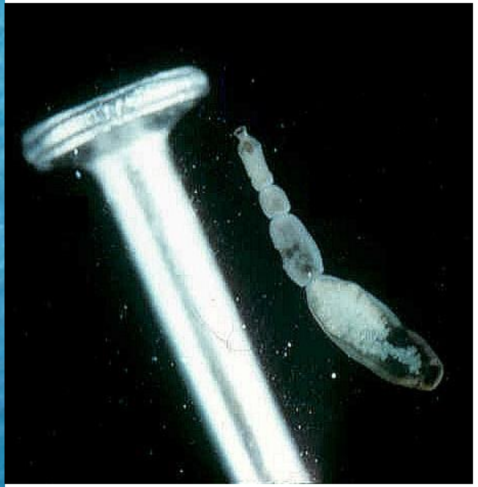
How are hydatids transmitted?

- Dogs eat cysts in offal
- Protoscoleces activate, attach to the inside of the dog’s gut and develop
- They are mature at about 42 days post infection and begin releasing eggs

Tapeworm transmission in dogs

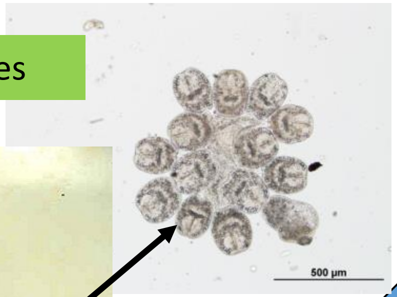
PPP=42 d

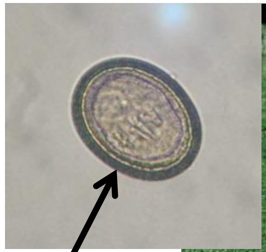
Cysts in internal organs of intermediate host, eaten by definitive host.



Eggs in faeces/environment.

Protoscoleces





6-hooked onchosphere

Eggs ingested by intermediate host – sheep.

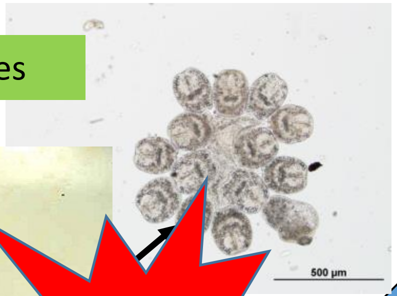
Tapeworm control in dogs

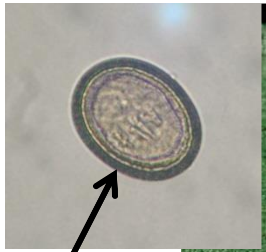
PPP=42 d

Cysts in internal organs of intermediate host, eaten by definitive host.

Eggs in faeces/environment.

Protoscoleces





6-hooked onchosphere

Eggs ingested by intermediate host – sheep.

The Australian hydatid transmission pattern has changed

- Hydatid disease in sheep now generally uncommon with localised areas of transmission
- Hydatid tapeworm infection in rural domestic dogs also uncommon
- Probably due to

  - the development of palatable, inexpensive, dry dog food

  - the inclusion of praziquantel in all widely available generic all- wormers for dogs

- Today hydatid disease is mainly perpetuated in a wildlife cycle between wild dogs (dingoes and their hybrids) and macropod marsupials, particularly wallabies

Tapeworms in definitive hosts - dingoes/& hybrids, (foxes)

