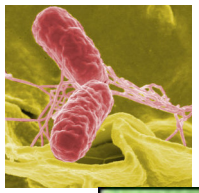
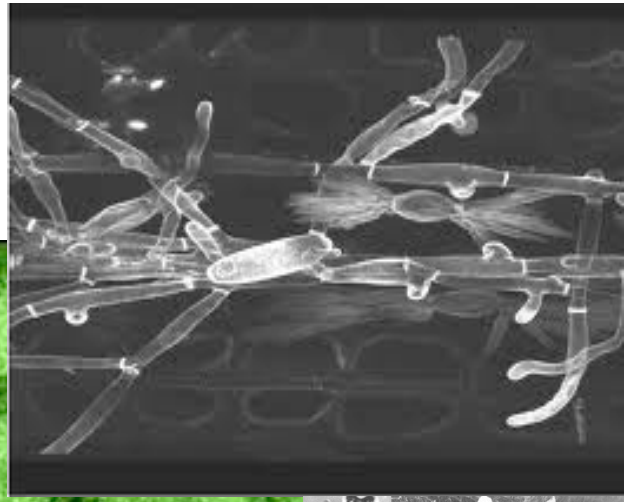
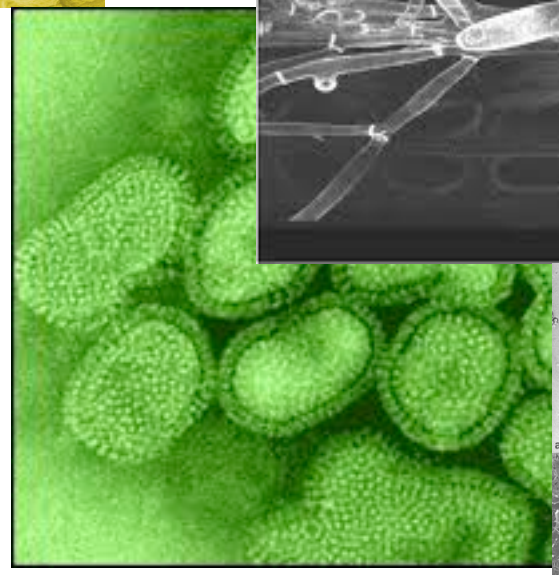
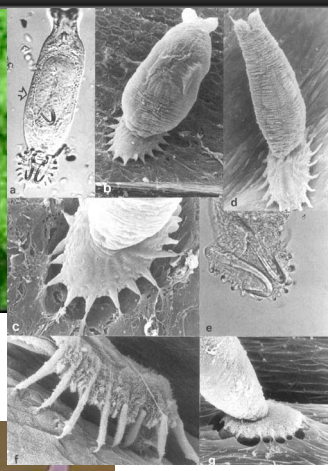
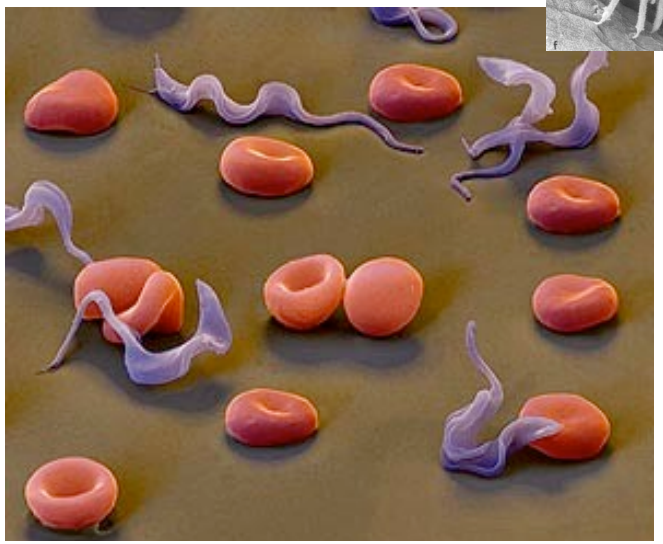
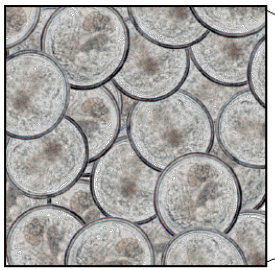












Photos: Gabe Harp


© Joe Boggs
Mossy Rose Gall Opened
Plurilocular, Unilarval
Gall Chambers

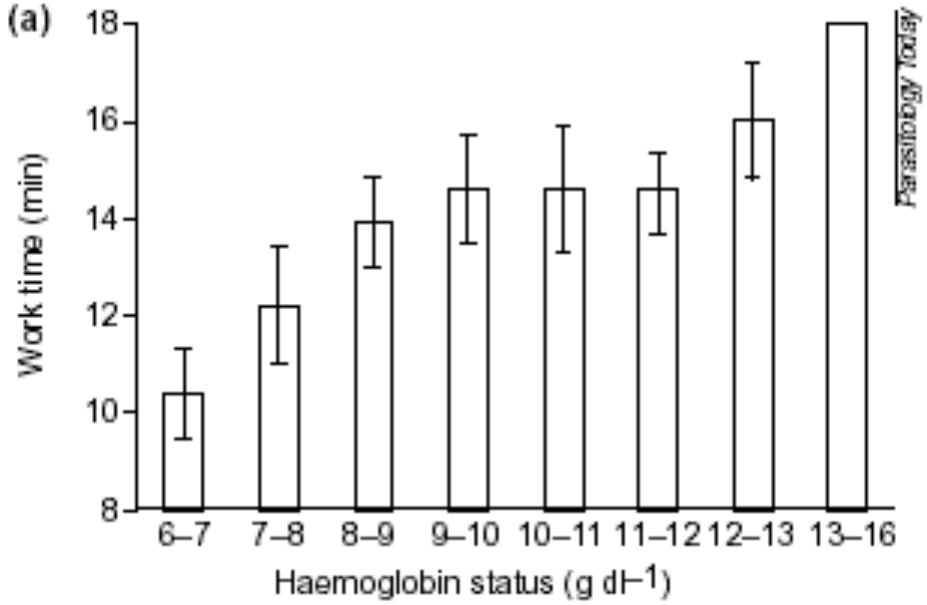
Sacculina

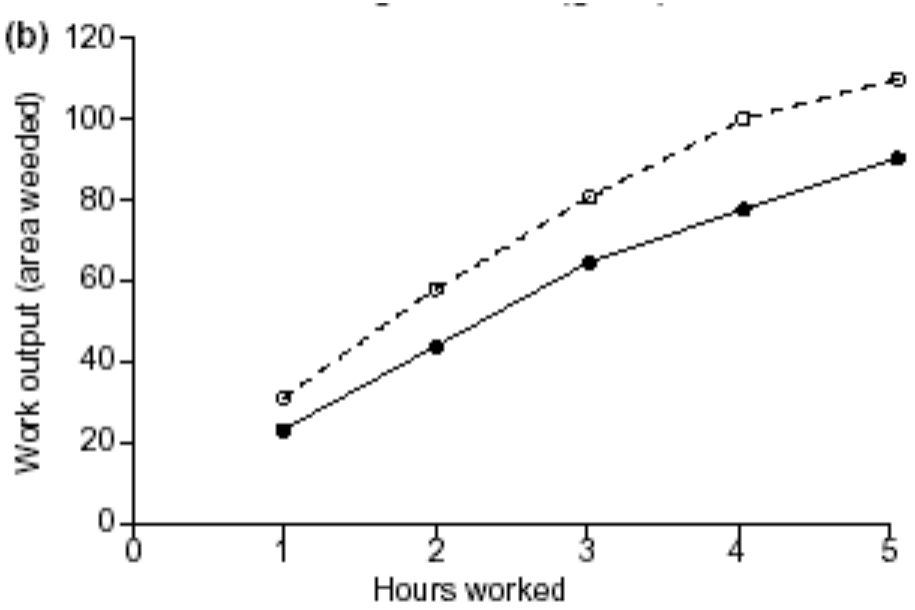
- Genus of barnacles that parasitize crabs
- Female larva finds a joint (chink in the armor), molts & injects itself into the crab
- Emerges as a sac on the crab's thorax
- Pretends it's eggs

Sublethal effects of parasite infection: *anemia & fatigue*

Maximum treadmill work time of female tea planters in Sri Lanka in relation to hemoglobin levels

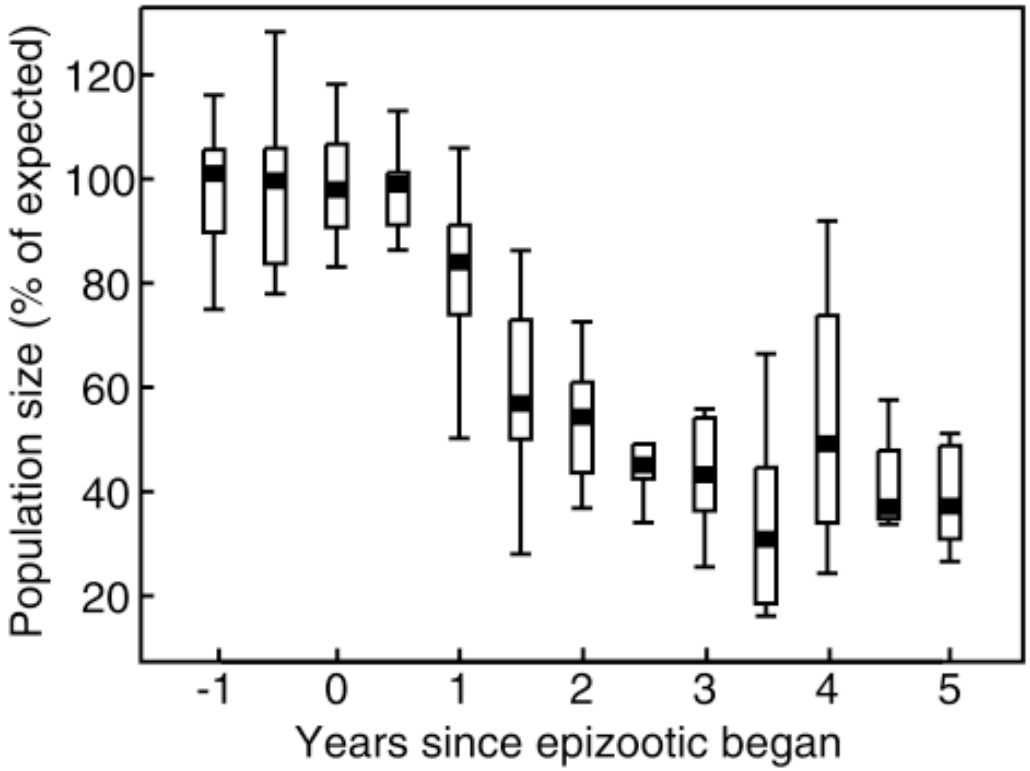
Productivity of Indonesian rubber plant weeders in a rubber plantation consistently lower amongst those with anemia

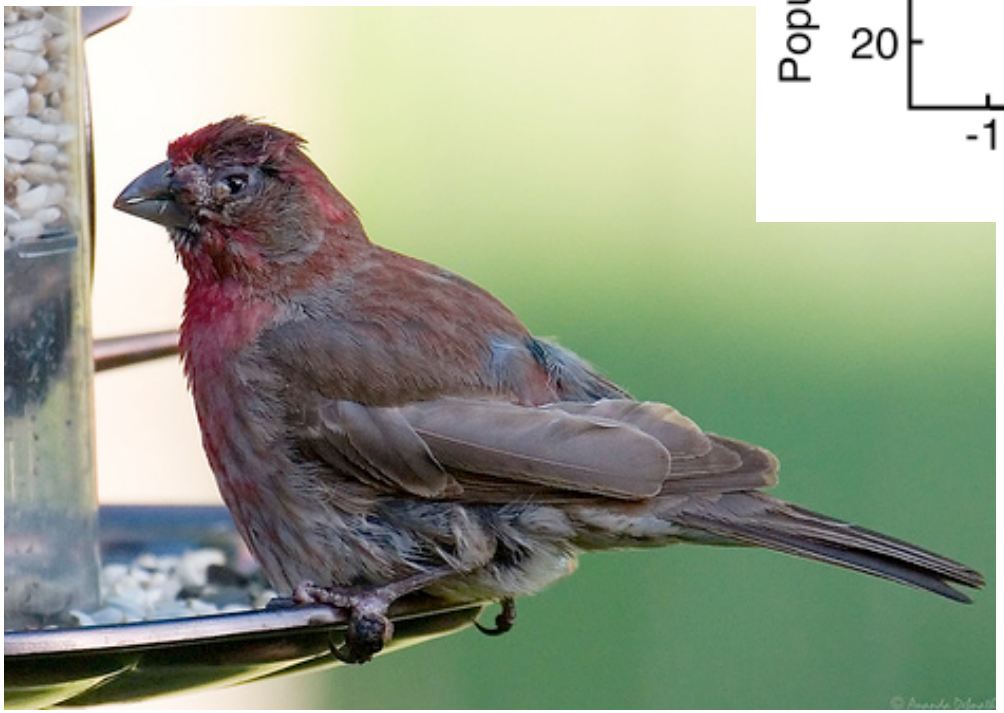




House Finch abundance after arrival of mycoplasmal conjunctivitis

60% reduction in host density!

