

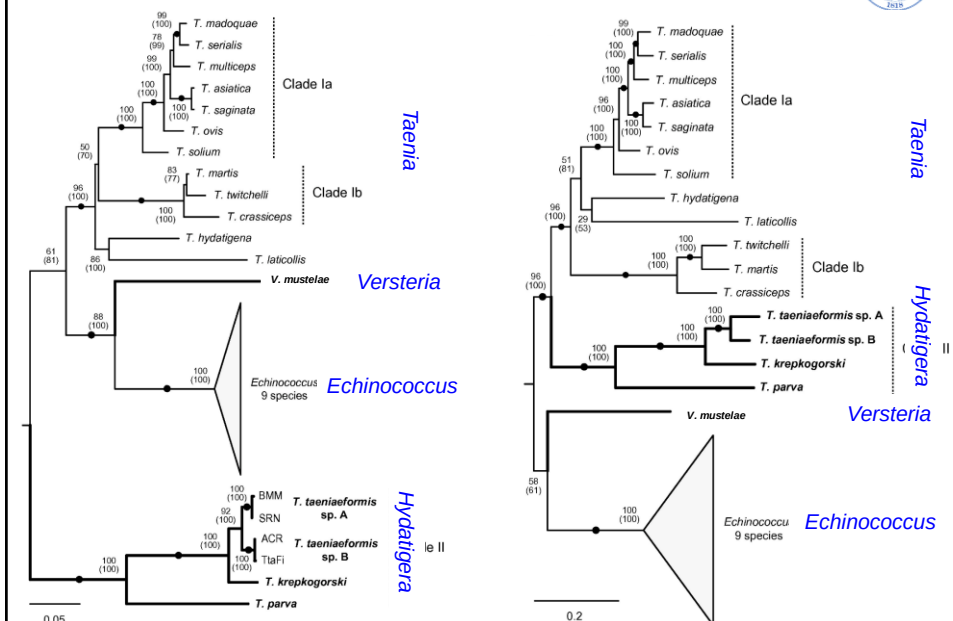


Species and genotypes – what is new?

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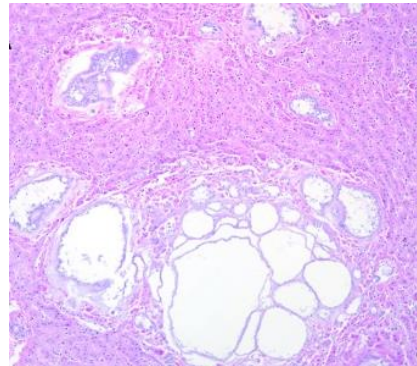
Phylogeny of Taeniidae (Nakao et al., 2013)





Fatal Metacestode Infection in Bornean Orangutan Caused by Unknown *Versteria* Species

Tony L. Goldberg, Annette Gendron-Fitzpatrick,
Kathleen M. Deering, Roberta S. Wallace,
Victoria L. Clyde, Michael Lauck, Gail E. Rosen,
Andrew J. Bennett, Ellis C. Greiner,
and David H. O'Connor



Goldberg et al., EID 20 (2014)



Conventional textbook-taxonomy:

E. granulosus ,dog tapeworm'

E. multilocularis ,fox tapeworm'

E. oligarthra

E. vogeli

cystic echinococcosis

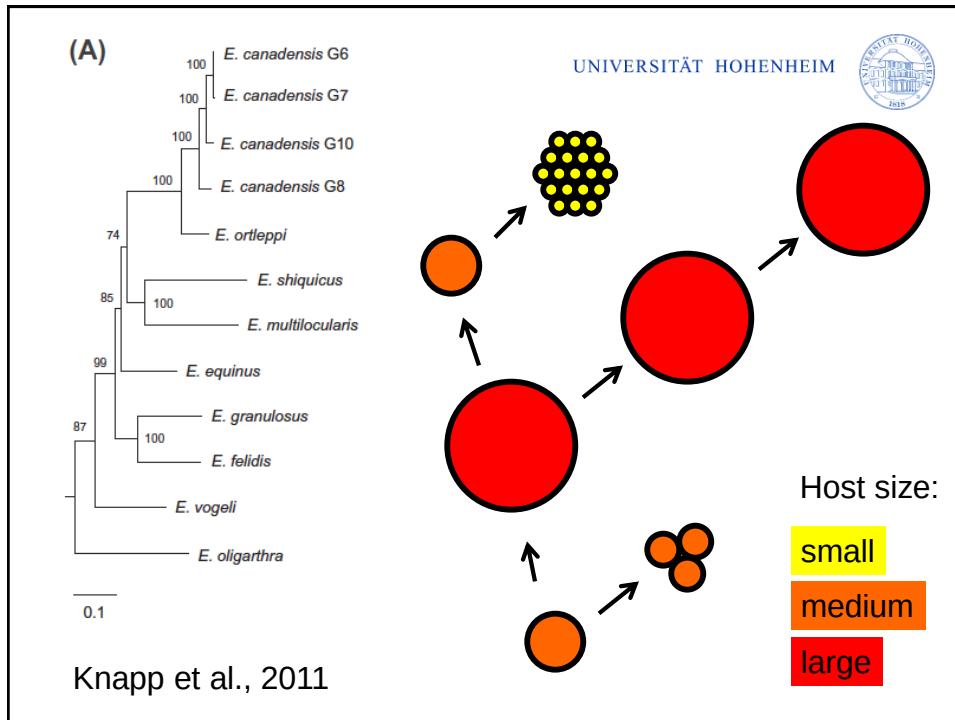
alveolar echinococcosis

,unicystic' echinococcosis

neotropical echinococcosis

polycystic echinococcosis

*E. multilocularis**E. shiquicus**E. oligarthra**E. vogeli**E. granulosus* s.s. G1/3, G-Omo*E. equinus**E. ortleppi**E. canadensis* G6/7, G8, G10*E. felidis**E. granulosus* s.l.*E. multilocularis**E. shiquicus**E. oligarthra**E. vogeli**E. granulosus* s.s. G1/3, G-Omo*E. equinus**E. ortleppi**E. canadensis* G6/7, G8, G10*E. felidis**E. granulosus* s.l.



Cystic echinococcosis can be caused by different parasites



CE caused by different parasites is transmitted by different animals

The presence of CE in animals hosts may or may not be relevant for public health



CE caused by different *Echinococcus* species
may not be the same disease

- cyst location
- disease progress
- diagnosis
- treatment ??



Most ,historical‘ data (until 2000s) are difficult to interpret, because species identities are not clear

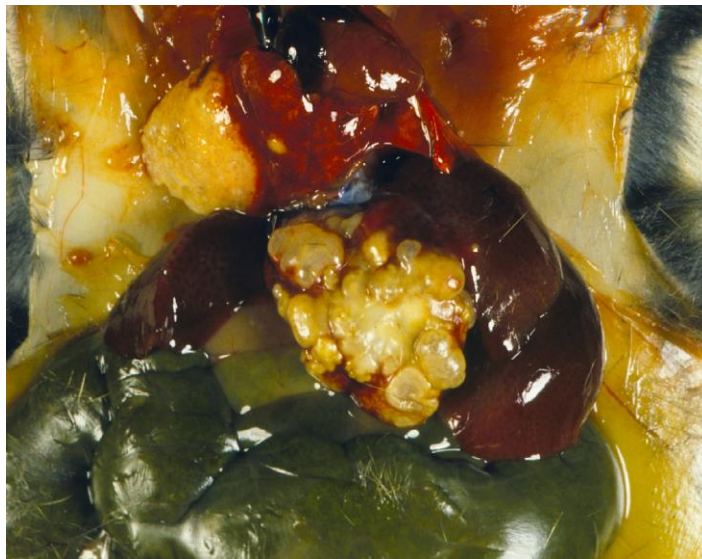
- epidemiology
- clinical data
- diagnostics
- immunology / vaccine studies



Brief species accounts.

***Echinococcus multilocularis***

- northern hemisphere
- wild canids – rodents
- moderate numbers of human cases in Europe, high numbers in part of Asia, only sporadic cases in North America
- **intraspecific variants with different infectivity / pathogenicity to humans?**
- **geography of genotypes still unclear**





Echinococcus shiquicus

- Tibetan plateau
- Tibetan fox - pika
- no human cases known (molecular discrimination from the sympatric *E. multilocularis*!)



Echinococcus oligarthra

- S-Argentina to N-Mexico
- felids – large rodents
- epidemiology unclear
- few human cases
- high genetic diversity (Soares et al., 2013)





Echinococcus vogeli

- South and Central America
- bush dog – large rodents
- synanthropic transmission via dogs
- epidemiology unclear
- moderate number of human cases (rural, remote areas)