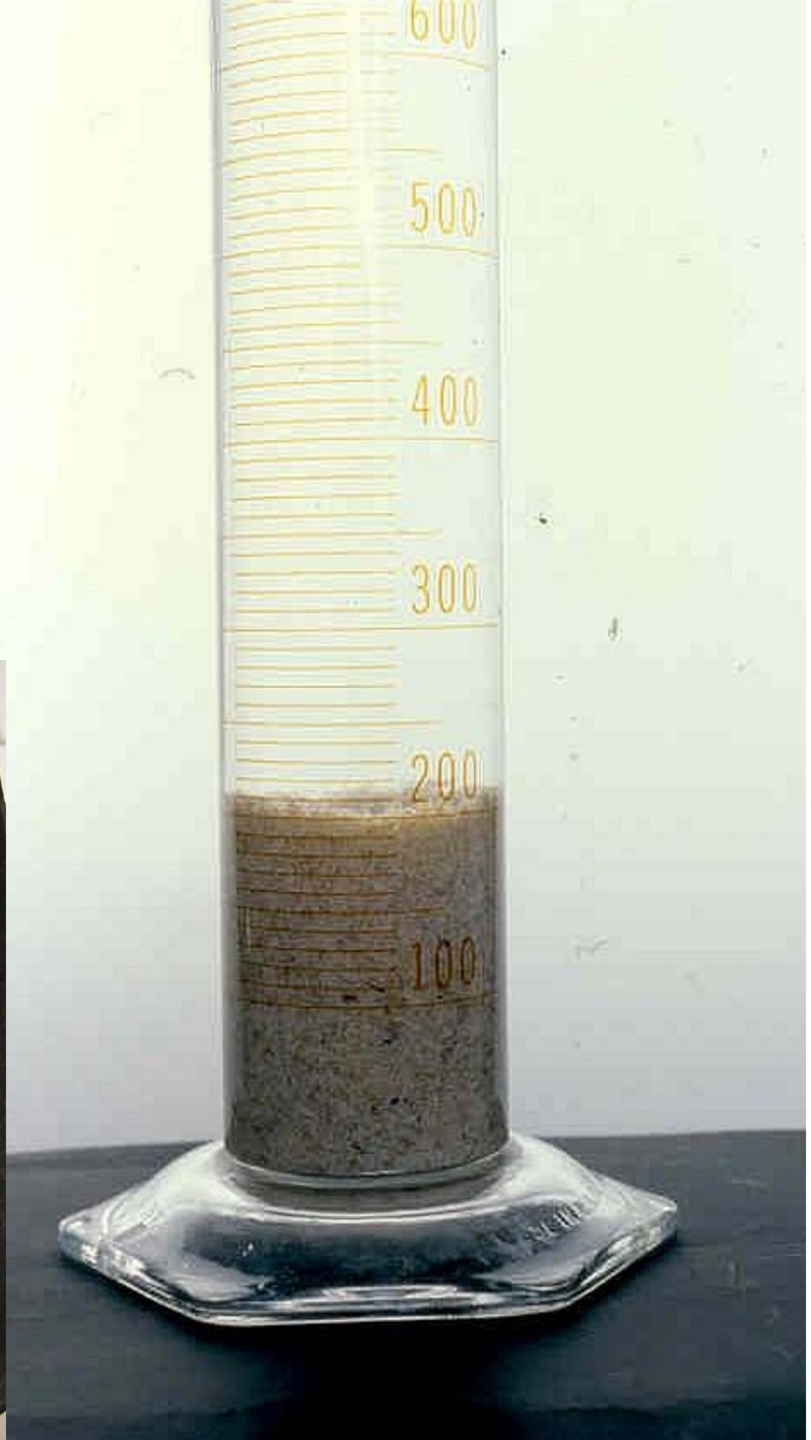
Cysts in internal organs of intermediate host, eaten by definitive host.

Eggs in faeces/environment

Eggs ingested by intermediate hosts – macropod marsupials/wombats, (feral pigs)