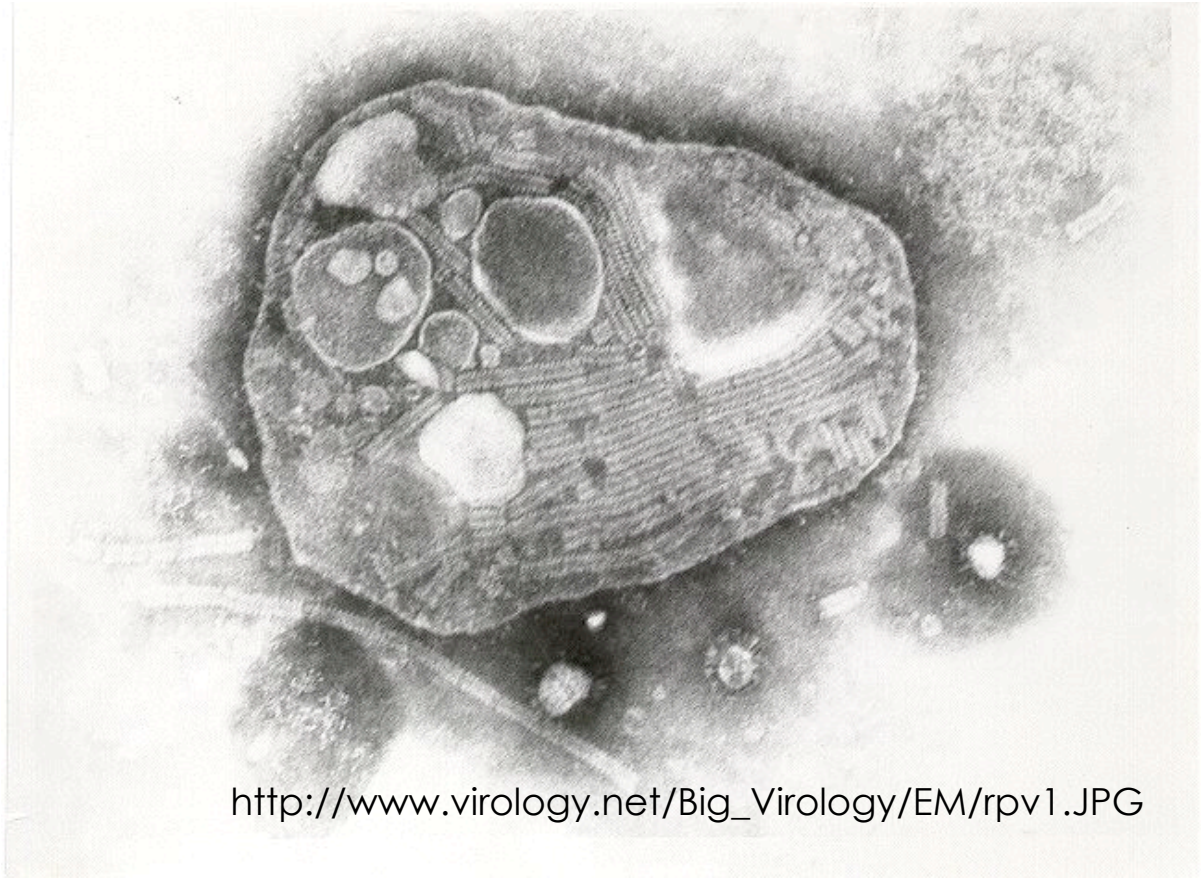




Density-dependent decline of host abundance resulting from a new infectious disease

Wesley M. Hochachka and André A. Dhondt*

PNAS | **May 9, 2000** | vol. 97 | no. 10 | **5303–5306**



http://www.virology.net/Big_Virology/EM/rpv1.JPG

Rinderpest

(aka Cattle Plague or Yearling disease)

A virus closely related to measles and canine distemper

Causes fever, anorexia, and depression. Forms lesions on the gums, tongue, and hard pallete, which "rapidly enlarge to form cheesy plaques." Animals may die from dehydration

Endemic/native to the Steppes of Central Asia, but made frequent forays into Europe, particularly during times of war

merckvetmanual.com

Introduced into Africa in 1887-1889 with the Italian campaign to conquer Somaliland and Ethiopia (probably ~5 infected cattle from India)

Spread swiftly through Ethiopia, was in East Africa within a year, and swept South Africa's Cape Province by 1897

www.gutenberg.org/files/ 15561/15561-h/15561-h.htm

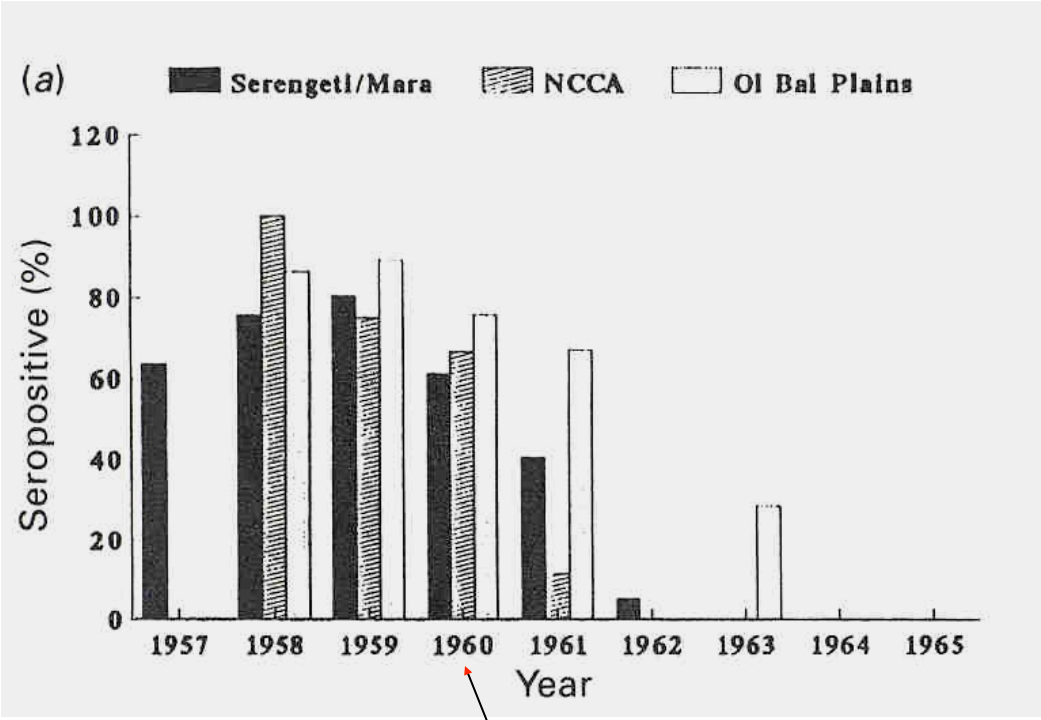
aleffgroup.com/images/ products/rdp-deadcow.jpg

Something on the order of 80-90% of the cattle, buffalo, and wildebeests in Africa died

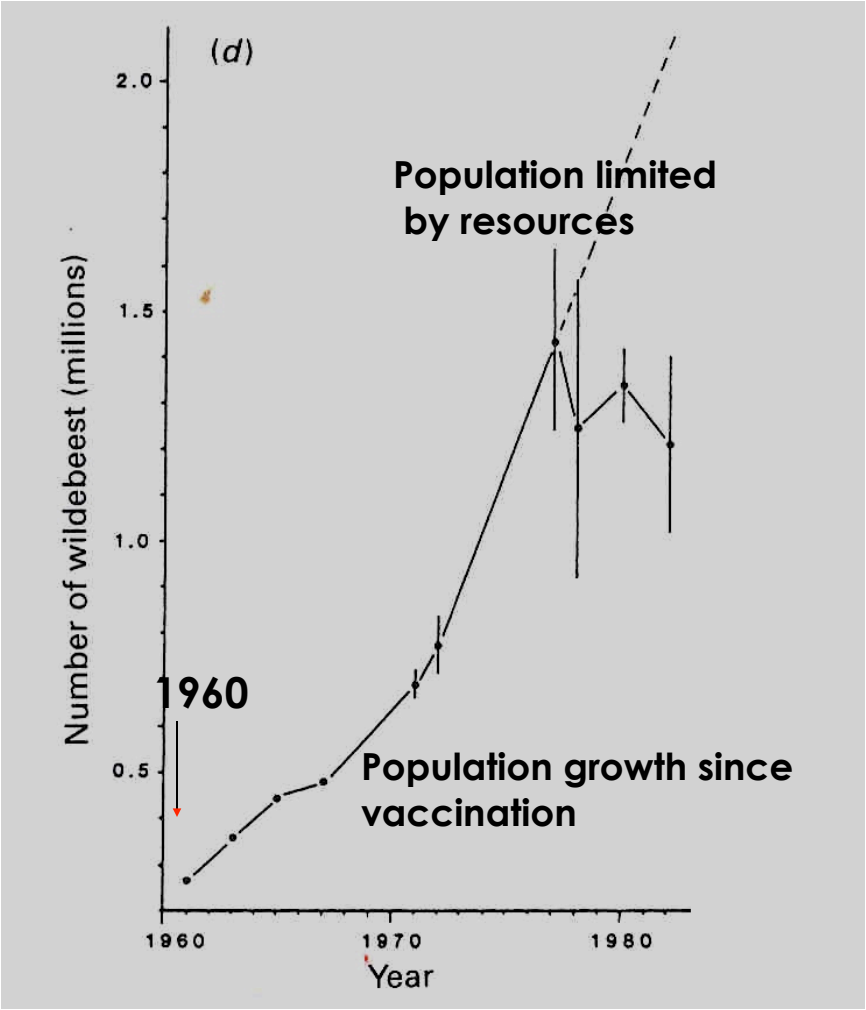
McNaughton (1992) The propagation of disturbance in savannas through food webs. J Veg Sci 3:301-314

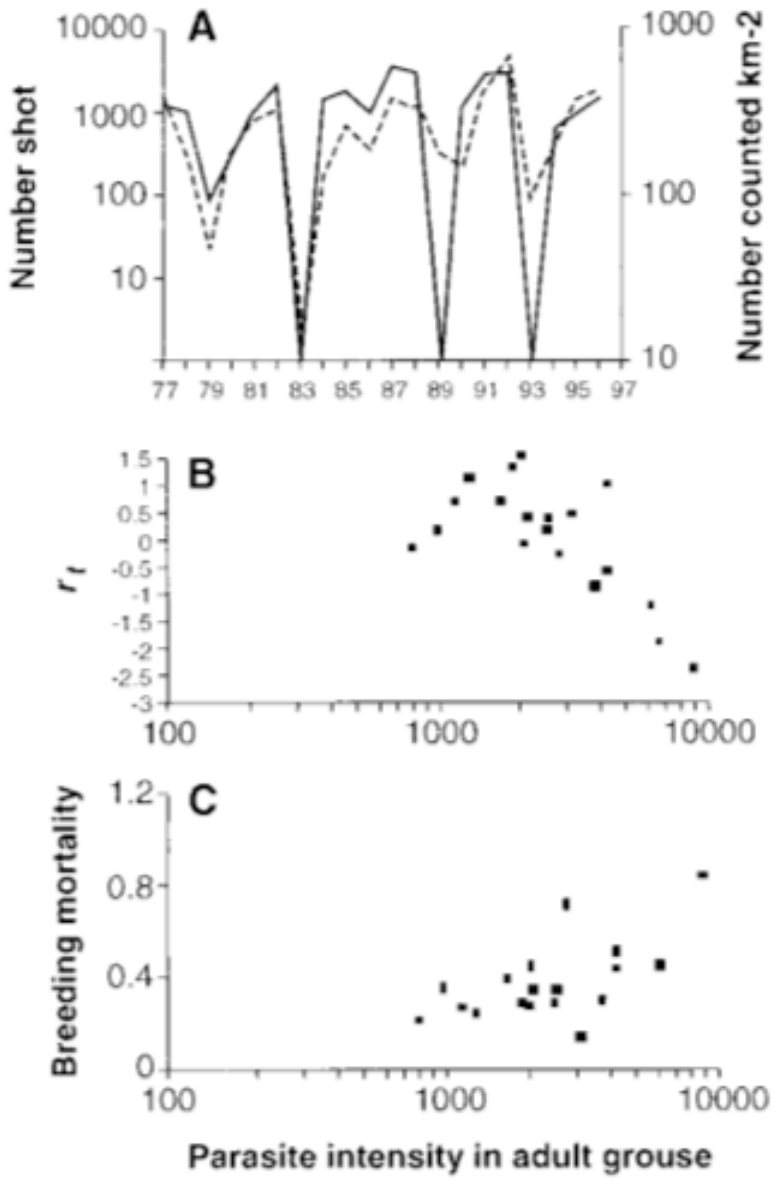
Effect of recovery from rinderpest (due to cattle vaccination) on growth rate of wildebeest populations in the Serengeti