D'Alessandro et al., 2008



E. multilocularis

E. shiquicus

E. oligarthra

E. vogeli

E. granulosus s.s. G1/3, G-Omo

E. equinus

E. ortleppi

E. canadensis G6/7, G8, G10

E. felidis

E. granulosus s.l.



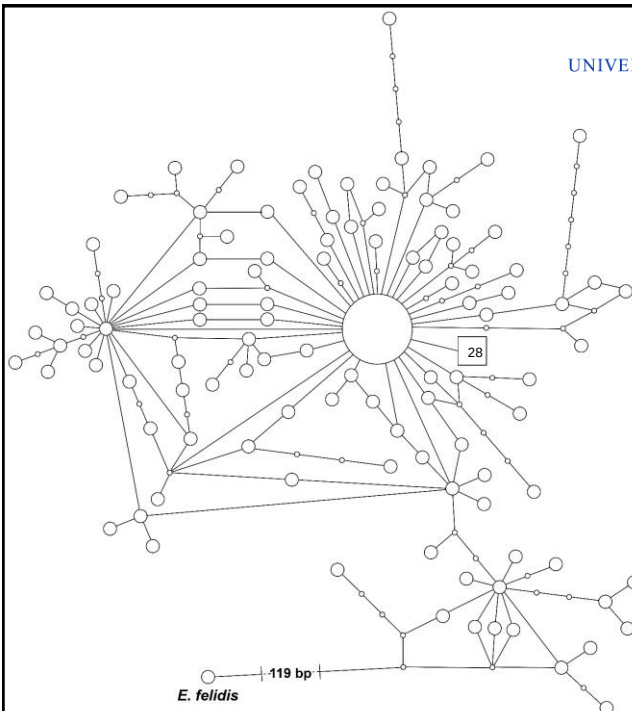
Echinococcus granulosus s.s.

- worldwide
- frequent and highly fertile in sheep (and pigs)
- frequent, but often infertile in cattle
- most frequent agent of human CE

Of 1661 genotyped cyst isolates from humans worldwide (Alvarez Rojas et al., 2014):

88.44% *E. granulosus* s.s.
 11.07% *E. canadensis* G6/7
 0.36% *E. ortleppi*
 0.12% *E. canadensis* G8 and G10

- infraspecific variants with different host affinities?

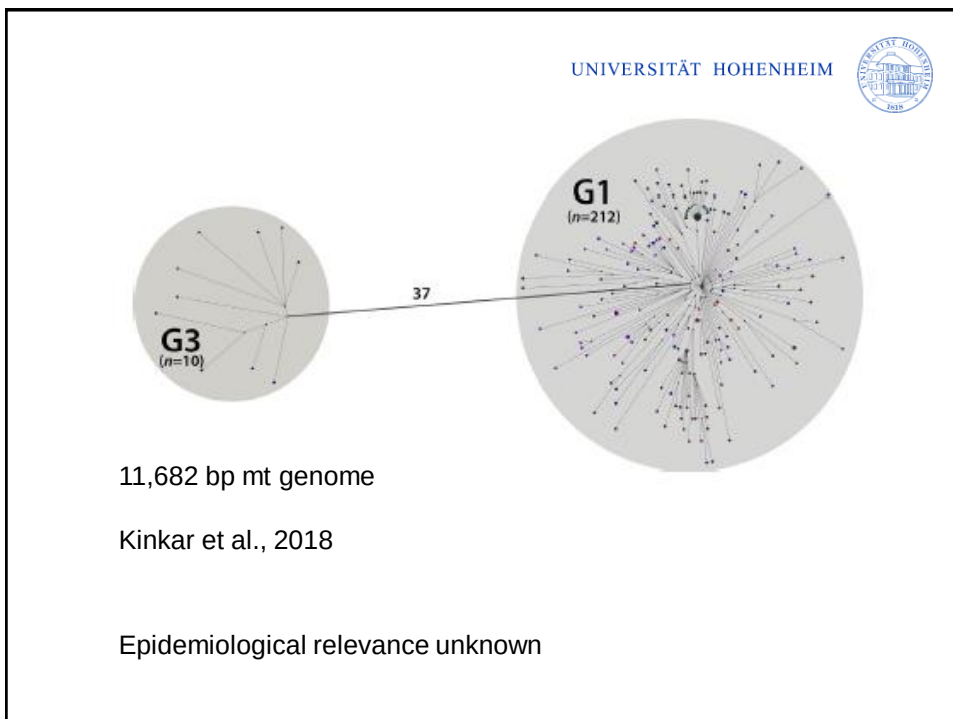
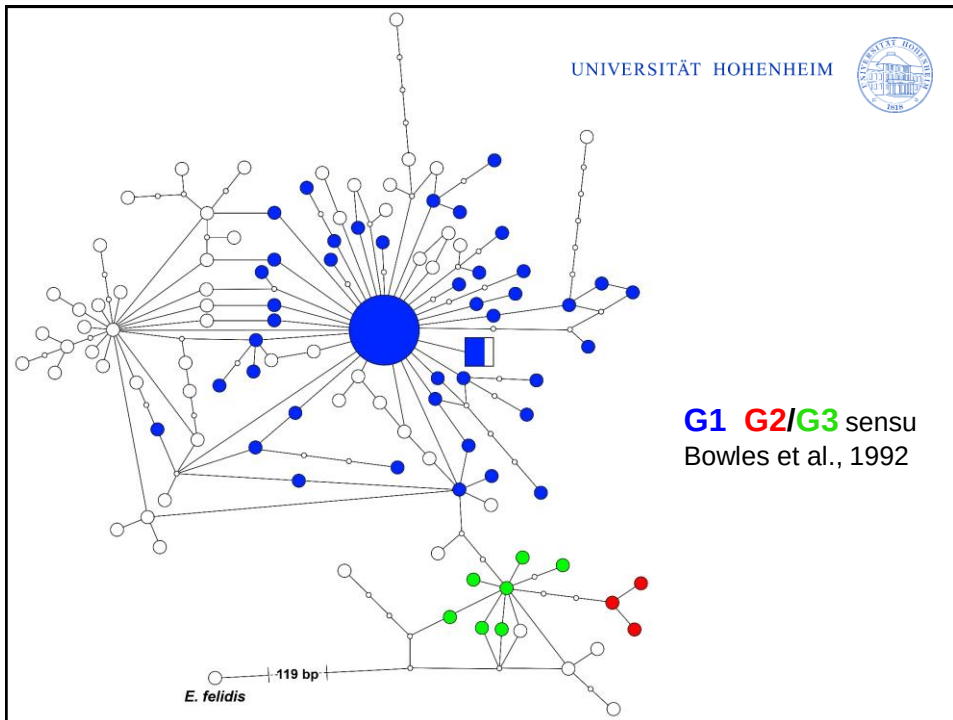


