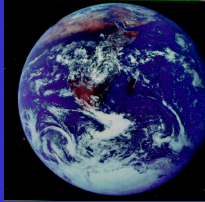


Ecology of Disease

Theme: Climate
Lecture: Global warming



Prof Peter O'Donoghue

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Global Warming

Book "The Weather Makers" Tim Flannery

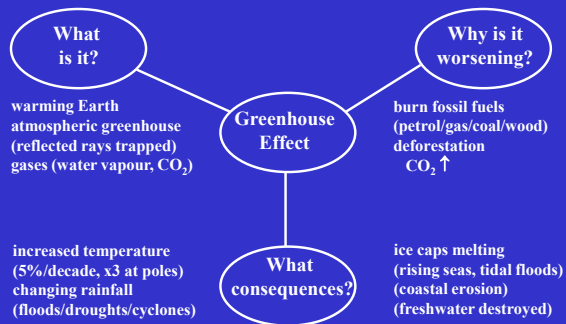
- greenhouse gases (sources, properties, effects)
- history (carbon dating, fossils, ice cores, ocean sediments, coral growth)
- future impacts (rising sea levels, slowing of Gulf Stream, demise of Amazon rainforest, release of hydrates from sea-floor)
- Montreal Protocol (CFC success story)
- Kyoto Protocol (greenhouse emission targets, carbon trading)

Video "Inconvenient Truth" Al Gore

- misconception: no scientific dissent
- do not have to choose between economy and environment
- can do something about it! www.climatecrisis.net
- "Political will is a renewable resource!"

2

Global Warming



3

Global Warming

Elevation in temperature due to:

- fossil-fuel combustion increasing CO₂
- deforestation reducing CO₂ absorption
- industry and biomass burning increasing CO
- production of volatile organic compounds (butane, propane) that undergo photo-oxidation to form tropospheric ozone
- doubling of atmospheric methane
- destruction of ozone layer by halogenated compounds

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Global Warming

Consequences

- more vigorous hydrological cycle
(↑ rainfall, ↑ cloud cover, ↑ sea level)
- more pressure cells
(↑ wind, hurricanes, cyclones, typhoons ..)
- more evaporation
(↓ soil moisture, ↓ vegetation)

⇒ more severe weather, droughts, floods

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Disease patterns

Many diseases will:

- increase in incidence
 - occur more often (more hosts, more vectors)
 - change from epidemic to endemic (become entrenched)
- increase in distribution
 - expanded geographic range (changing optima)
 - enhanced survival in environment (warm moist conditions)
- increase in severity
 - spread of drug resistance (uncontrolled dosing)
 - rapid transmission of virulent strains (transport)
 - increase in host susceptibility (diminished resistance)

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Seasons

Quarterly fluctuations in:

- temperature (minimum, maximum)
- rainfall (total and residual), humidity
- evaporation/evapotranspiration

Manifest as:

summer



autumn



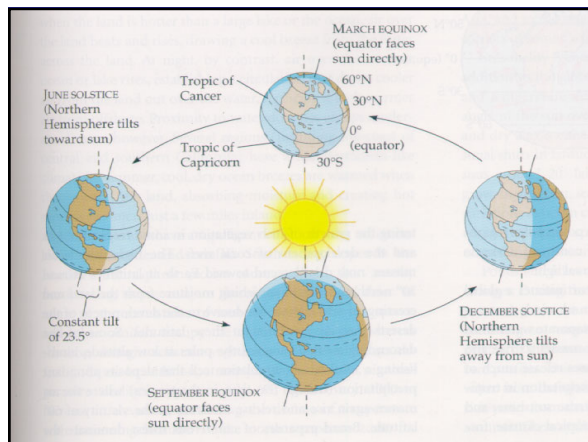
winter



spring



7



8

Latitudinal variation

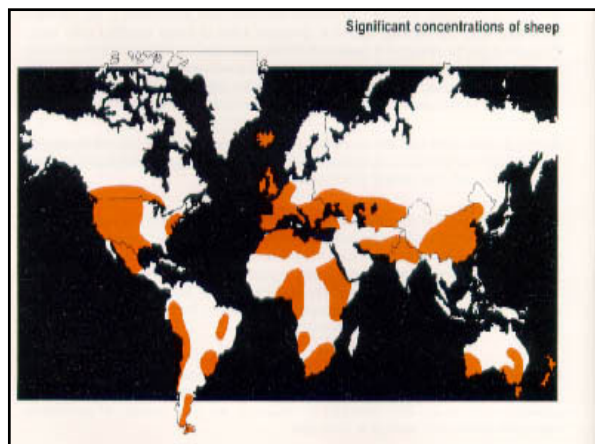
	Temperate	Tropics
Summer	hot, dry	warm, wet
Autumn	mild, dry	mild, moist
Winter	cold, wet	mild, dry
Spring	mild, moist	mild, dry

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What should worms do?