Note: in June 2011, FAO formally declared rinderpest eradicated



1960, Cattle vaccination



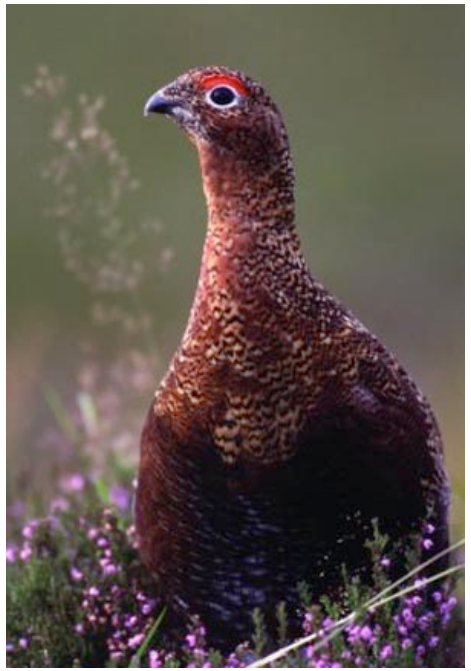


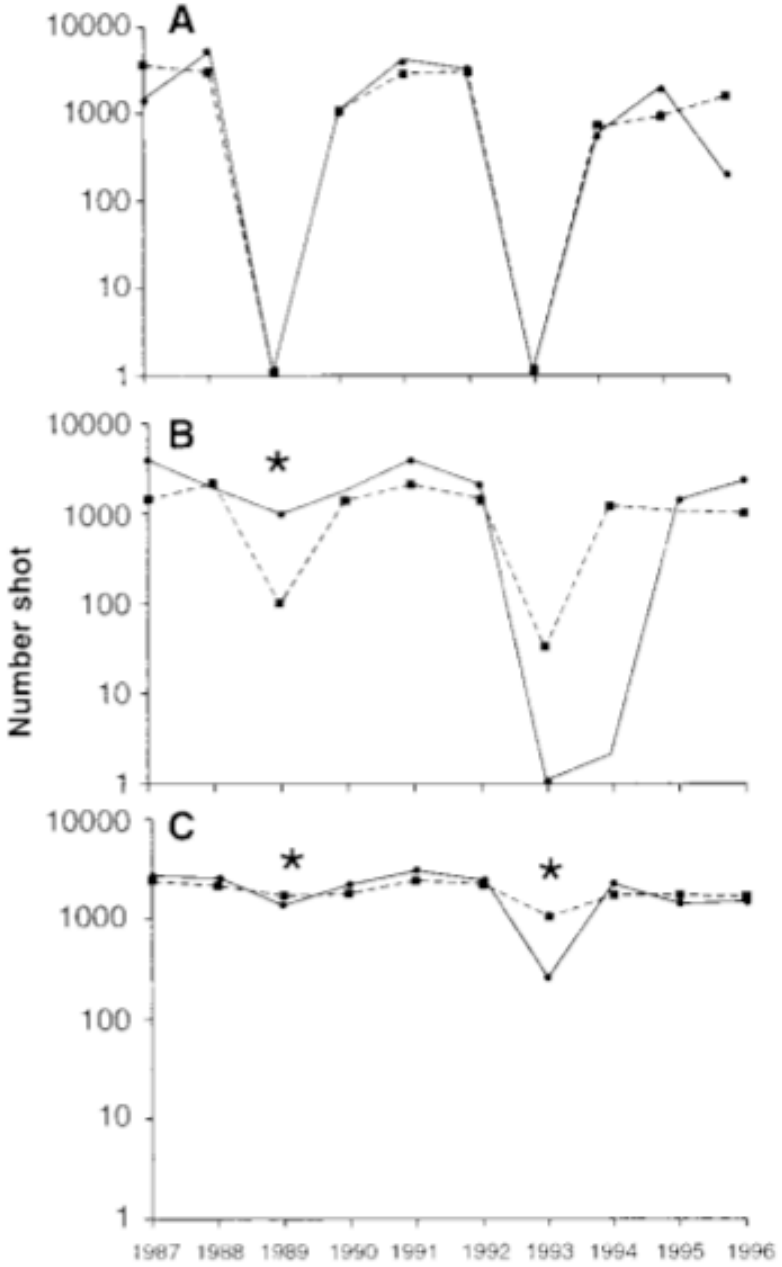
Prevention of Population Cycles by Parasite Removal

Peter J. Hudson,* Andy P. Dobson, Dave Newborn

18 DECEMBER 1998 VOL 282 SCIENCE

Trichostrongylus tenuis in red grouse





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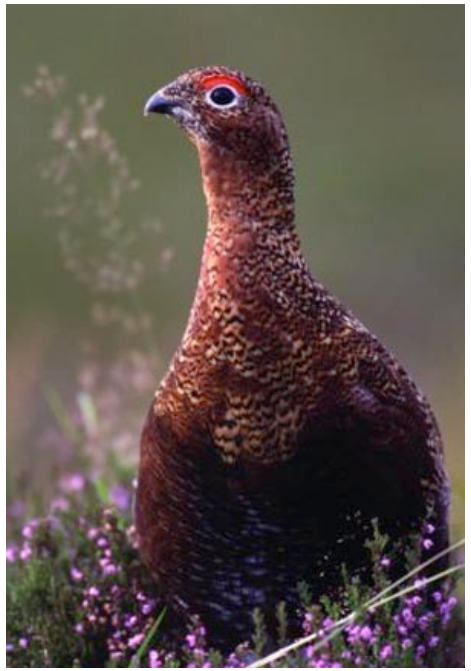
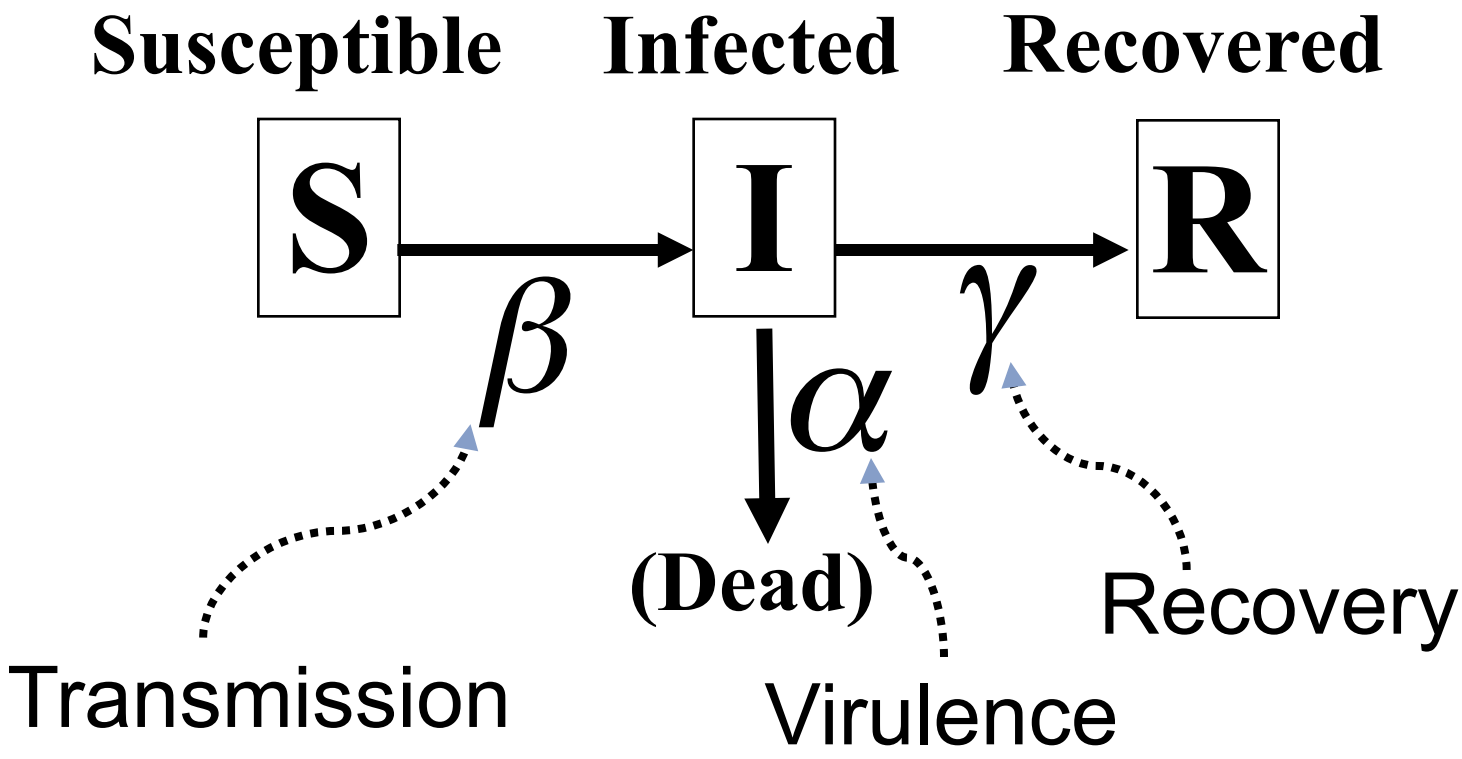
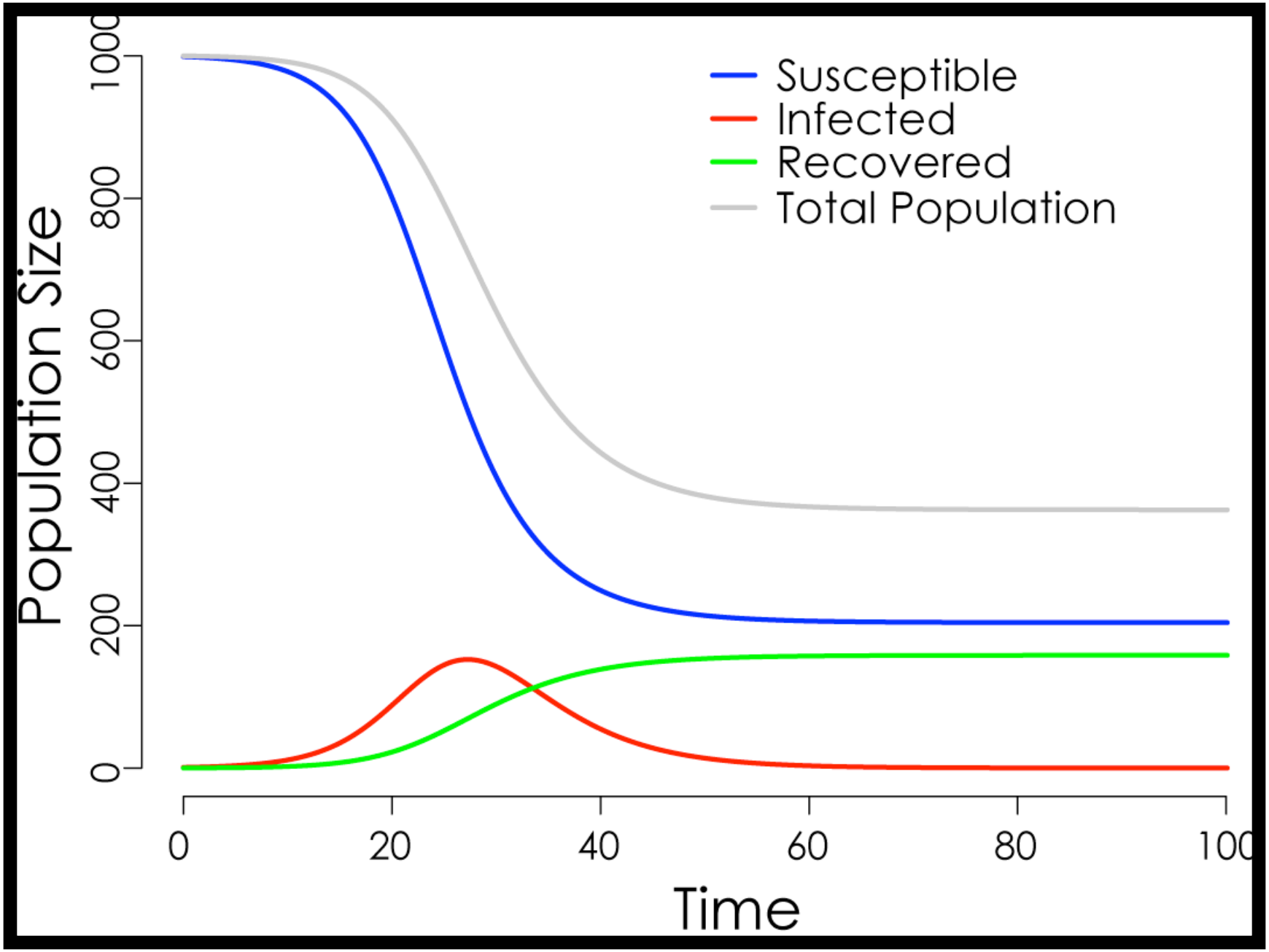
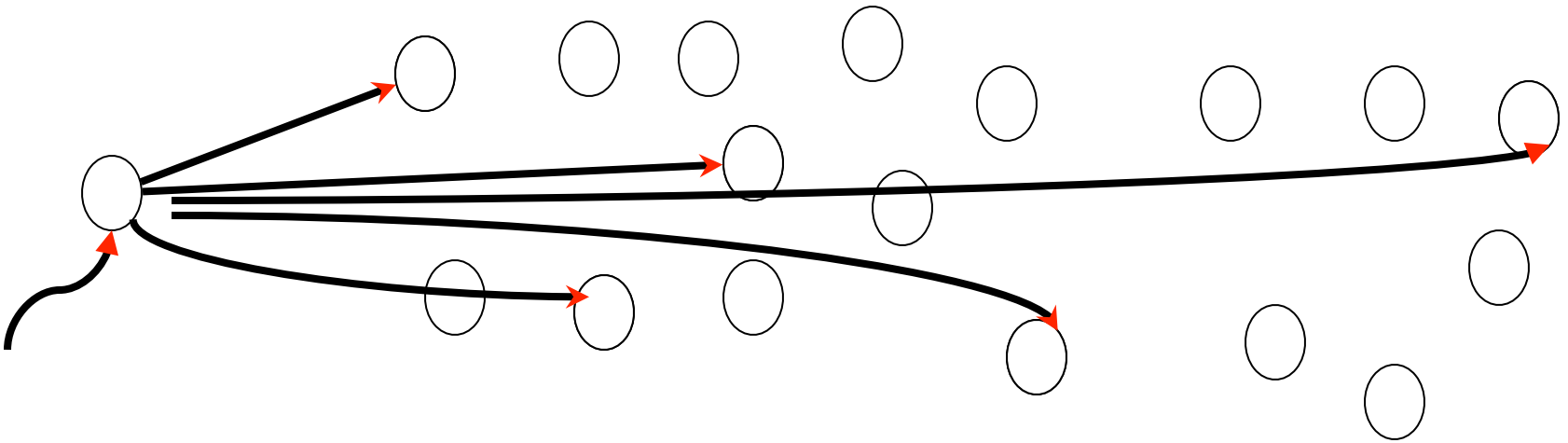
Trichostrongylus tenuis **in red grouse**