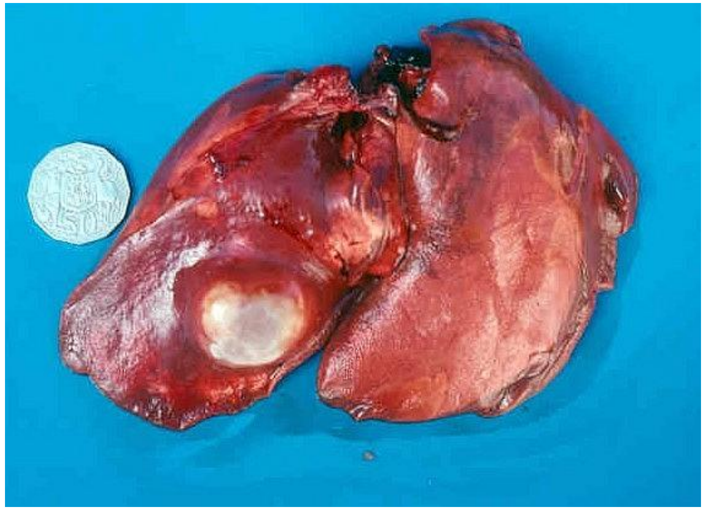
Predator/prey interaction


E. granulosus
segments

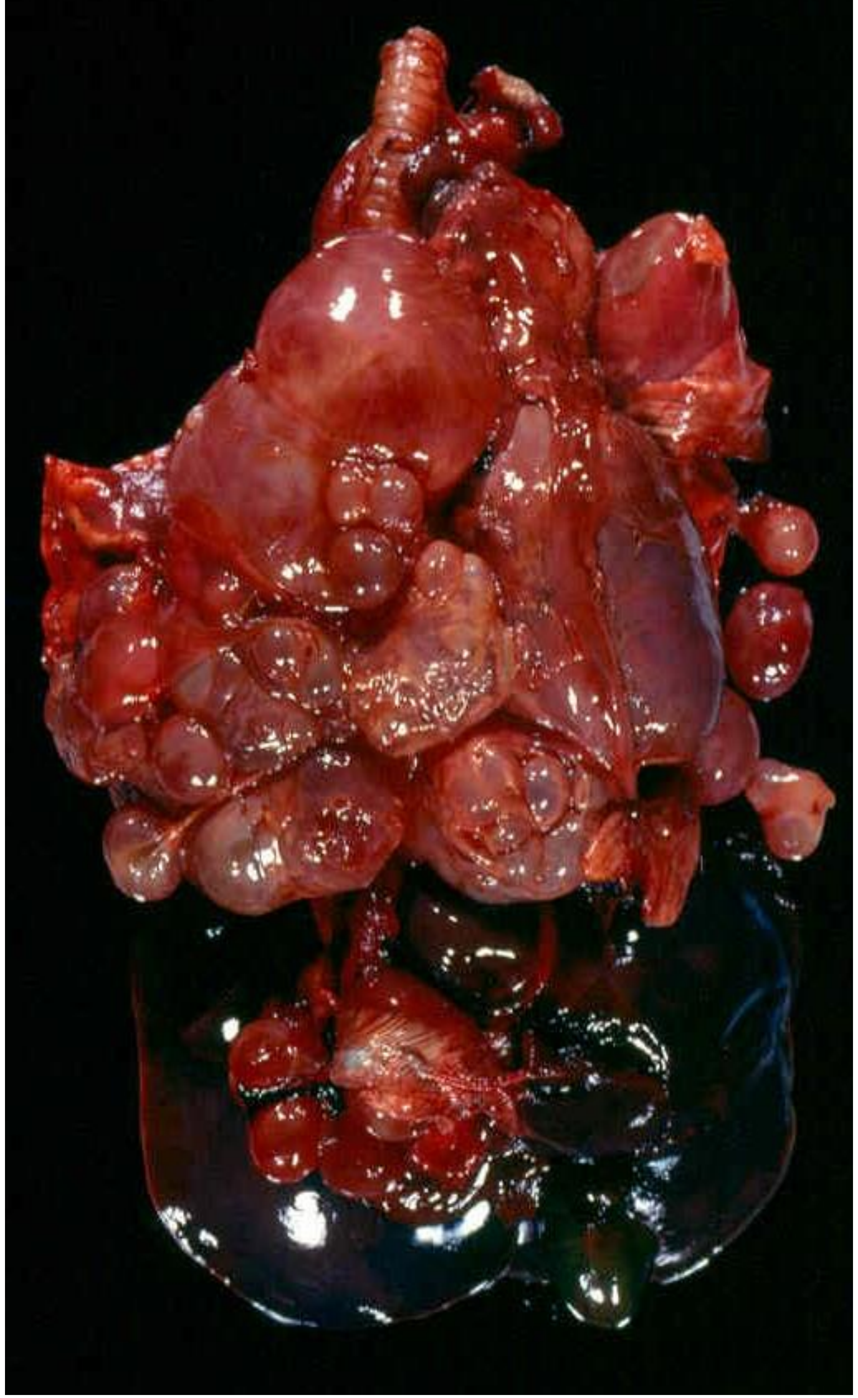

600
500
400
300
200
100

Hydatids in wildlife

Eastern Grey Kangaroo



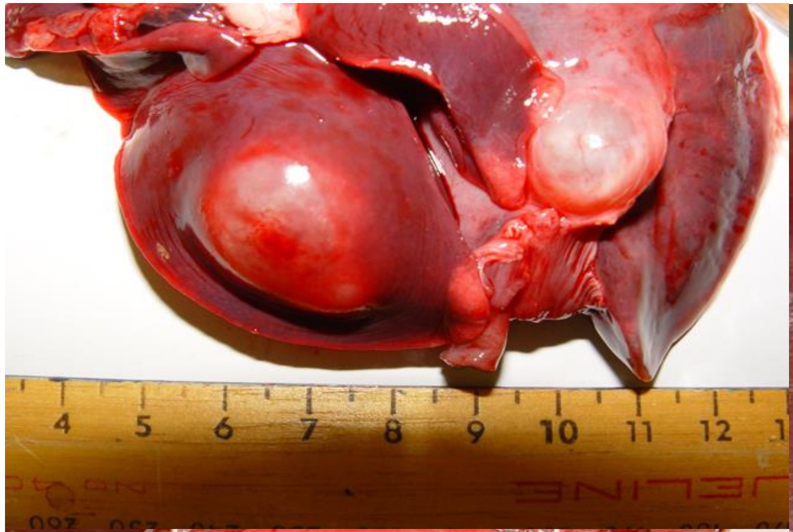
Wombat