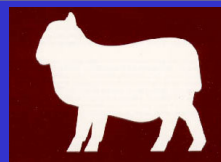
	Temperate	Tropics
Summer	adverse stay in host	ideal seek new hosts
Winter	ideal seek new hosts	adverse stay in host

10



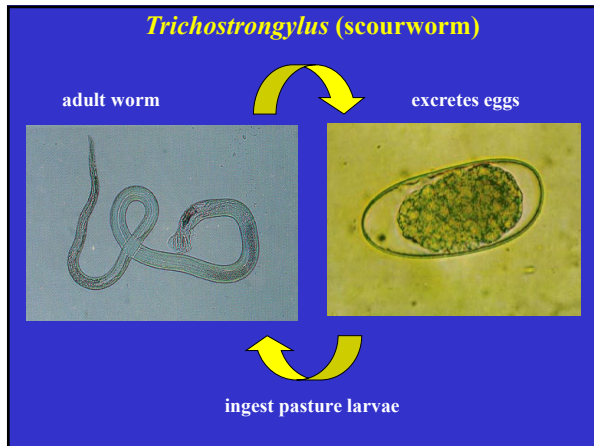
11

Gastro-intestinal nematodes of sheep

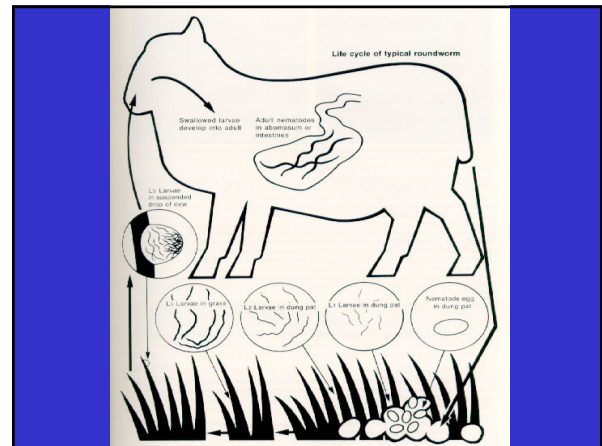


- Abomasum:** *Ostertagia* (small brown stomach worm)
Haemonchus (Barber's pole worm)
- Small intestine:** *Trichostrongylus* (black scour worm)
Nematodirus (thin-necked intestinal worm)
- Large intestine:** *Chabertia* (large-mouthed bowel worm)
Oesophagostomum (bowel worm)

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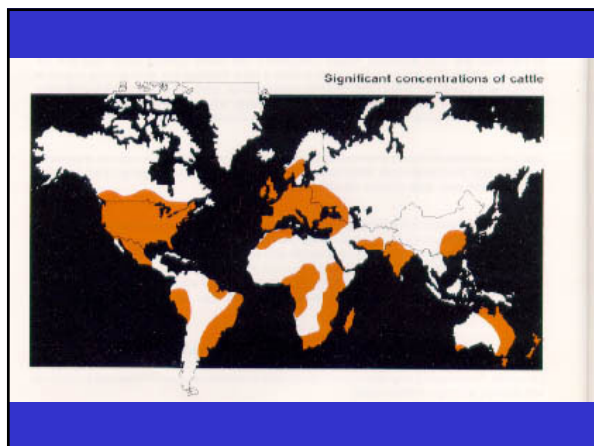
14



15



16



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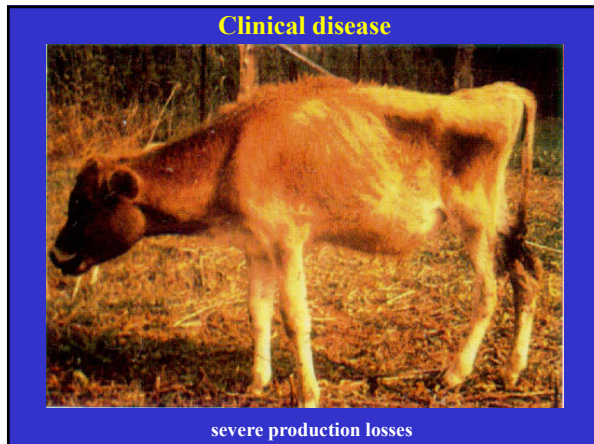
Gastro-intestinal nematodes of cattle

