A model to assess effects of climate change on infections

Tularemia

Reported cases
2000-2005:
Finland >2,500
Sweden 2,000

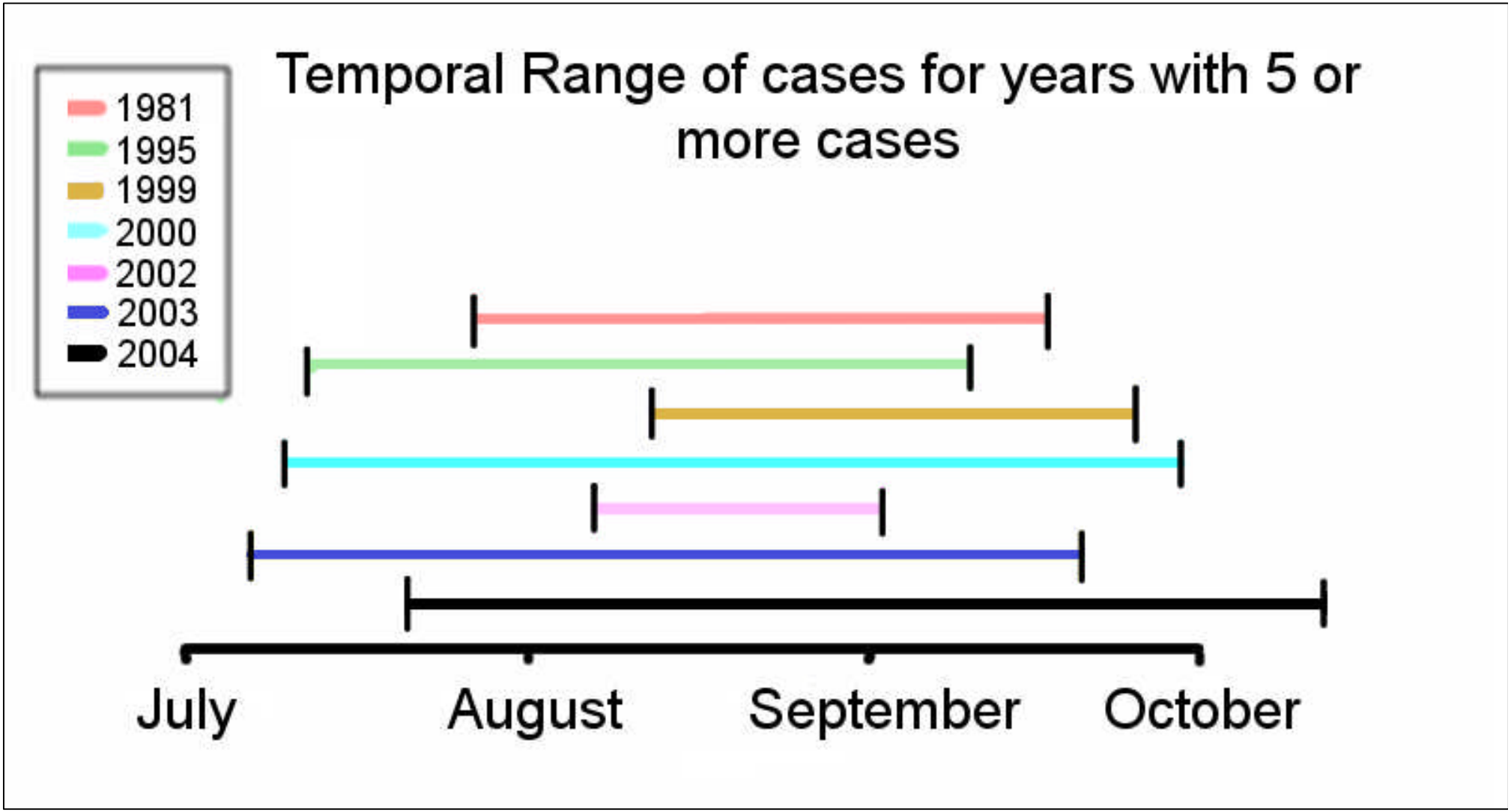
2006-
Finland >1,500
Sweden 1,000

Francisella tularensis

- Causative agent of tularemia
- Highly infectious – infectious dose <10 bacteria
- Spreads by rodents, hares, mosquitoes, ticks etc.
- Infects through the skin, mucous membranes, gastro-intestinal tract, lungs
- 2 clinically important subspecies

  tularensis (Type A) only North America
  holarctica (Type B) Northern hemisphere

- Infectious cycle is normally dependent in ticks, but in Scandinavia most cases are related to mosquito-bites