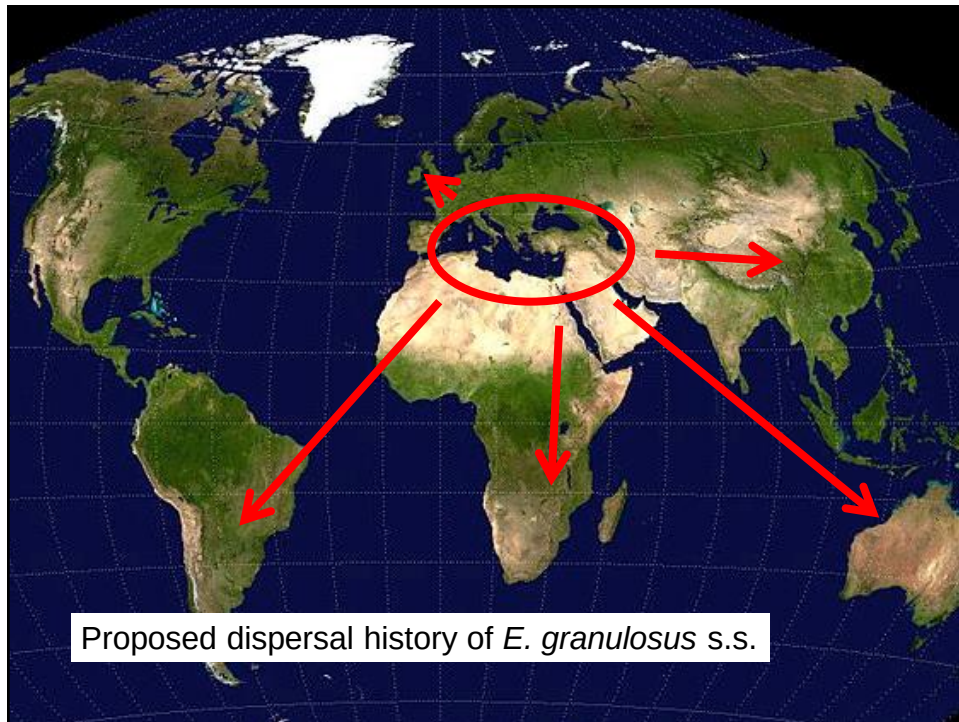
haplotype network of
cox1 (1608 bp)

137 haplotypes

304 isolates:
 Europe (16)
 W-Asia (140)
 E/S-Asia (40)
 Africa (78)
 S-America (30)

Yanagida et al., 2012
 Konyaev et al., 2013
 Joshi & Yamasaki, 2010
 Ebi, unpubl.





