Selection of Beef Cattle for Harsh Environments

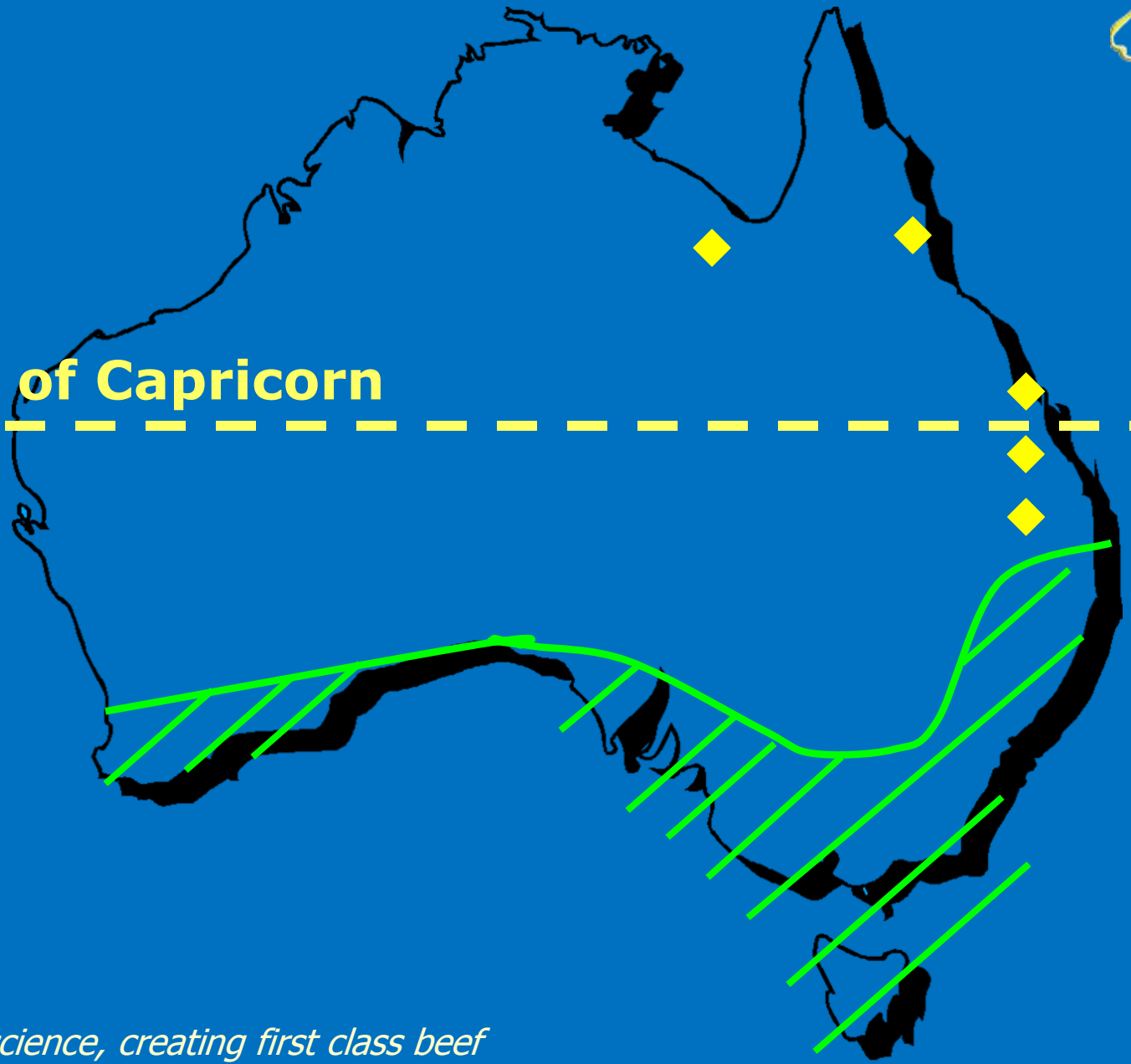
EAAP 2009

Barcelona, 25 August 2009

What's different about cattle breeding in harsh environments?