Temporal Range of cases for years with 5 or more cases
1981
1995
1999
2000
2002
2003
2004
July
August
September
October

CLIMATE CHANGE AND INFECTIOUS DISEASES

Effects of climate change on tularaemia disease activity in Sweden

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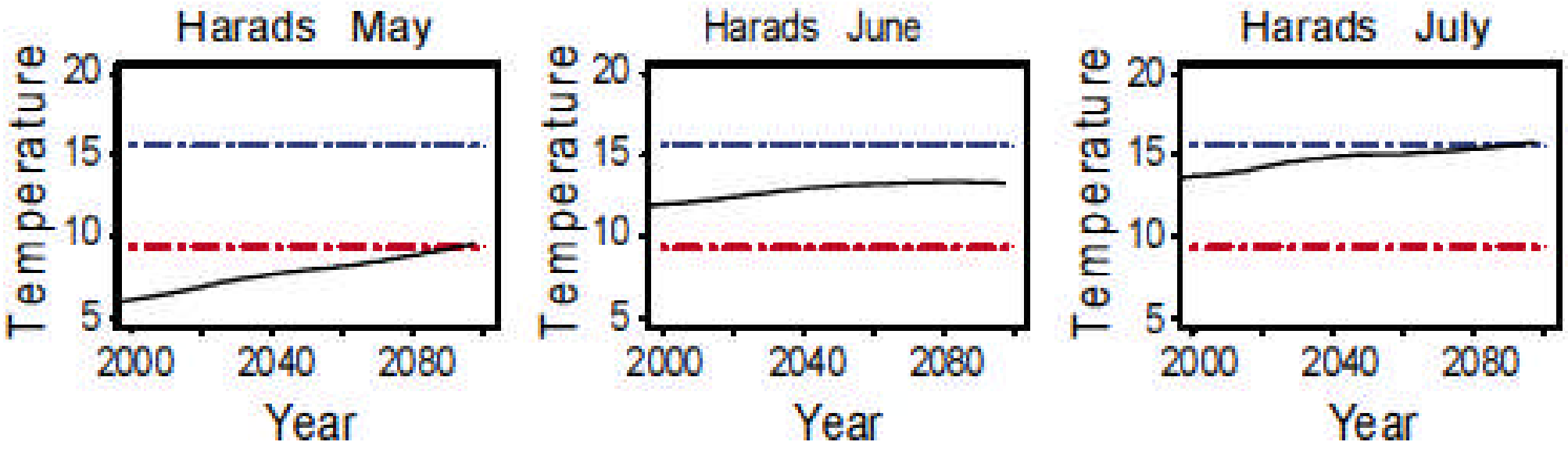
Projected future temperatures