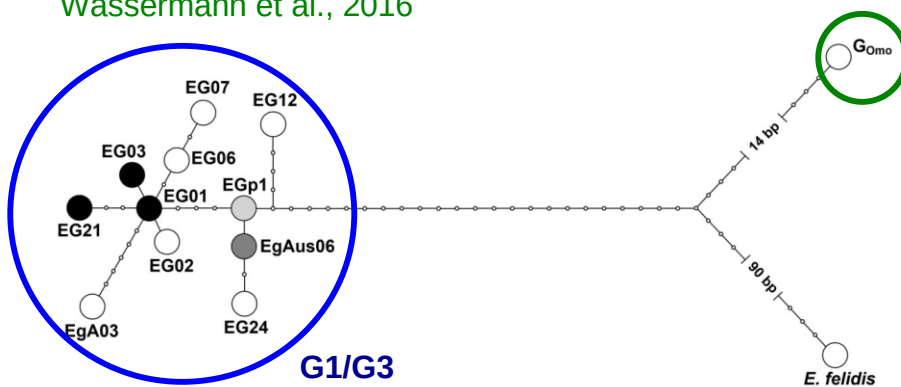
G-Omo

UNIVERSITÄT HOHENHEIM



- undescribed taxon from East Africa
- unclear host range, known from humans and cattle
- sister taxon to *E. granulosus*

Wassermann et al., 2016





Echinococcus felidis
(,lion strain ‘)

- sister taxon to *E. granulosus* s.s.
- no human cases known
- wildlife in sub-Saharan Africa



Hüttner et al., 2008
Hüttner et al., 2009
Kagendo et al., 2014



Echinococcus equinus

- adapted to equids
- dog – horse/donkey cycles
- one recent human case in Uzbekistan
- lion – zebra cycle in southern Africa





Echinococcus ortleppi

- typical cycle: dog – cattle (locally pigs)
- worldwide, usually rare (no home slaughter of cattle?)
- foci in southern Africa, southern Brazil, formerly central Europe)

Only six human cases known (globally distributed)





Echinococcus canadensis

Highest intra(?)specific complexity of all *Echinococcus* spp.

G6/7: Worldwide domestic cycles dog – pigs/camels/goats

G8 and G10: northern wildlife and semi-domestic cycles

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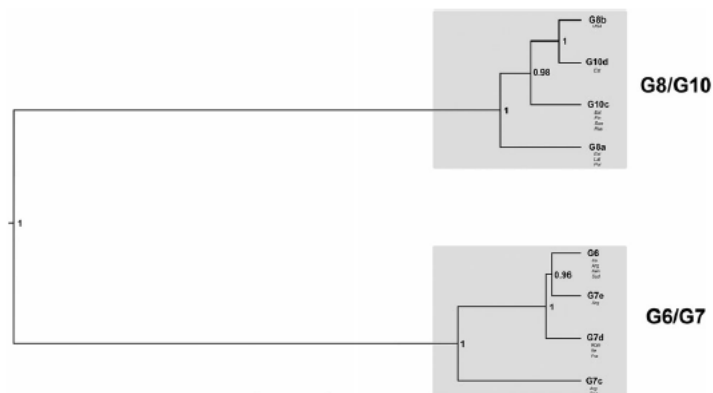
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Echinococcus canadensis

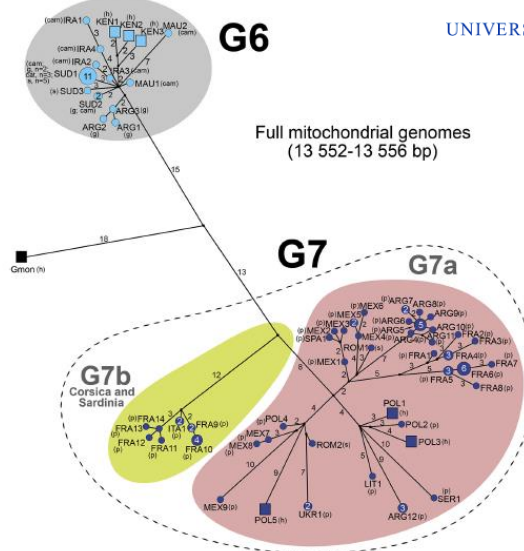
Two clades (6 nuclear loci – Laurimae et al., 2018):





Echinococcus canadensis

- two distinct species?
- distinction not supported by the mt genome: 1 or 3 species
- genetic exchanges in sympatry (Yanagida et al., 2017)
- name for new species? *E. intermedius*?



Laurimae et al., 2018

**Outlook:**

Large parts of epidemiological and clinical data on CE have to be re-evaluated

Characterization of G-Omo

Internal structure of the *E. canadensis* cluster

Avoidance of overdiscrimination (‘cactusisation’) – relevance for epidemiology and public health?