(tropics and tropical composites used very selectively by way of example)

Experimental Locations



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Environmental Stressors

Ecto- & endo-parasites

Buffalo & Horn flies
Filaria nematodes

Ticks &
tick-borne
diseases

***Tsetse fly &
trypanosomiasis***

Worms

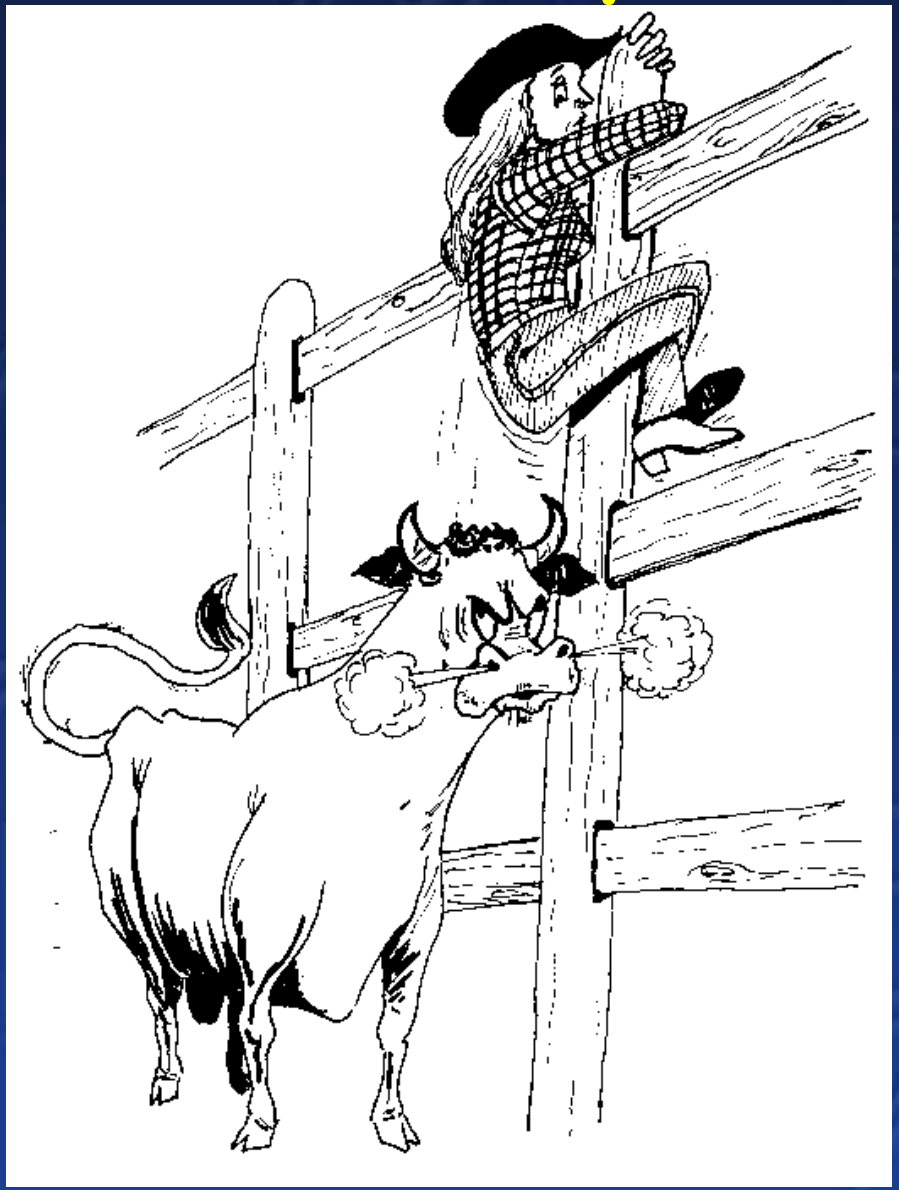
Environmental Stressors

Seasonally poor nutrition

Environmental Stressors

High temperatures and humidity (rectal temperatures during heat stress; coat colour & scores)

Temperament-an adaptive trait



Measuring temperament (flight time)

Measuring temperament (crush score)

How important are the traits?