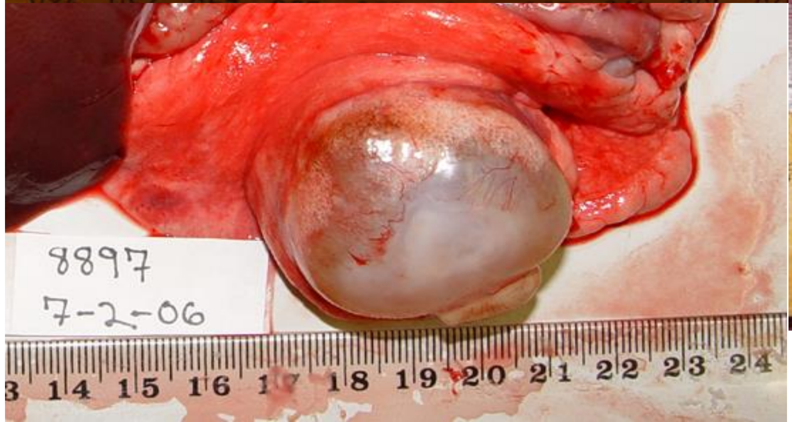


Swamp wallaby

Exotic parasites and naïve host populations.

Cysts 9 months post experimental infection (infected with same batch of eggs)….





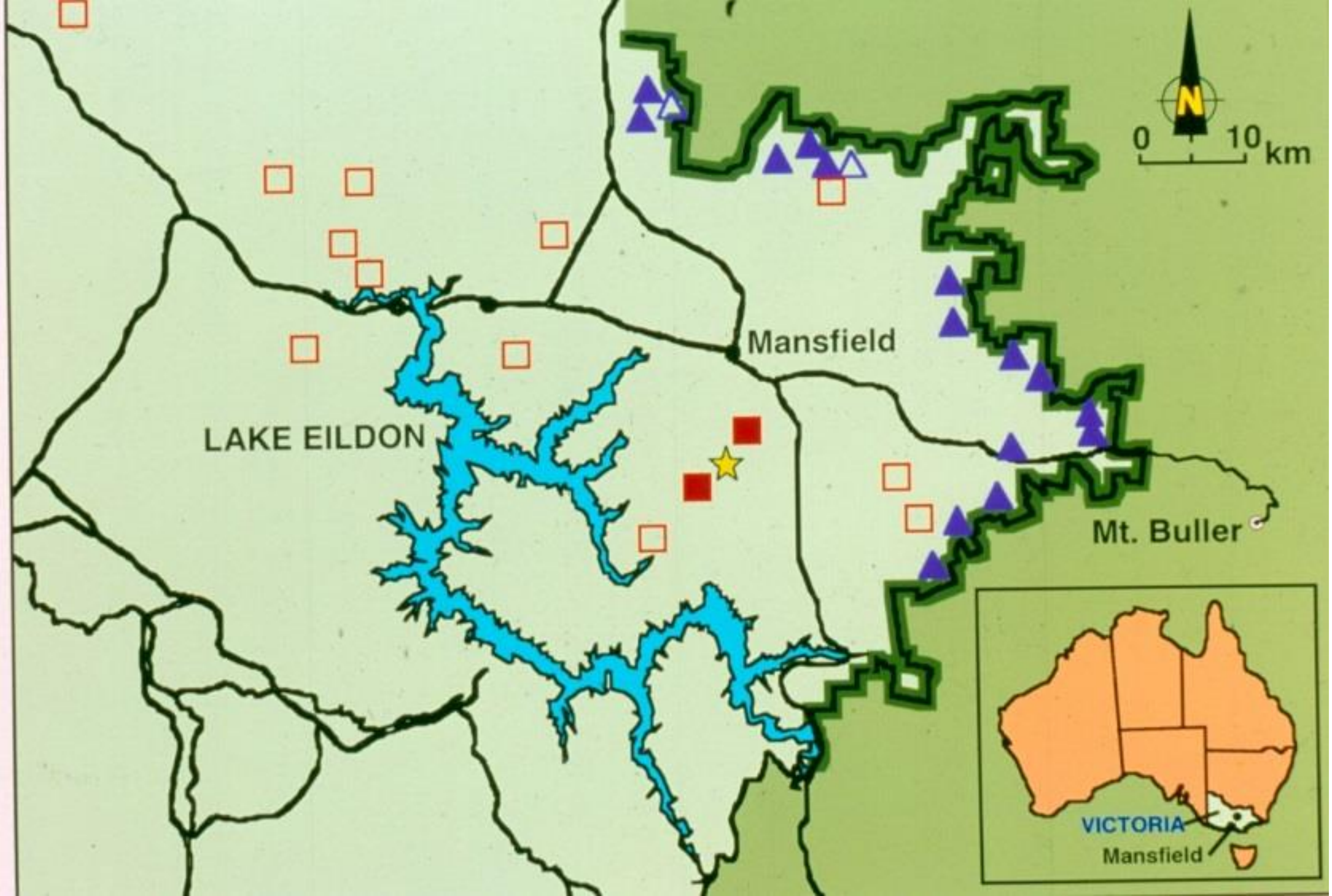
Barnes et al (2011) *J Comp Path* 144; 113-122