Abomasum: *Ostertagia* (brown stomach worm)
Haemonchus (Barber's pole worm)
Trichostrongylus (stomach hair worm)

Small intestine: *Cooperia* (cattle bankrupt worm)
Nematodirus (thin-necked intestinal worm)

Large intestine: *Oesophagostomum* (nodular worm)
Trichuris (whipworm)

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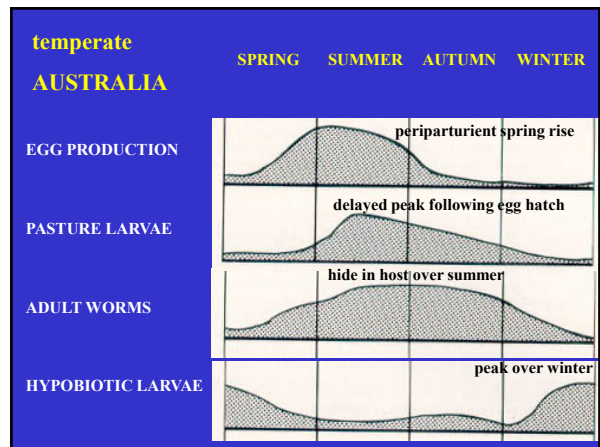


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Life cycle stages

- worm eggs
(faecal examination - eggs per gm)
- pasture larvae
(pasture examination - larvae per Kg)
- hypobiotic larvae
(hidden in mucosa)
- adult worm burden
(post-mortem examination - counts)

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Effect of Season

TEMPERATE REGIONS	TROPICAL REGIONS
<ul style="list-style-type: none"> • parasite load higher in hot summer <ul style="list-style-type: none"> - summer drenching • hypobiosis over winter <ul style="list-style-type: none"> - nil control • spring rise (periparturient rise) <ul style="list-style-type: none"> - drench breeding ewes - drench weaners - rotational grazing - mixed grazing 	<ul style="list-style-type: none"> • parasite load higher in dry winter <ul style="list-style-type: none"> - winter drenching • hypobiosis over summer <ul style="list-style-type: none"> - nil control • autumn rise (periparturient rise) <ul style="list-style-type: none"> - drench breeding ewes - drench weaners - rotational grazing - mixed grazing

Global warming will bring the tropics to higher latitudes

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Effect exacerbated

Hosts	<ul style="list-style-type: none"> - seasonal breeders - aggregated distribution
Vectors	<ul style="list-style-type: none"> - seasonal breeders - population explosions
Diseases	<ul style="list-style-type: none"> - seasonal occurrence - distribution boundaries

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Seasonal peaks for arthropods

Arthropods

- cattle tick (greater in warm wet months)
- buffalo fly (greater following high rainfall)
- fly strike (greater following persistent rainfall wetting fleece)

Arthropod-borne diseases (ar-bo viruses) (mossies/midges/ticks)

- human viruses (Ross River, Barmah Forest, Murray Valley encephalitis, Kunjin, Japanese encephalitis, dengue)
 - animal viruses (bovine ephemeral fever, blue tongue, Akabane)
- (disease incidence greater following heavy rains, flooding, tidal inundation due to increase in vector abundance)

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Other pathogens

Effect of increasing temperature modelled for huge range of infectious diseases, especially:

- water-borne diseases (esp. bacterial)
- ruminant nematodes (trichostrongyles)
- geohelminths (ascarids, hookworms)
- snail-borne trematodes (blood/tissue flukes)
- vector-borne diseases
 - protozoa (malaria)
 - helminths (filaria)
 - arthropods (ticks, buffalo fly, fly strike)
 - ar-bo viruses (JE, MVE, blue tongue)

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What's examinable?

Consequences of global warming

- more vigorous hydrological cycle
(⇒ floods)
- more pressure cells
(⇒ storms)
- more evaporation
(⇒ droughts)

Many diseases will:

- increase in incidence
- increase in distribution
- increase in severity

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