Susceptible
Infected
Recovered
S
I
R
β
α
γ
(Dead)
Transmission
Virulence
Recovery


Susceptible
Infected
Recovered
Total Population
Population Size
0
200
400
600
800
1000
0
20
40
60
80
100
Time

Basic reproductive number

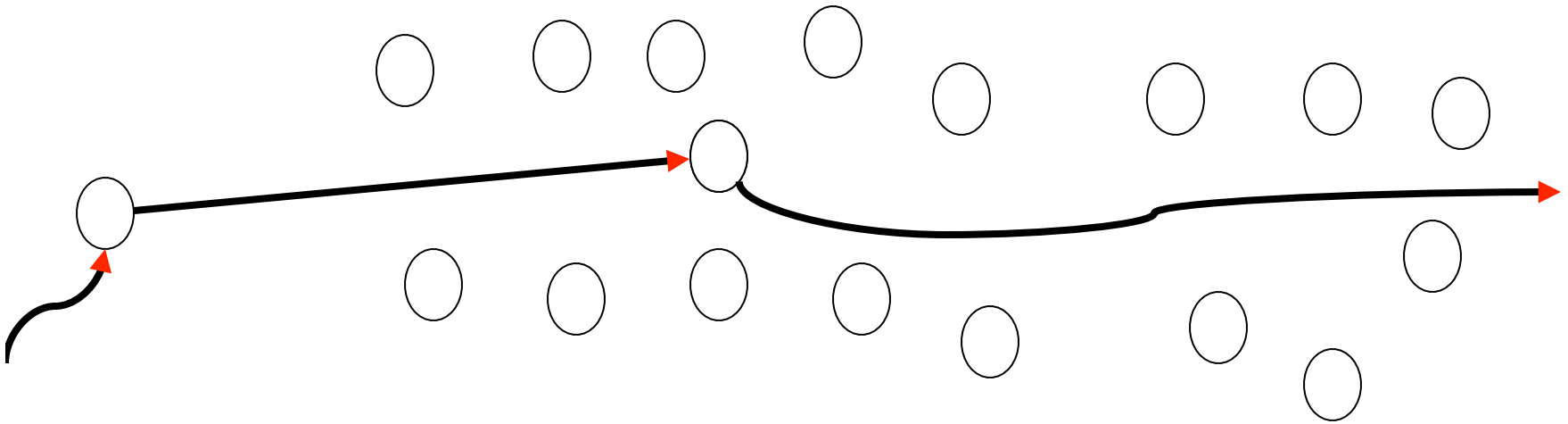


- **# secondary infections produced by a single infected host in a susceptible population**

  ……here R_0=5

- You need enough susceptibles for the chain of infection to establish

Rule #1: R_0 Must be > 1 for Invasion



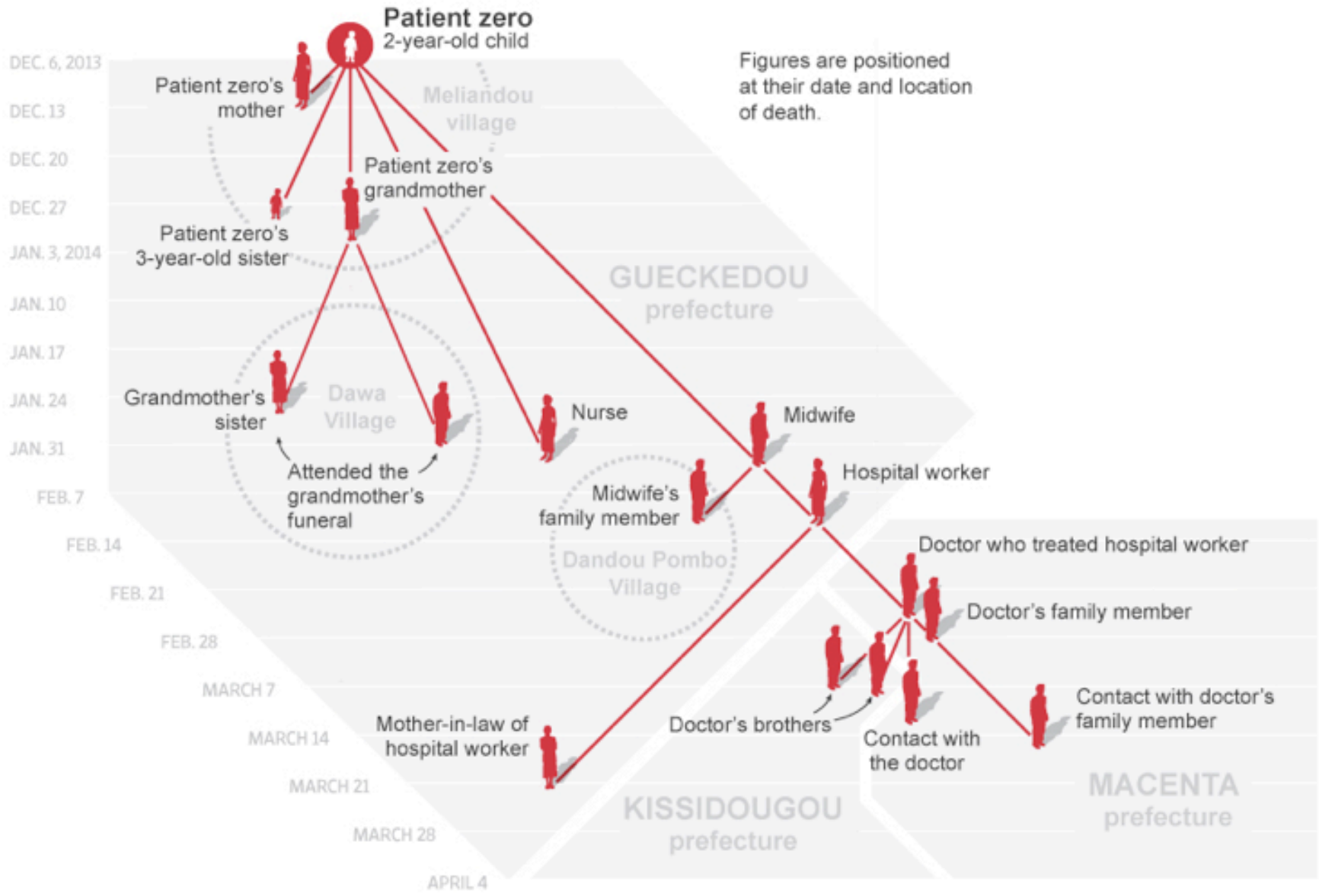
- When R_0 >1 then Pathogen invades
- When R_0<1 then Pathogen no invasion
- When R_0 = 1 Pathogen just replaces itself

R_0 is the key to understanding disease invasion

Table 4.1 Estimated values of the basic reproductive rate, R_0, for various infections (data from Anderson (1982*b*), Anderson and May (1982*d*, 1985*c*, 1988), Anderson *et al.* (1988), Nokes and Anderson (1988)).

Infection	Geographical location	Time period	R_0
Measles	Cirencester, England	1947–50	13–14
	England and Wales	1950–68	16–18
	Kansas, USA	1918–21	5–6
	Ontario, Canada	1912–13	11–12
	Willesden, England	1912–13	11–12
	Ghana	1960–8	14–15
	Eastern Nigeria	1960–8	16–17
Pertussis	England and Wales	1944–78	16–18
	Maryland, USA	1943	16–17
	Ontario, Canada	1912–13	10–11
Chicken pox	Maryland, USA	1913–17	7–8
	New Jersey, USA	1912–21	7–8
	Baltimore, USA	1943	10–11
	England and Wales	1944–68	10–12
Diphtheria	New York, USA	1918–19	4–5
	Maryland, USA	1908–17	4–5
Scarlet fever	Maryland, USA	1908–17	7–8
	New York, USA	1918–19	5–6
	Pennsylvania, USA	1910–16	6–7
Mumps	Baltimore, USA	1943	7–8
	England and Wales	1960–80	11–14
	Netherlands	1970–80	11–14
Rubella	England and Wales	1960–70	6–7
	West Germany	1970–7	6–7
	Czechoslovakia	1970–7	8–9
	Poland	1970–7	11–12
	Gambia	1976	15–16
Poliomyelitis	USA	1955	5–6
	Netherlands	1960	6–7
Human Immunodeficiency Virus (Type I)	England and Wales (male homosexuals)	1981–5	2–5
	Nairobi, Kenya (female prostitutes)	1981–5	11–12
	Kampala, Uganda (heterosexuals)	1985–7	10–11

Whooping cough



http://graphics.wsj.com/ebola-crisis/

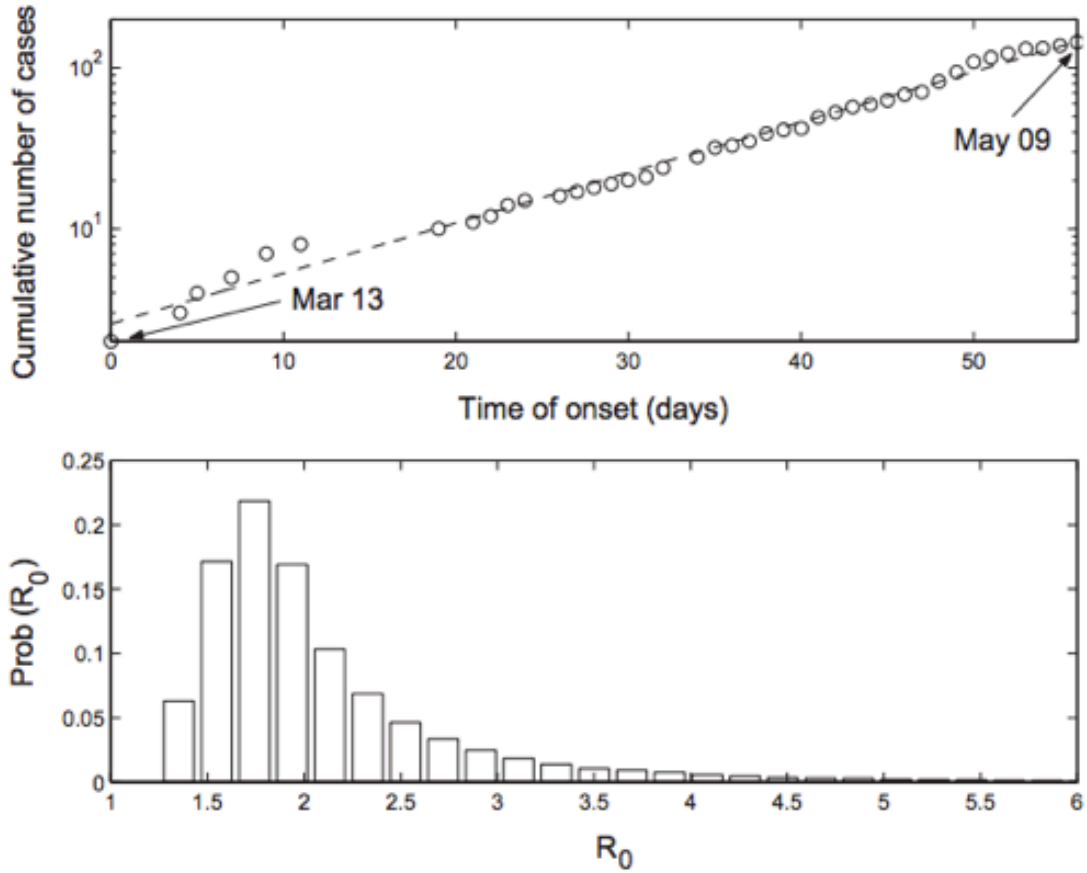
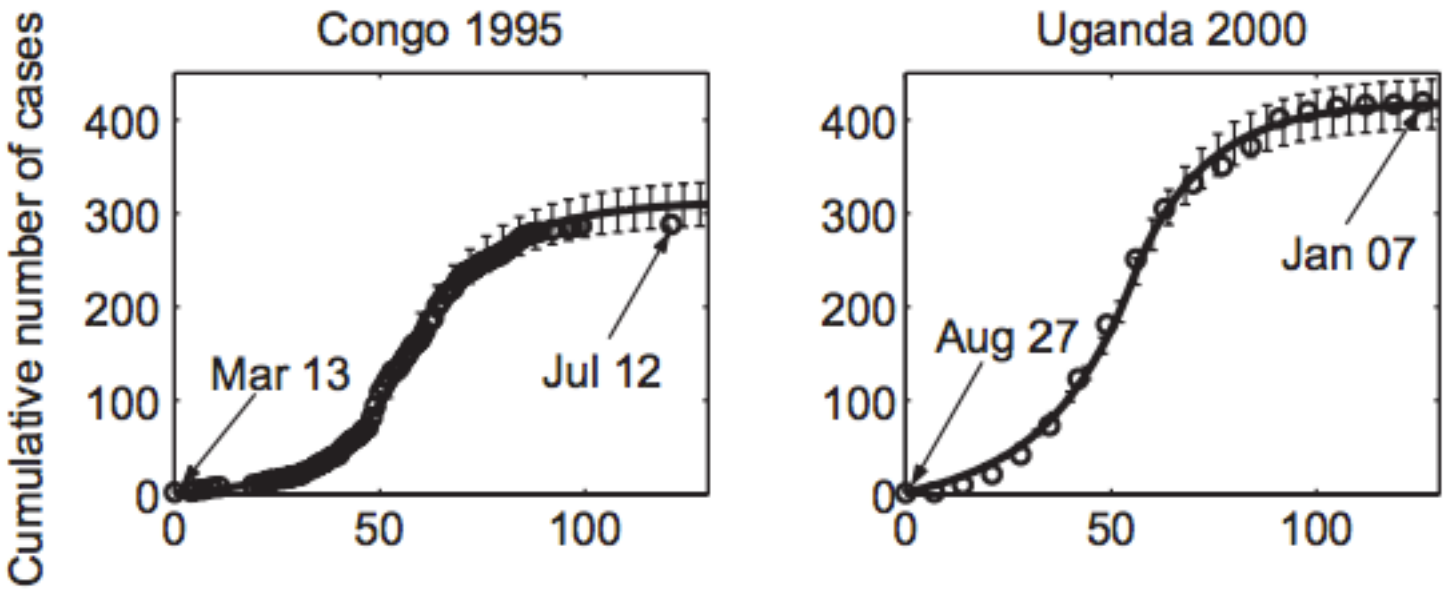