Transmission importance of flies?

International Journal for parasitology (1996) 26;1263-1270

Transmission of Hydatid Disease to Sheep from Wild Dogs in Victoria, Australia

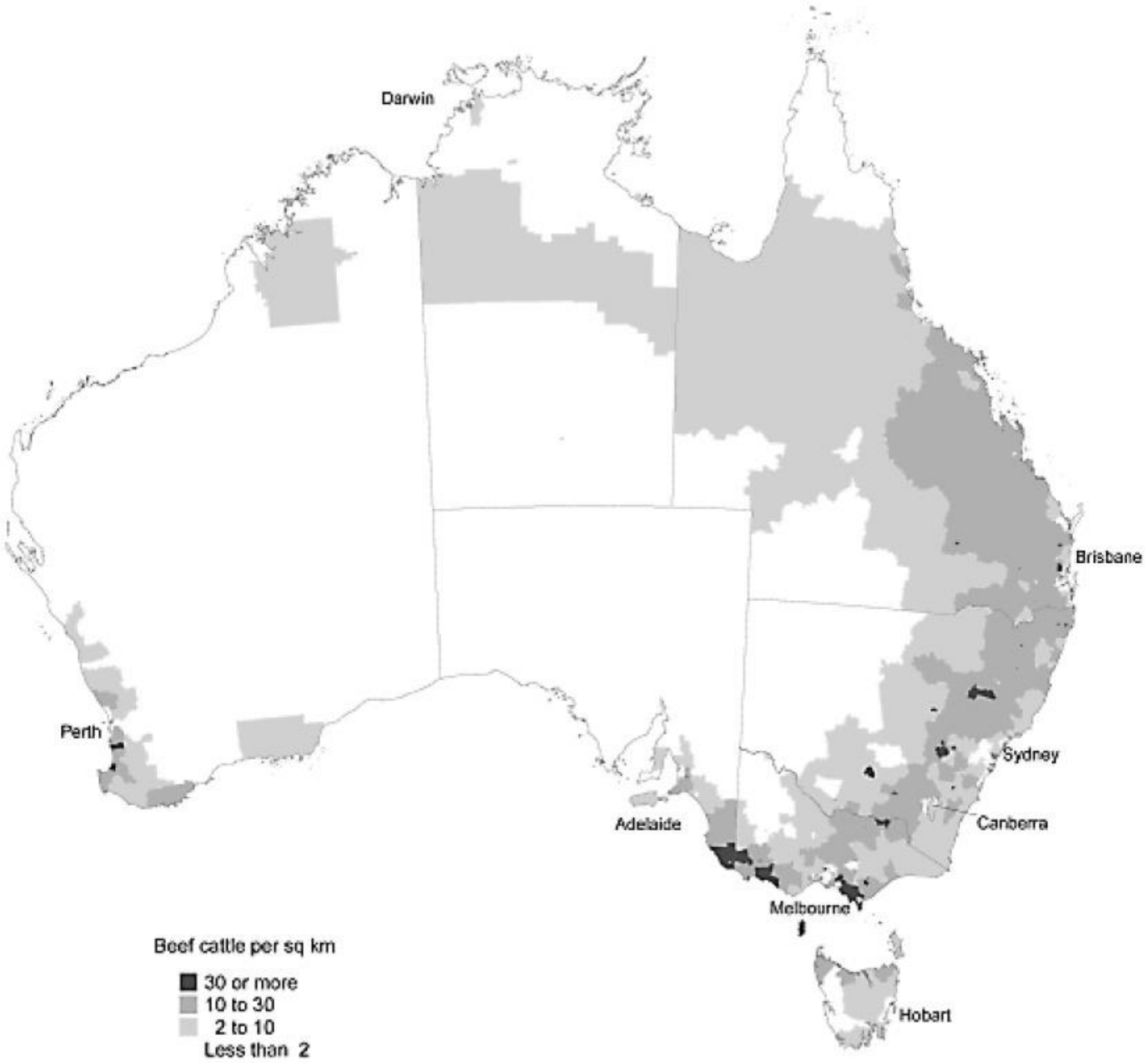