IPCC Special Report on Emissions Scenario B2



Periods with transmission-permissive temperatures

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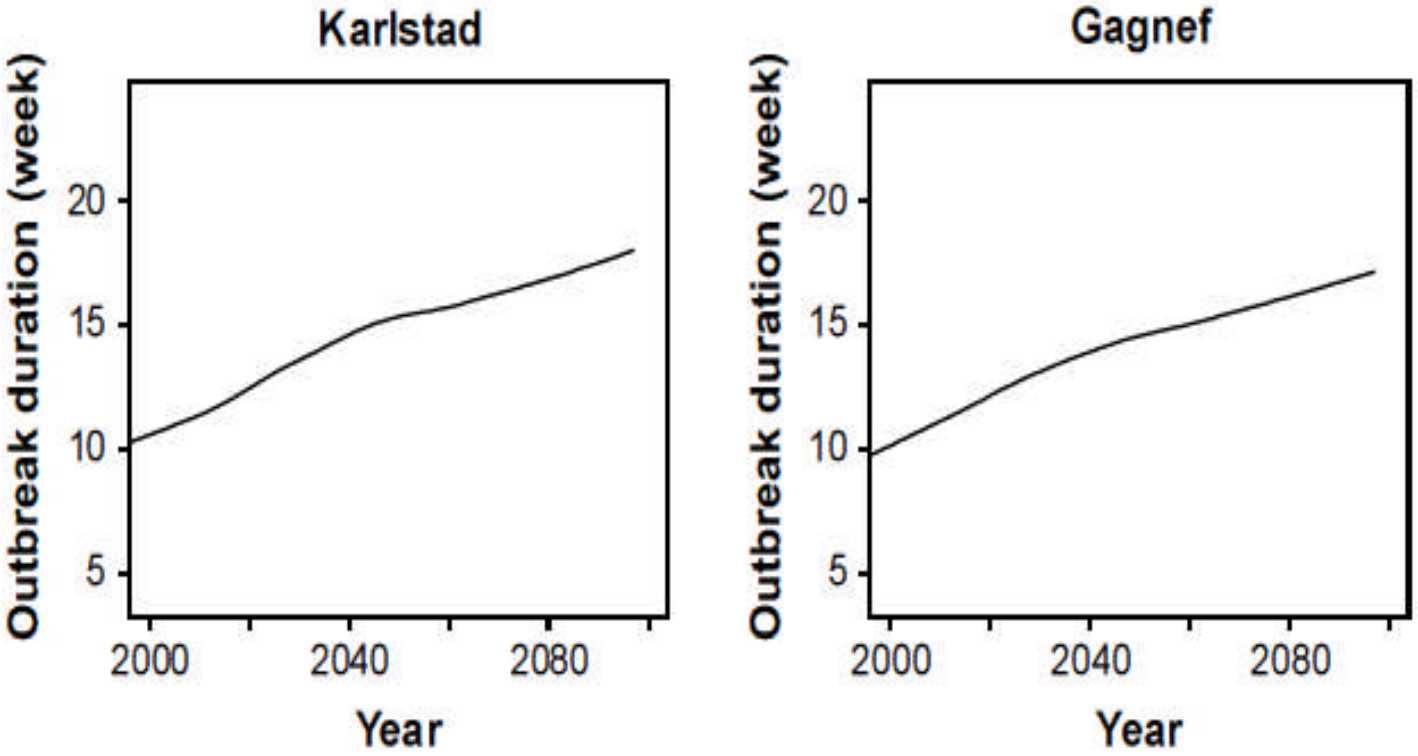
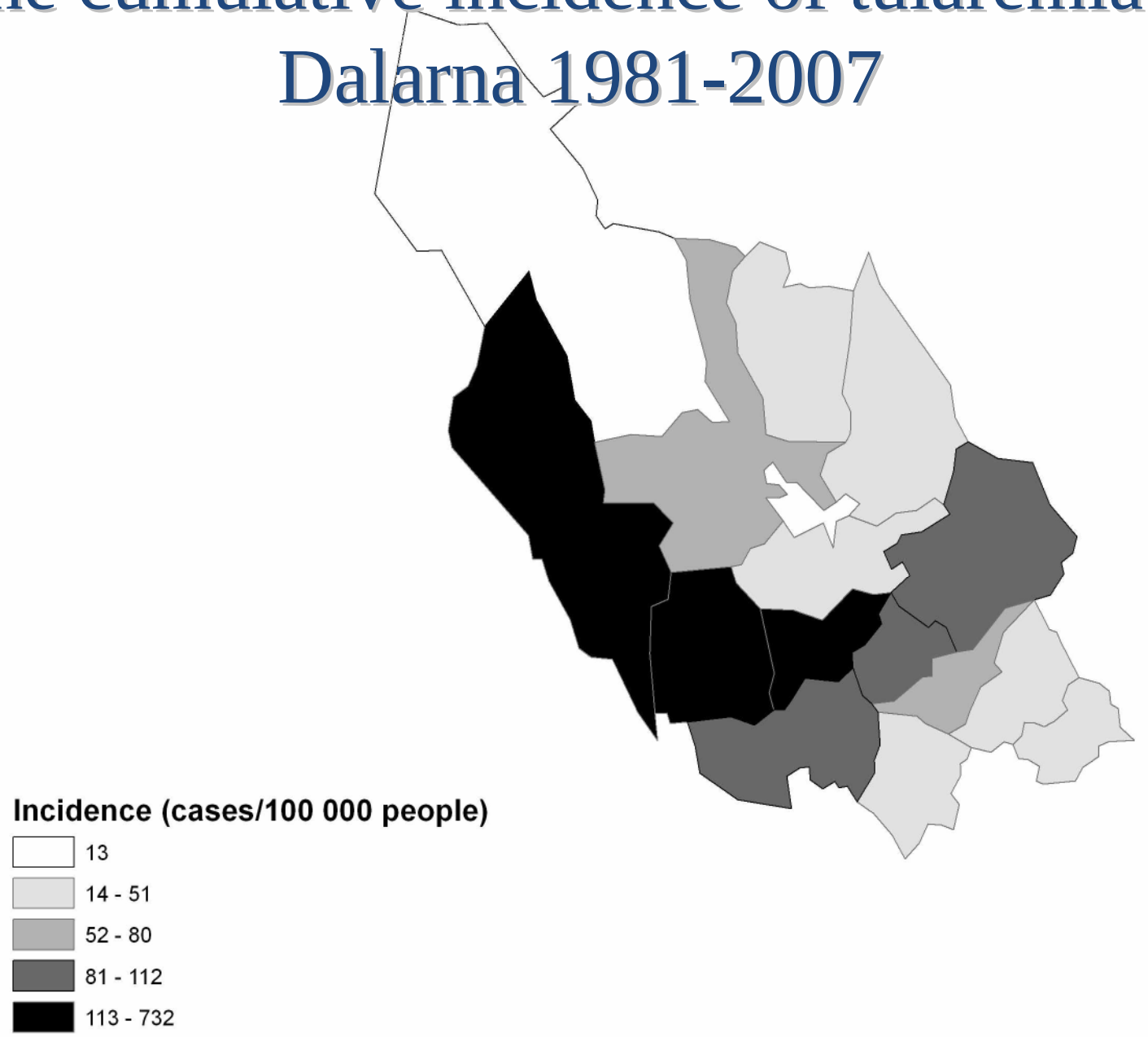
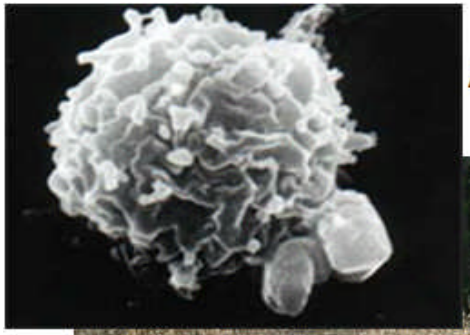