Fig. 4. (Top) cumulative number of cases (log-lin scale) during the exponential growth phase of the Congo 1995 epidemic as identified by the date of start of interventions (09 May 1995 (Khan et al., 1995)). The model-free initial growth rate of the number of cases for Congo 1995 is 0.07 (linear regression); (bottom) estimated distribution of R_0 from our uncertainty analysis (see text). R_0 lies in the interquartile range (IQR) (1.66–2.28) with a median of 1.89. Notice that 100% of the weight lies above $R_0 = 1$.

Estimates of R_0 based on exponential growth of the number of cases (R_0=exp(slope)^T=1.83)
And from epidemic (SEIR) models fit to data.

The basic reproductive number of Ebola and the effects of public health measures: the cases of Congo and Uganda

G. Chowell[a,d,*], N.W. Hengartner[b], C. Castillo-Chavez[a,d], P.W. Fenimore[a], J.M. Hyman[c]



Epidemics grow exponentially until they run out of resources (susceptibles) or interventions slow their growth

PLOS | CURRENTS OUTBREAKS

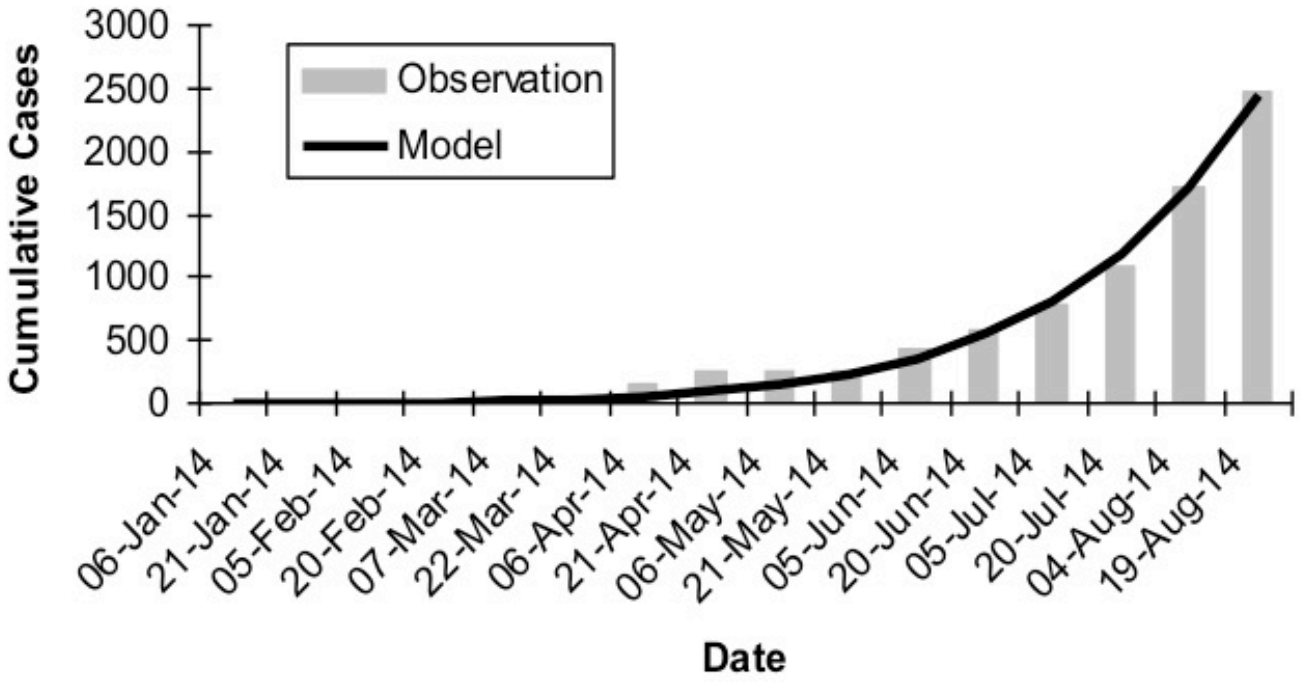
Early Epidemic Dynamics of the West African 2014 Ebola Outbreak: Estimates Derived with a Simple Two-Parameter Model

September 8, 2014 · Research

David Fisman[1], Edwin Khoo[1], Ashleigh Tuite[1]

1 Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada

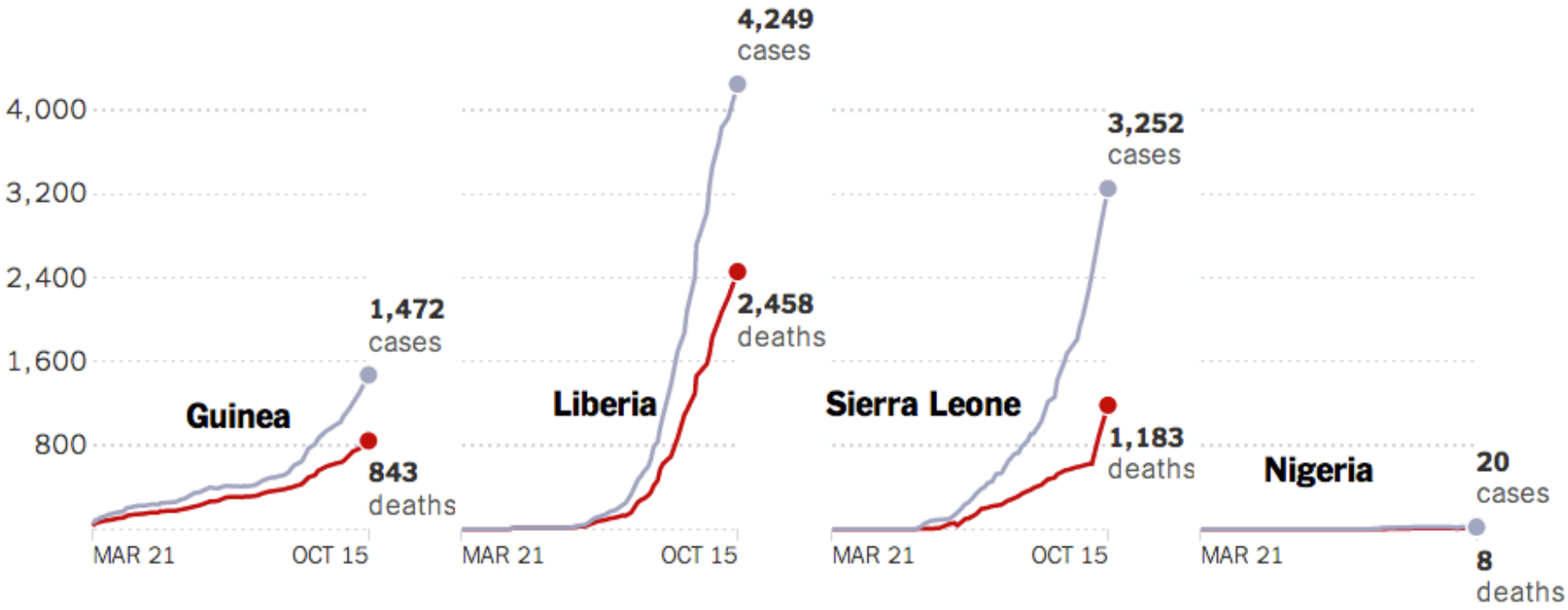
Fisman D, Khoo E, Tuite A. Early Epidemic Dynamics of the West African 2014 Ebola Outbreak: Estimates Derived with a Simple Two-Parameter Model. PLOS Currents Outbreaks. 2014 Sep 8. Edition 1. doi: 10.1371/currents.outbreaks.89c0d3783f36958d96ebbae97348d571.



Best fit model (dark curve) (R_0 = 1.78, d = 0.009) to observed cumulative incidence for West Africa by generation (gray bars). A 15 day serial interval is assumed, and first reported cases are assumed to have been reported in generation 5.

How many people have been infected in Africa?

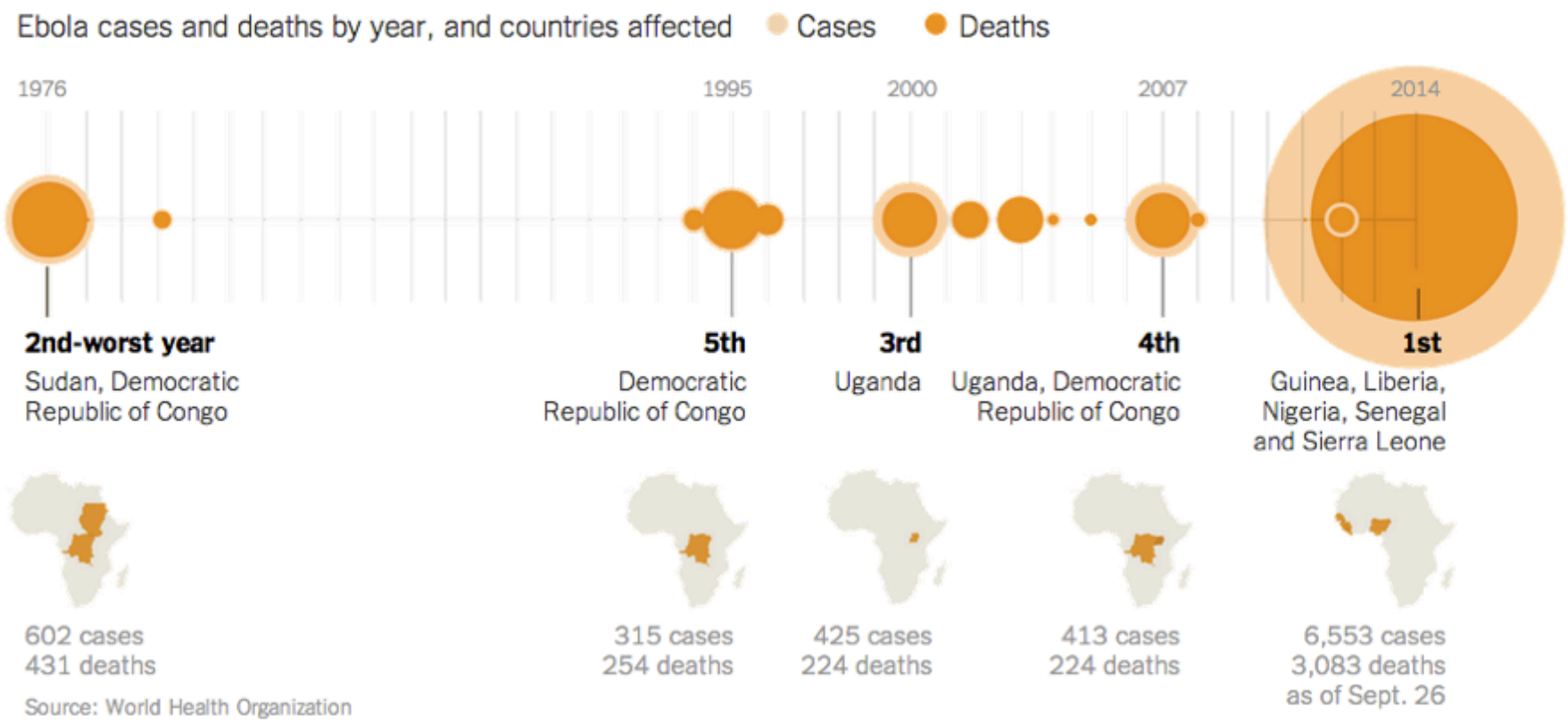
More than 8,900 people in Guinea, Liberia, Nigeria, Senegal and Sierra Leone have contracted Ebola since March, according to the World Health Organization, making this the biggest outbreak on record. More than 4,400 people have died.