H. J. GRAINGER*† and D. J. JENKINS‡


N
0
10 km
Mansfield
LAKE EILDON
Mt. Buller
VICTORIA
Mansfield

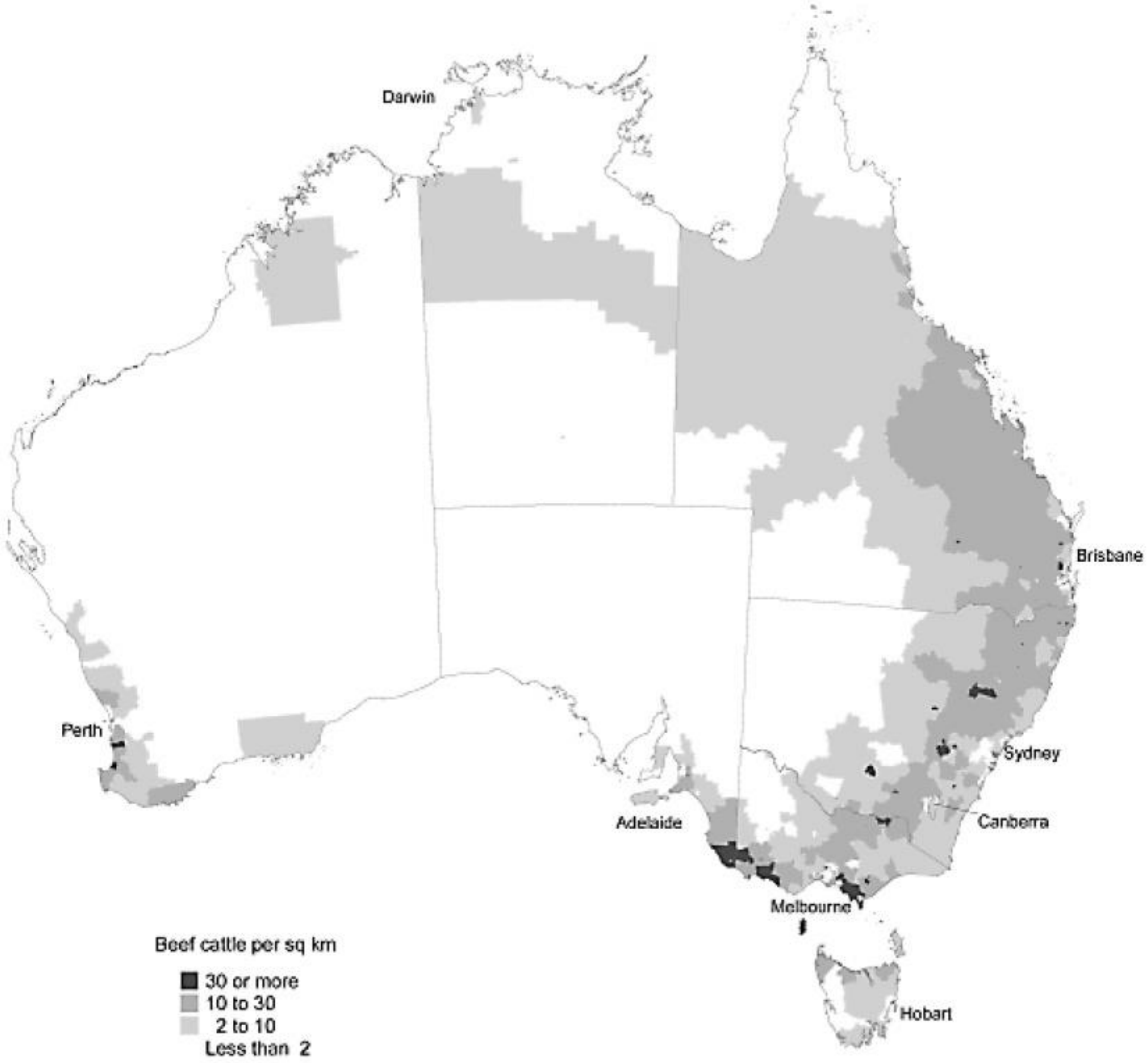
Bovine hydatidosis financial impact study