Economic considerations include:

Ticks: mortalities; production losses; treatment costs; chemical residues (market access)

Worms: mortalities & post-weaning production losses; treatment costs; residues

Buffalo flies: ?production losses; treatment costs; residues; animal welfare concerns

Heat & Humidity: production losses (British breeds)

Poor nutrition: mortalities; production losses

Temperament: production losses under intensive management systems

Control of stressors

- Impact of stressors often multiplicative rather than additive
- Under extensive production systems, generally not feasible to control stressors through management strategies alone
- Best option: breed cattle that are productive in presence of stressors, without need for managerial interventions

Diverse breed resources

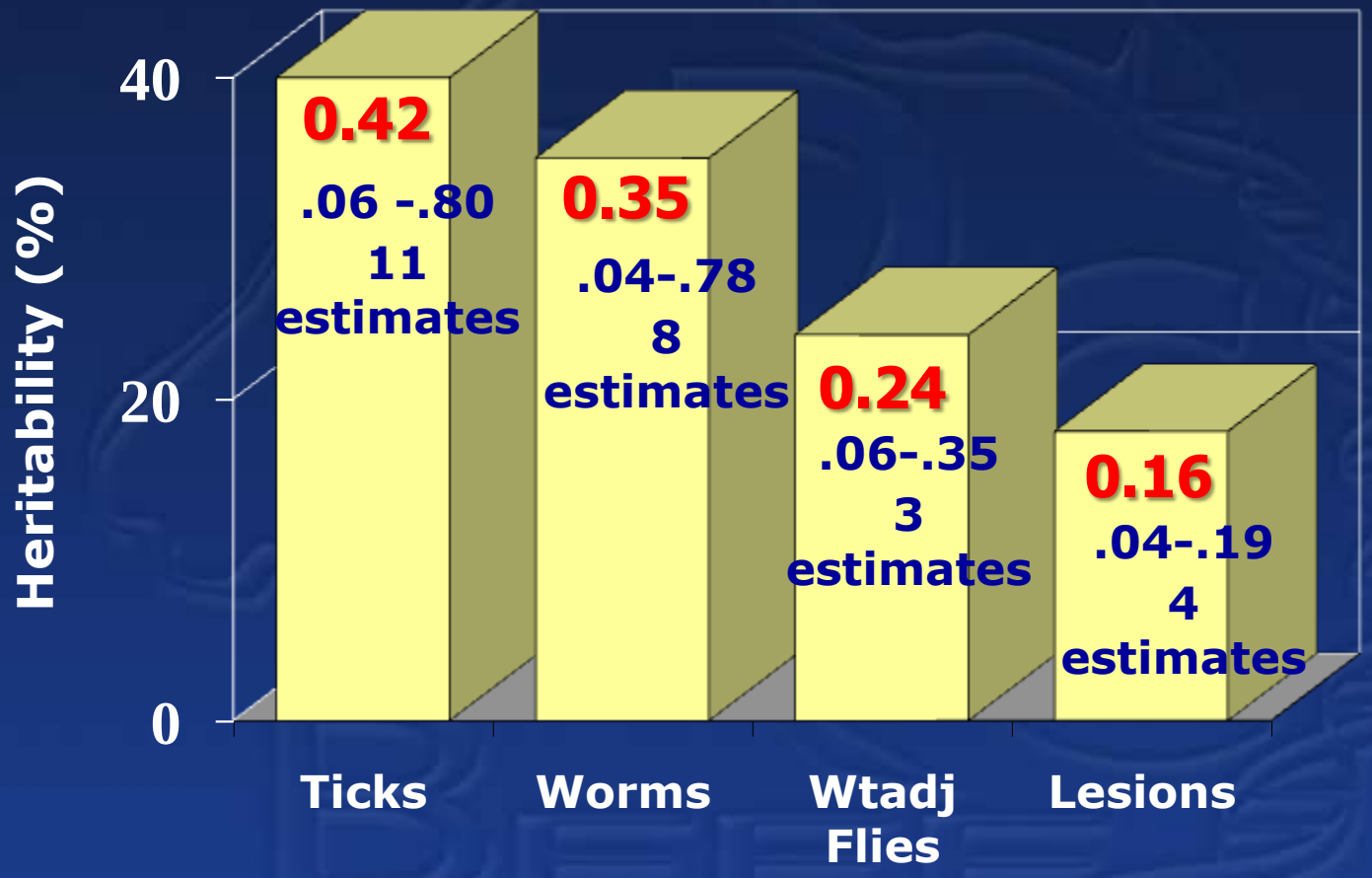
4 breed types (*differences between individual breeds masked in tropics*)