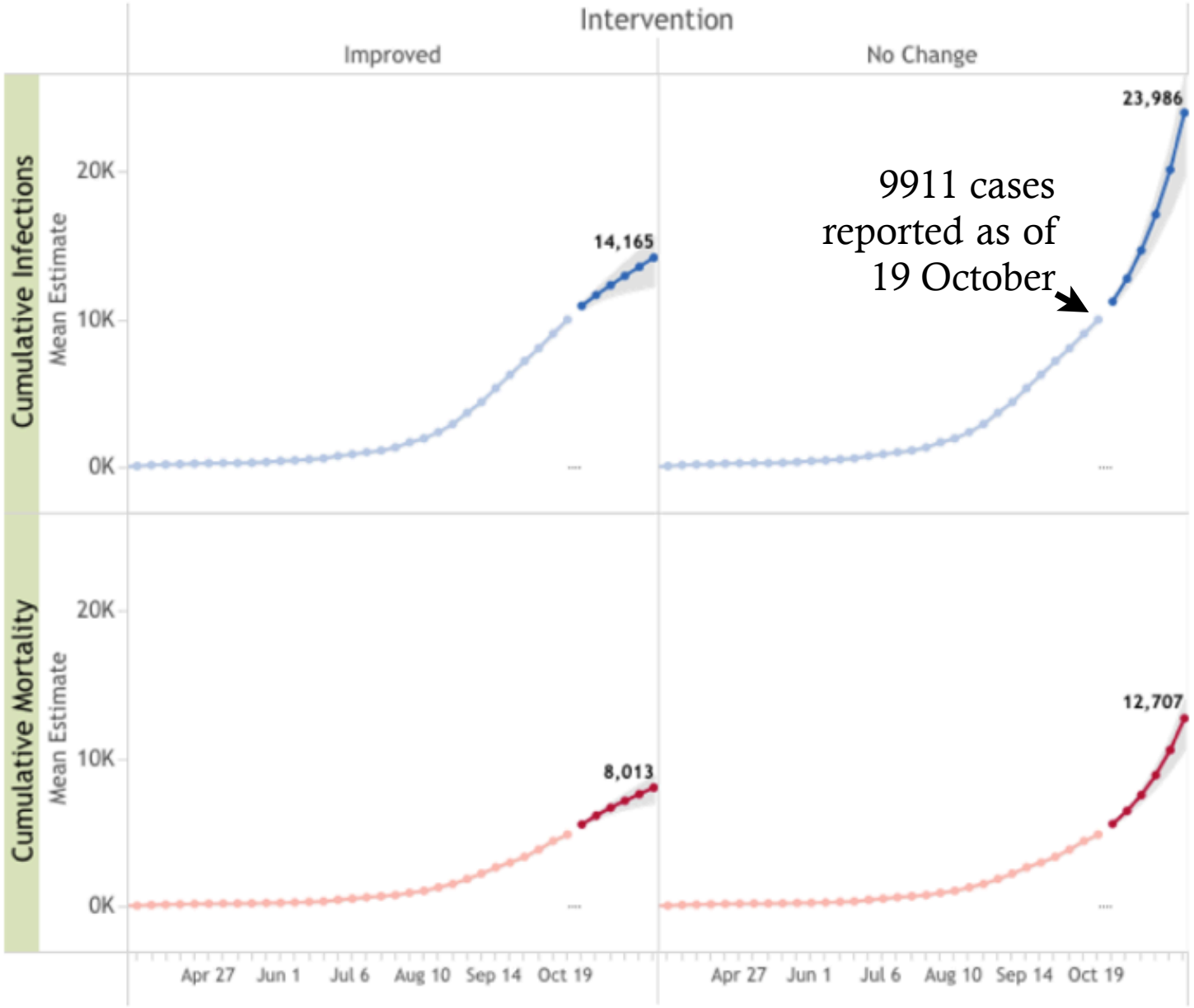
http://www.nytimes.com/interactive/2014/07/31/world/africa/ebola-virus-outbreak-qa.html

How does this compare to past outbreaks?

It is the deadliest, eclipsing an outbreak in 1976, the year the virus was discovered.

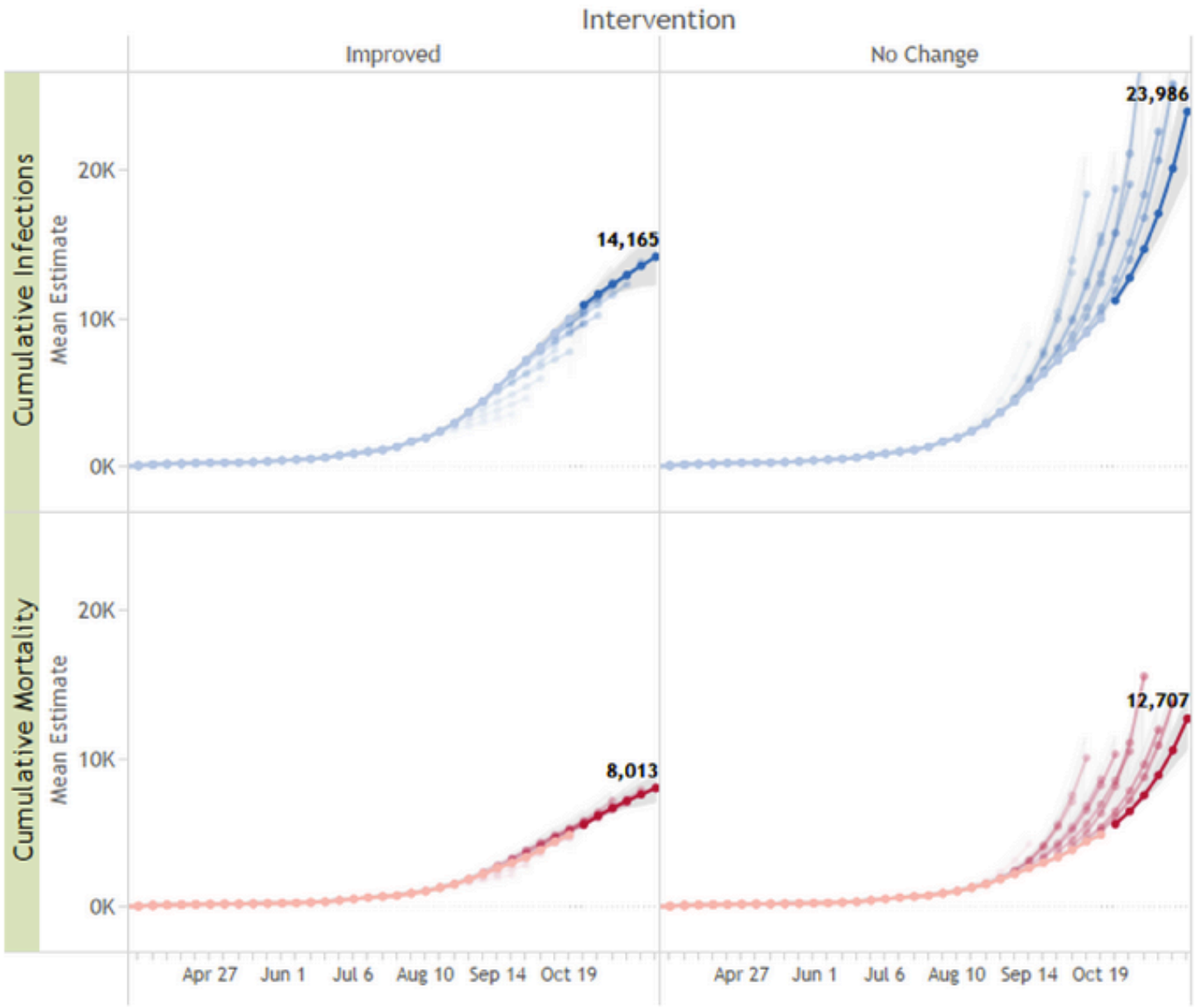


http://www.nytimes.com/interactive/2014/07/31/world/africa/ebola-virus-outbreak-qa.html