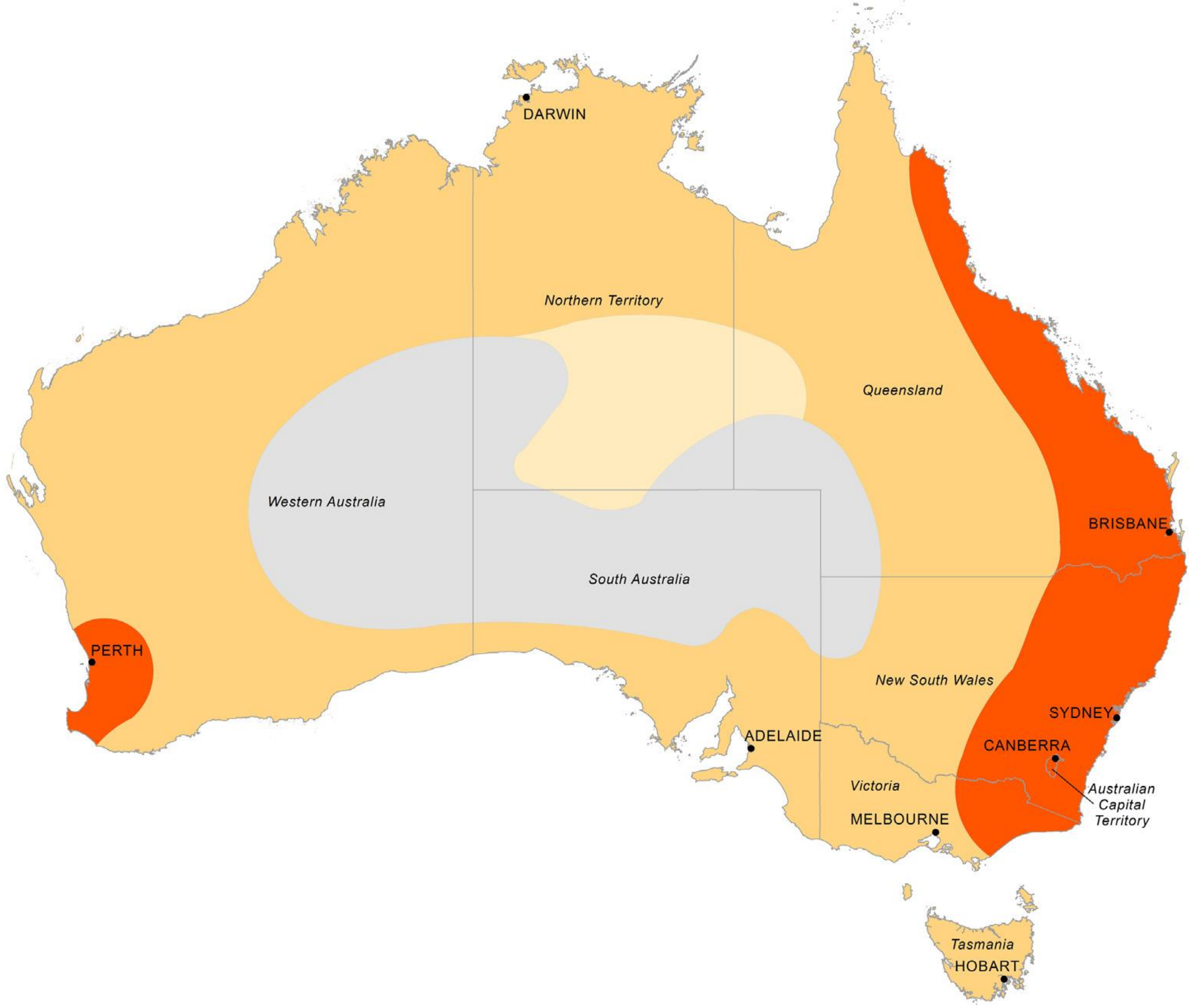
Although hydatid disease in sheep is now uncommon in many areas of eastern Australia hydatid disease in cattle is common

Distribution of cattle rearing areas in Australia



Cattle rearing and *E. granulosus* transmission areas





Team-hydatid

Sarah Fotheringham

Allan Gunn

Phil Kemsley

Vikki Brookes

Data collected……

- from one abattoir in north-eastern NSW
- between 1st of July 2013 - 30th of June 2015
- n = 781,873
- 43,002 (5.5%) infected with hydatid disease