- ***Bos taurus* (British)** – highly productive in absence of stressors; poorly adapted to tropics
- ***Bos taurus* (Continental)** – highly productive in absence of stressors; more susceptible to parasites and limited nutrition than British breeds
- ***Bos indicus*** – greatest resistance to most stressors; least productive in absence of stressors
- **Tropically adapted *Bos taurus* (Sanga, N'dama Criollo)** – less productive than British in benign environments; more resistant than British in tropics

Comparative performance of breed types

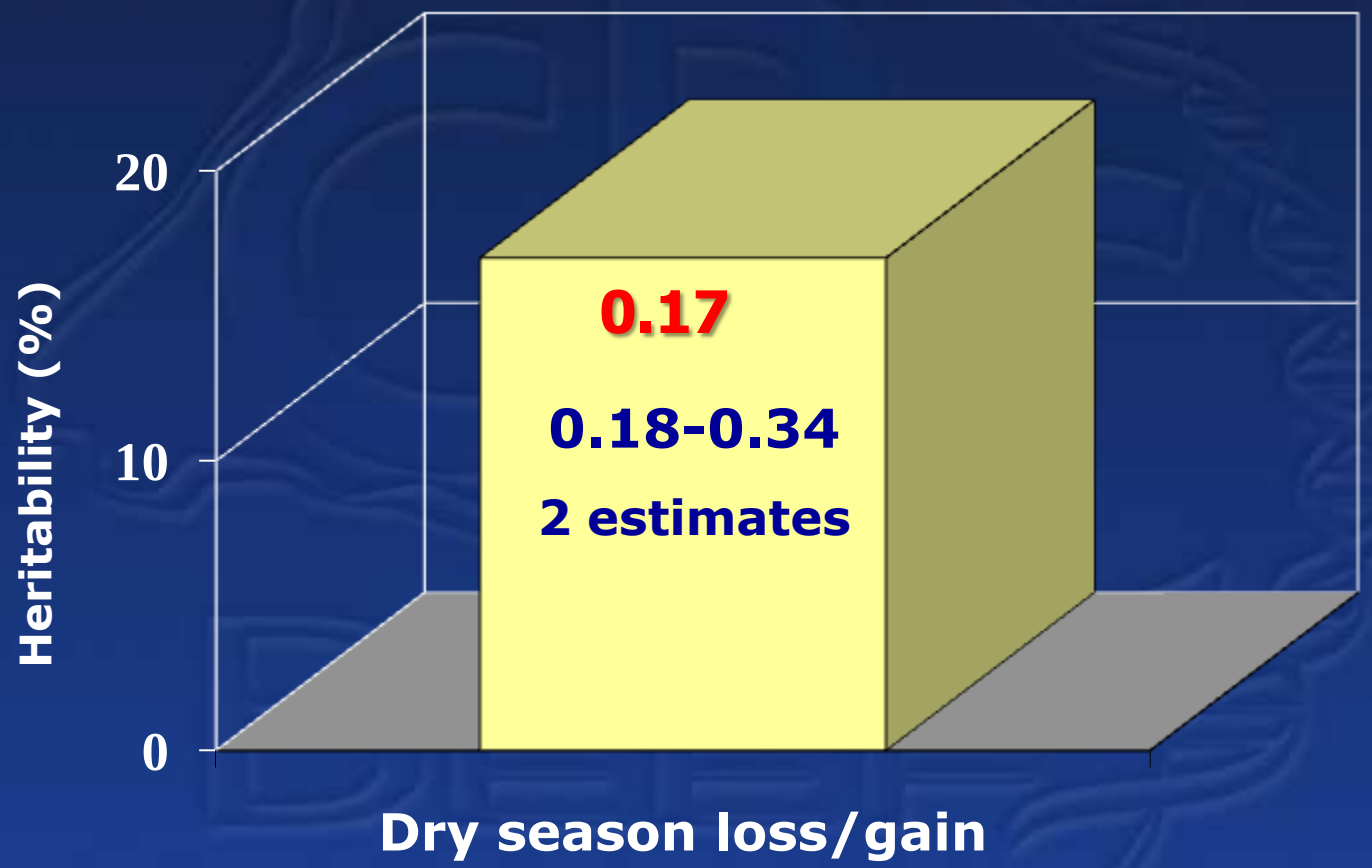
- No one breed "best" in all environments
- Select most appropriate breed type for use in specific environment e.g. use some component of 'adapted genes' (*B. indicus* / tropically adapted taurine) in tropics
- Many breeds in tropically adapted taurine breed type poorly characterized
- ***Essential these breeds be characterized and conserved: the need for well adapted, productive breeds is great ...***

Are the traits under genetic control?