Ebola data 2014 &
Model predictions

cpid.iri.columbia.edu/ebola.html



Ebola data 2014 &
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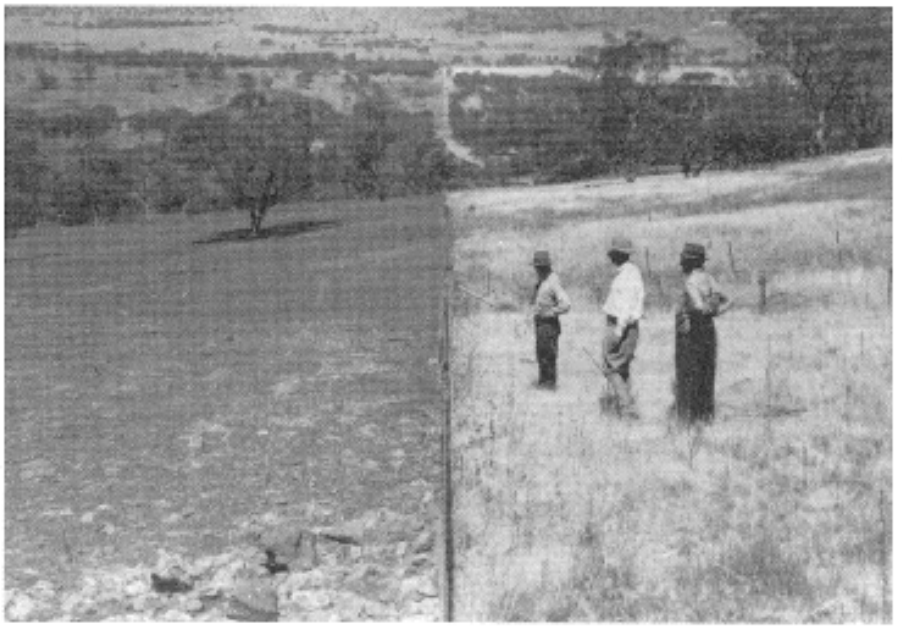
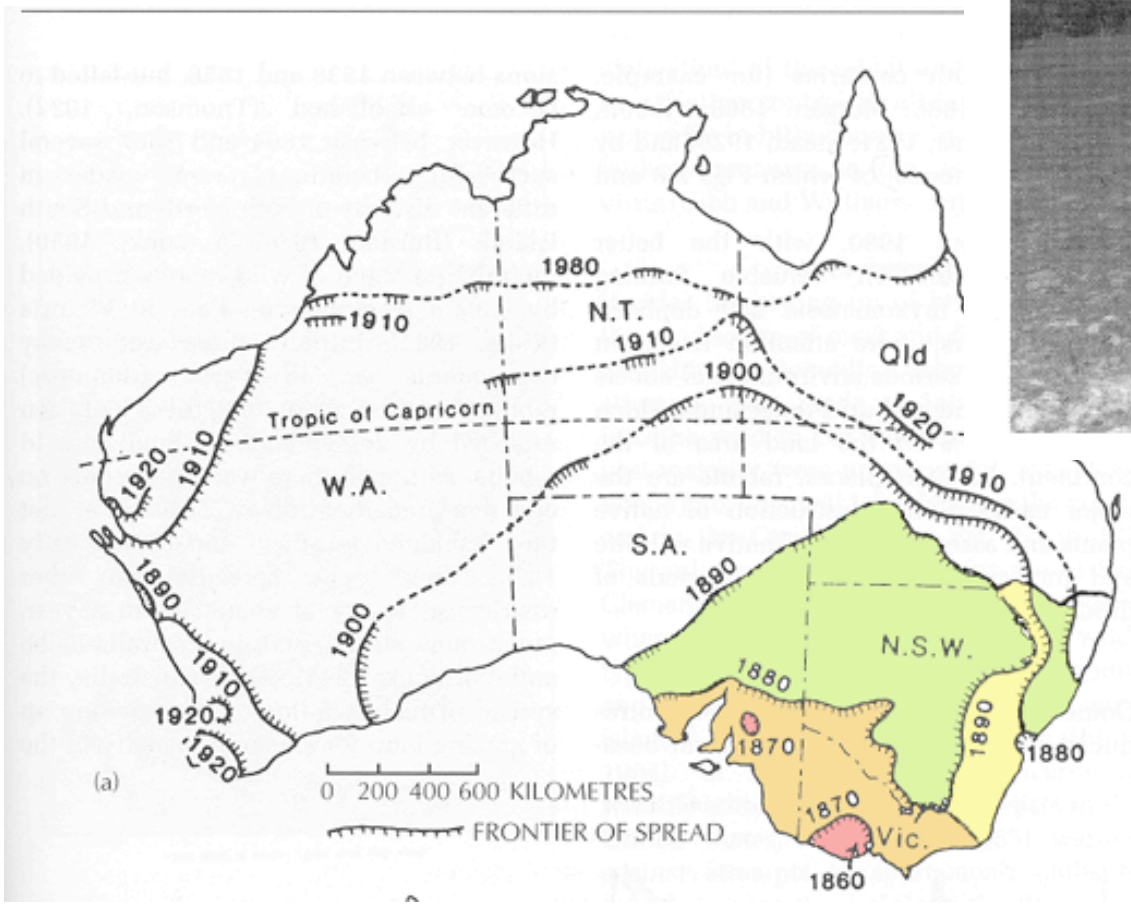
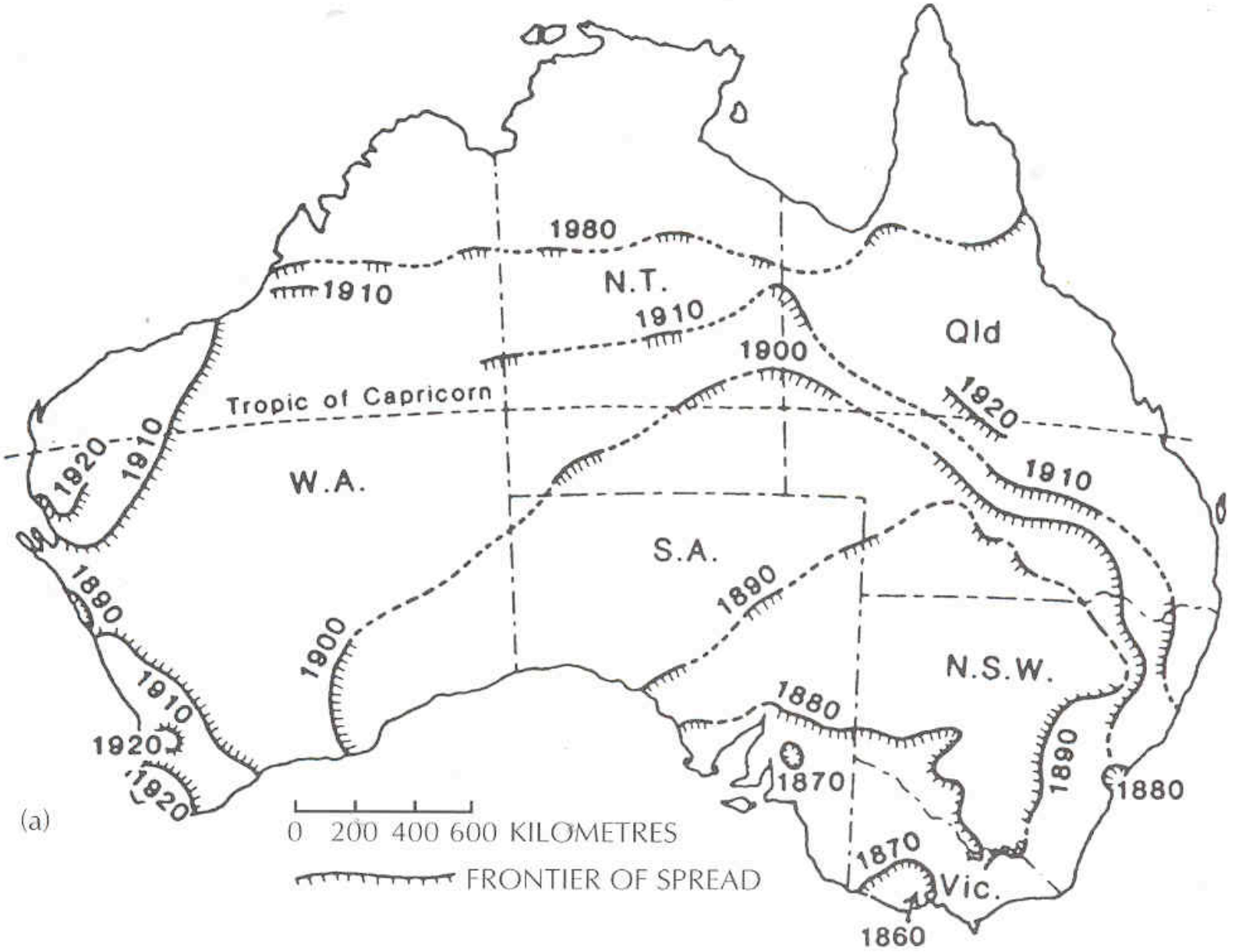
cpid.iri.columbia.edu/ebola.html

Spread of rabbits in Australia





Spread of rabbits in Australia



Myxomatosis in Rabbits

Fenner, F., and Fantini, B. 1999. Biological control of vertebrate pests: The history of myxomatosis – an experiment in evolution. CABI Publishing, Oxford.

Introduction/trials of myxoma viruses from South American hares

–Highly lethal

–Host specific

–Transmitted by fleas (turns out mostly by mosquitoes)

1930's-1950's in Australia

- Early experiments failed
- Political pressures to control rabbits spearheaded by Dr. Jean MacNamara, a pediatrician and virologist

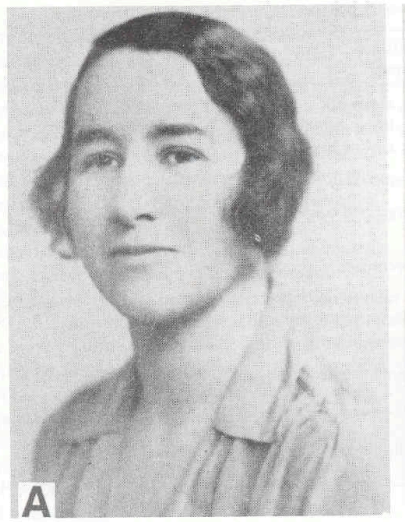
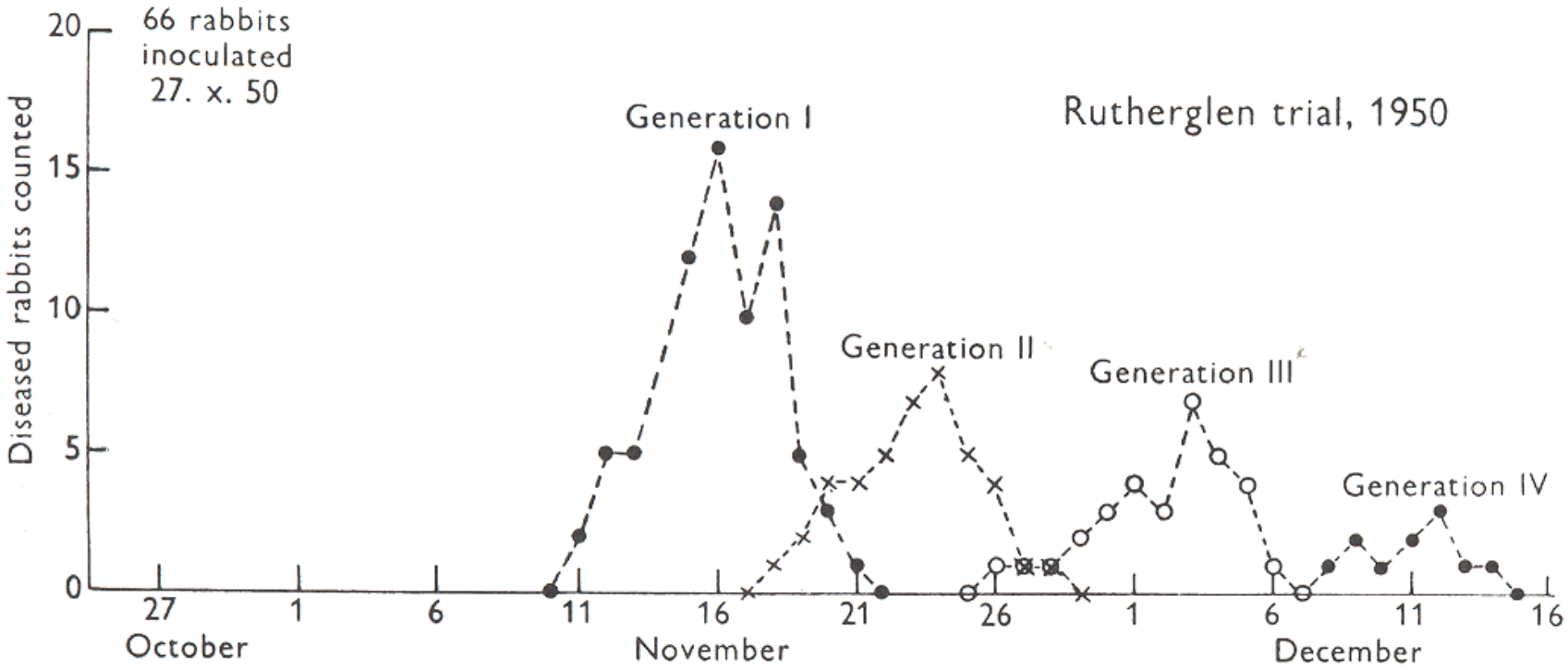


Fig. 6.1. (A) Annie Jean Macnamara (1899–1968).

Few advances would have been made in medical research if work had been abandoned after such a pathetically limited inquiry ... It is difficult to understand why the work was given up, why promising possibilities were not explored, why the virus was not tried on areas more favourable.

1950 “final last ditch effort”