- 5.5% beasts infected with hydatid cysts

- organs condemned
  for hydatid infection:

- 51% livers
- 48% lungs
- 1% spleen
- < 1% heart

- 93% of infected cattle had both liver and lung infection

- Mean weight loss in cattle infected with hydatid cysts
  - hide = 1.24 kg
  - carcass = 16.8 kg

- Financial loss per annum
  - Hide = $32,155
  - Carcass = $1,255,574
  - Liver = $283,126
  - Lung = $166,767
  - Heart = $1,687
  - Spleen = $588

- Financial value model
  - Financial loss = Total loss due to carcass weight loss + total loss due to hide weight loss + cost due to organ condemnation/ downgrading

- Total lost over the two year period $3,479,738.05

- Total lost per year = $1,739,869.03

- Potential confounders:

- Not all data were available that might influence prevalence and financial impact of hydatid disease were included. For example:
  - Breed of cattle
  - Travel time of cattle to abattoir
  - Pasture raised vs. grain-fed (feed lot)
- This is a case study based on an individual abattoir, therefore results cannot be extrapolated to fit other abattoirs

Cara Wilson - PhD student

Investigating, in much more detail, the data generated by Sarah Fotheringham.

- Cara has a total data base of 5.2 million slaughtered cattle (2000-2016).
- However, she is currently working on a sub-set of 1.8 million (2010-2016) for which she has complete data on hydatid infection and other conditions
- Cara will re-assess prevalence, losses, risk factors and also determine spatial distribution of bovine hydatidosis in Australia and assess financial viability of mitigation strategies

First report of an effective vaccine against sheep measles

Johnson, K.S., Harrison, G.B., Lightowlers, M.W., O'Hoy, K.L., Cougle, W.G., Dempster, R.P., Lawrence, S.B., Vinton, J.G., Heath, D.D., Rickard, M.D., 1989. **Vaccina-tion against ovine cysticercosis using a defined recombinant antigen**. *Nature* 338, 585

/
587.

EG95 vaccine against hydatid disease in sheep

Lightowlers MW, Lawrence SB, Gauci CG et al.

Vaccination against hydatidosis using a defined recombinant antigen

Parasite Immunology (1996) 18; 457-62

International Journal for Parasitology 29 (1999) 531-534

Vaccination trials in Australia and Argentina confirm the efectiveness of the EG95 hydatid vaccine in sheep

M.W. Lightowlers, O. Jensen, E. Fernandez, J.A. Iriarte, D.J. Woollard, C.G. Gauci, D.J. Jenkins, D.D. Heath

2 isolates of eggs used in challenge infections:

- NZ sheep/dog
- Australian macropod/dingo

96-100% protection achieved

Experimental use of the EG95 sheep hydatid vaccine in cattle

Vaccine 30 (2012) 3076– 3081

Expt 1

Vaccination of bovines against *Echinococcus granulosus* (cystic echinococcosis)

David D. Heath, Christine Robinson, Trevor Shakes, Yan Huang, Tursun Gulnur, Baoxing Shi, Zhuangzhi Zhang, Garry A. Anderson, Marshall W. Lightowlers

Vaccine 30 (2012) 7321–7326

Expt 2

Maternal antibody parameters of cattle and calves receiving EG95 vaccine to protect against *Echinococcus granulosus*

David D. Heath, Christine Robinson, Marshall W. Lightowlers

Expt 1: Vaccination of bovines against *Echinococcus granulosus* (cystic echinococcosis)

- Scaled-up the vaccine for sheep (x5 sheep dose) administered
- Gave 2 vaccinations one month apart
- This treatment gave 90% protection to expt challenge infection that lasted for 12 months

- Giving a 3rd vaccination 12 months after vax 1 & 2 gave 99% protection to expt challenge infection that lasted for at least 11 months

Expt 2:
Maternal antibody parameters of cattle and calves receiving EG95 vaccine to protect against *Echinococcus granulosus*

- 2 gps of pregnant cows, one gp vaccinated (2 vaccinations, 4 wks apart), the other unvaccinated
- Calves of both groups expt challenged @ 4; 9; 13 or 17 wks post vax
- Colostral antibodies from vaccinated cows protected calves for 17 weeks

- 8 &12 week old calves responded well to vax (made antibodies) but incomplete protection
- Full protection only achieved if vaccinated @ 16 weeks old (same for calves from unvaccinated cows)

- Suggests immune system of calves not fully functional until 4-5 months old