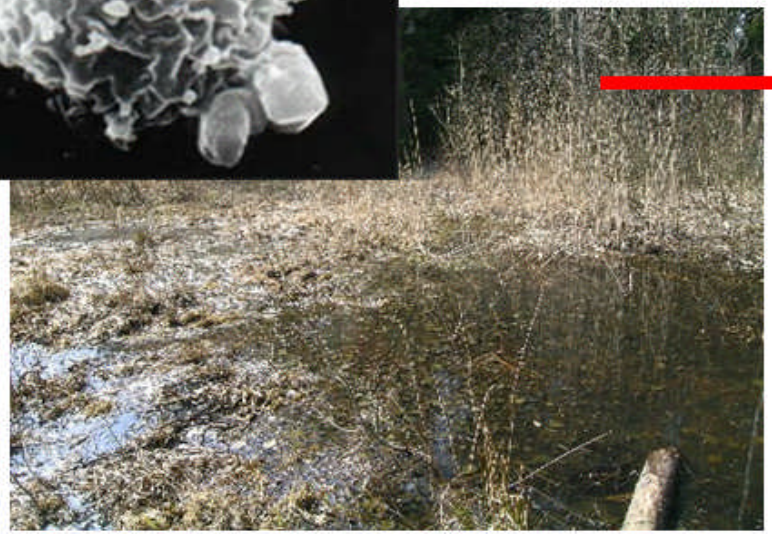
The cumulative incidence of tularemia in Dalarna 1981-2007



The Water Transmission Hypothesis



A) Francisella associated with water



B) Francisella infects mosquito larva

C) Mosquitos transmits the bacteria to humans and rodants

Environmental factors that can explain the occurrence of outbreaks

- Temperature, precipitation, humidity, snow cover, water flow
- Summer precipitation
- Summer humidity
- Lag-1 summer temperature
- Winter temperature

The role of mosquitoes for tularemia outbreaks

No mosquito data available for Dalarna

Solution: Predict mosquito abundance using environmental data and a predictive mosquito model

Conclusions

- There is a temporal relationship that support a causative relationship
- The predicted future warming will significantly increase the risk of tularemia outbreaks
- There is quantative correlation of mosquito abundance in late summer and tularemia in humans
- The tools are generally applicable for forecasting outbreaks and their relationship to arthropod distribution

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