By May of the following year…

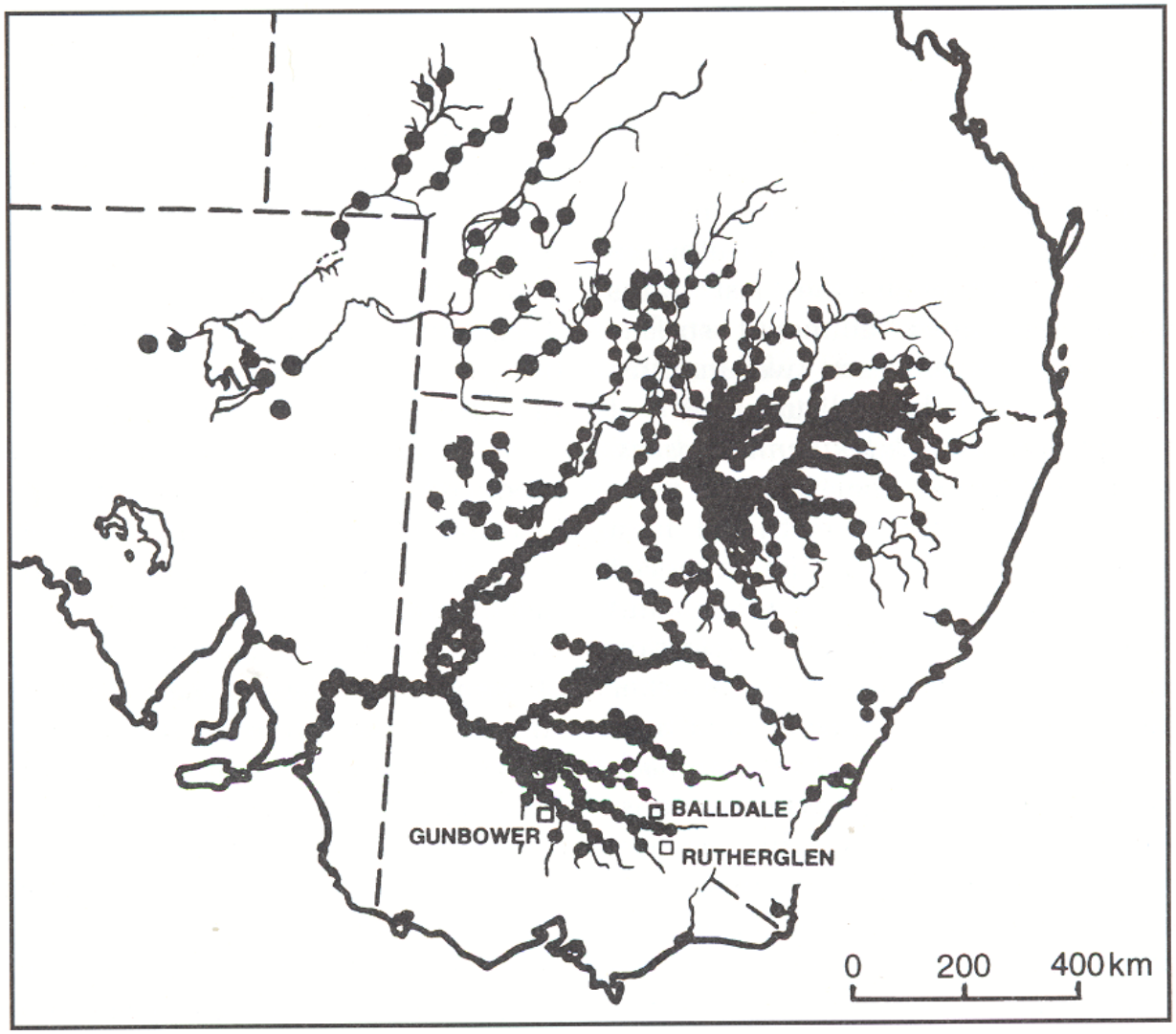
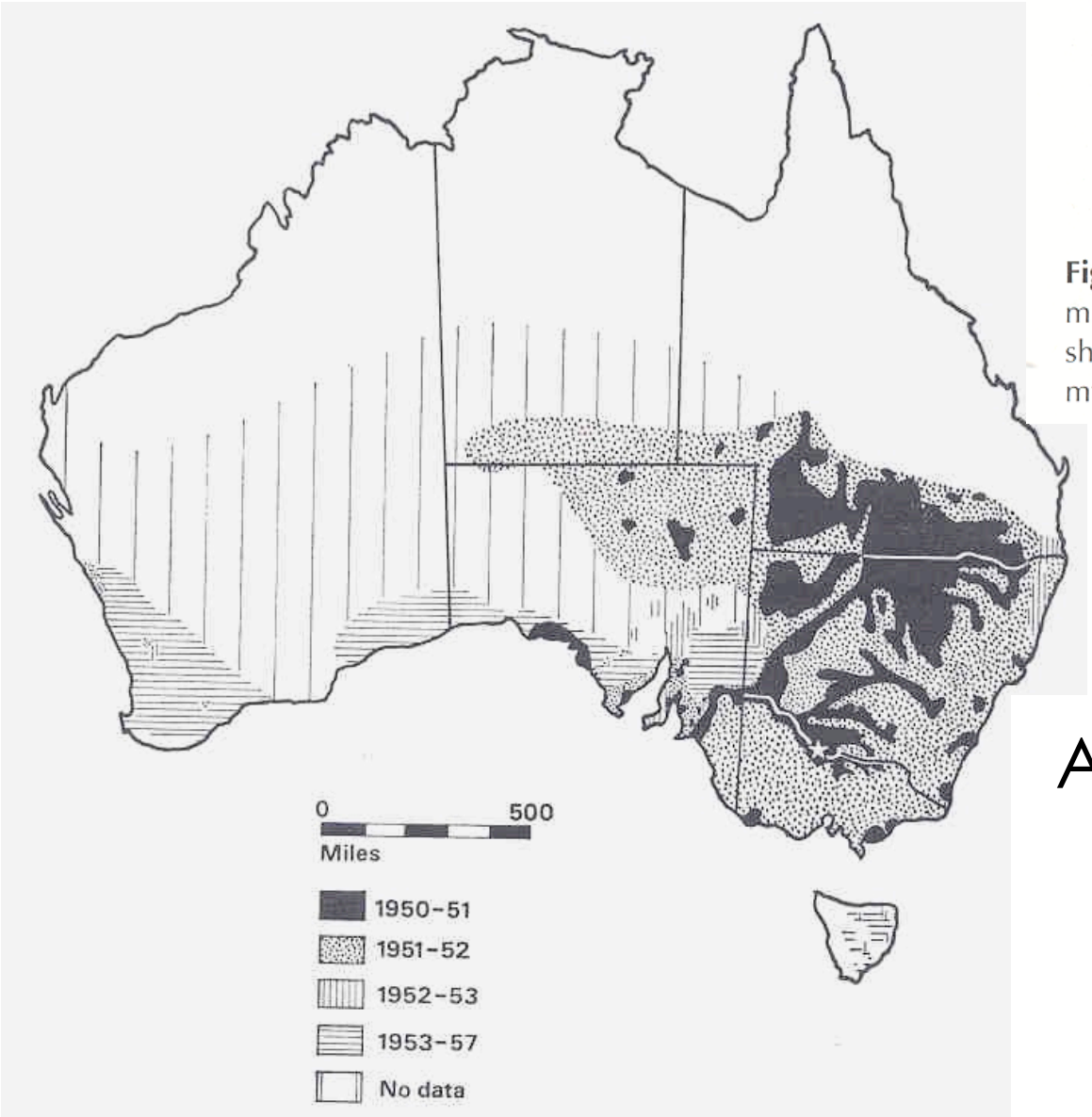


Fig. 6.10. The spread of myxomatosis in south-eastern Australia between December 1950 and May 1951.

Spread of myxomatosis in Australia



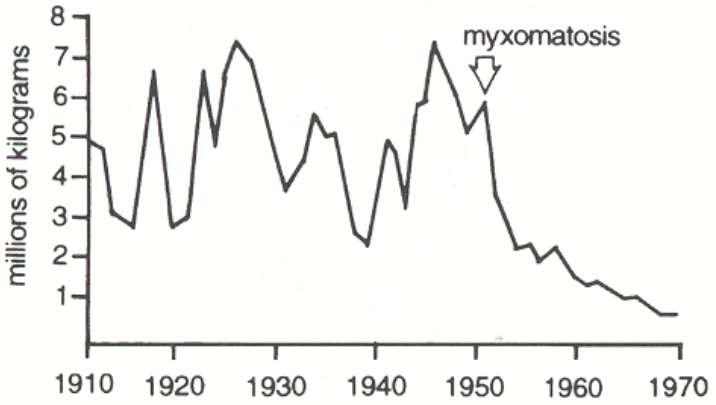
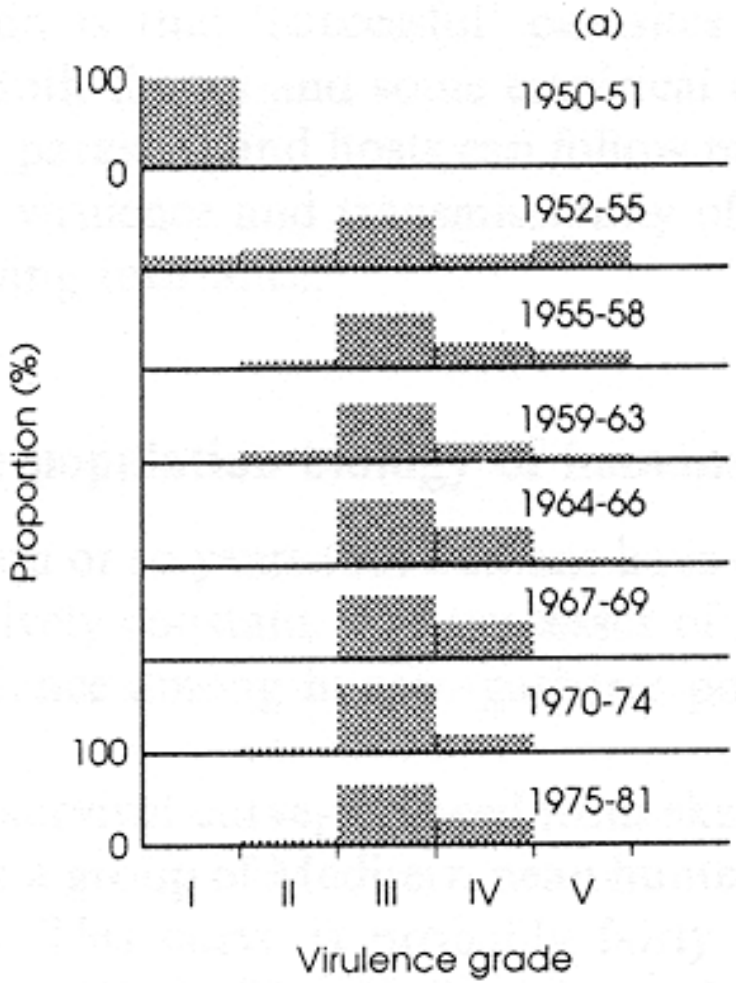


Fig. 2.10. Rabbit skins exported from Australia, in millions of kilograms, between 1910 and 1970, showing the abrupt fall after the spread of myxomatosis in the early 1950s.

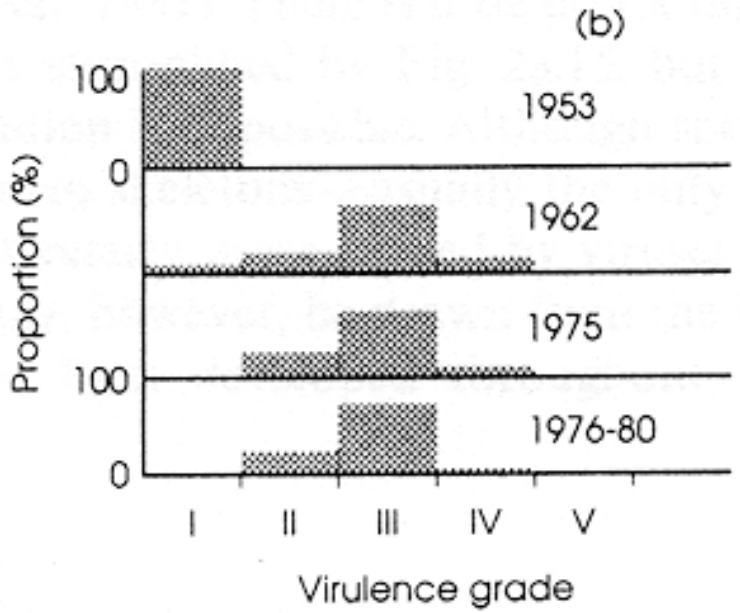
Achieved substantial (>90%) reduction in rabbit numbers…

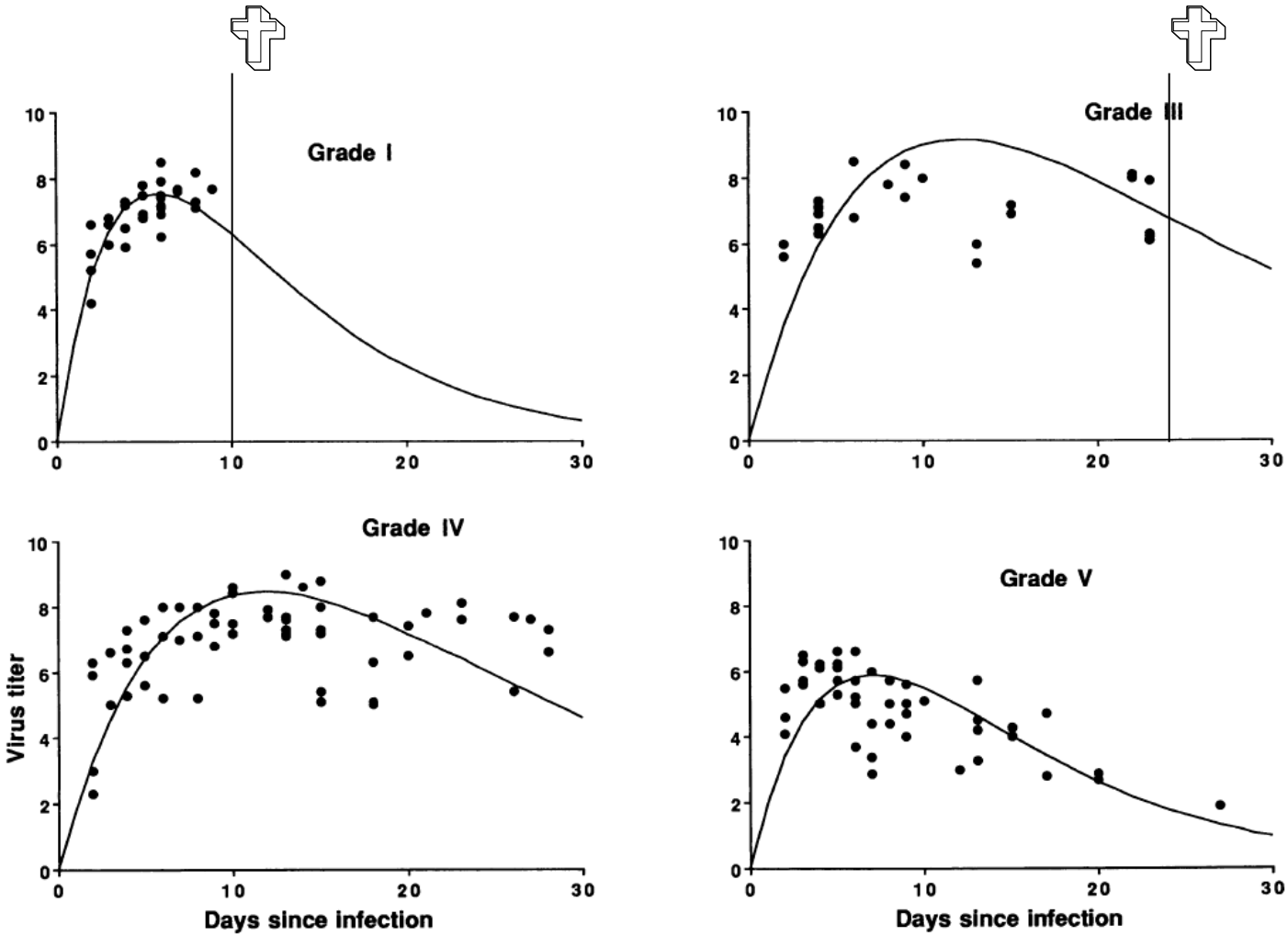
but, they

Australia 1950-81



Britain 1950-80




Grade I
Grade III
Grade IV
Grade V
Virus titer
Days since infection
Days since infection
0
2
4
6
8
10
0
10
20
30