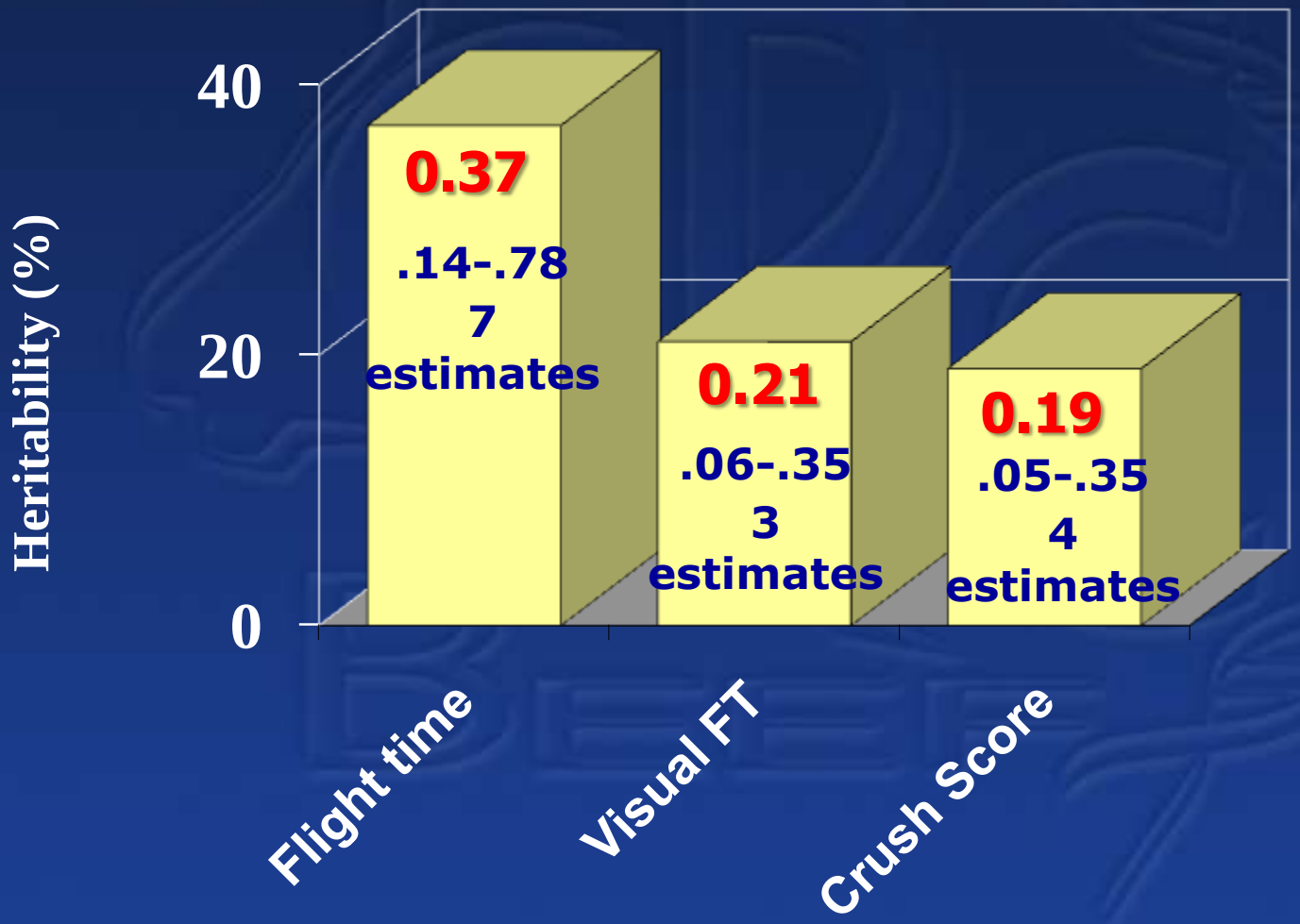
- h^2 lower in British *cf.* tropically adapted breeds
- most estimates derived from Belmont
- higher estimates in early years

Are the traits under genetic control?



Are the traits under genetic control?

(tropically adapted breeds; n = 3,594)

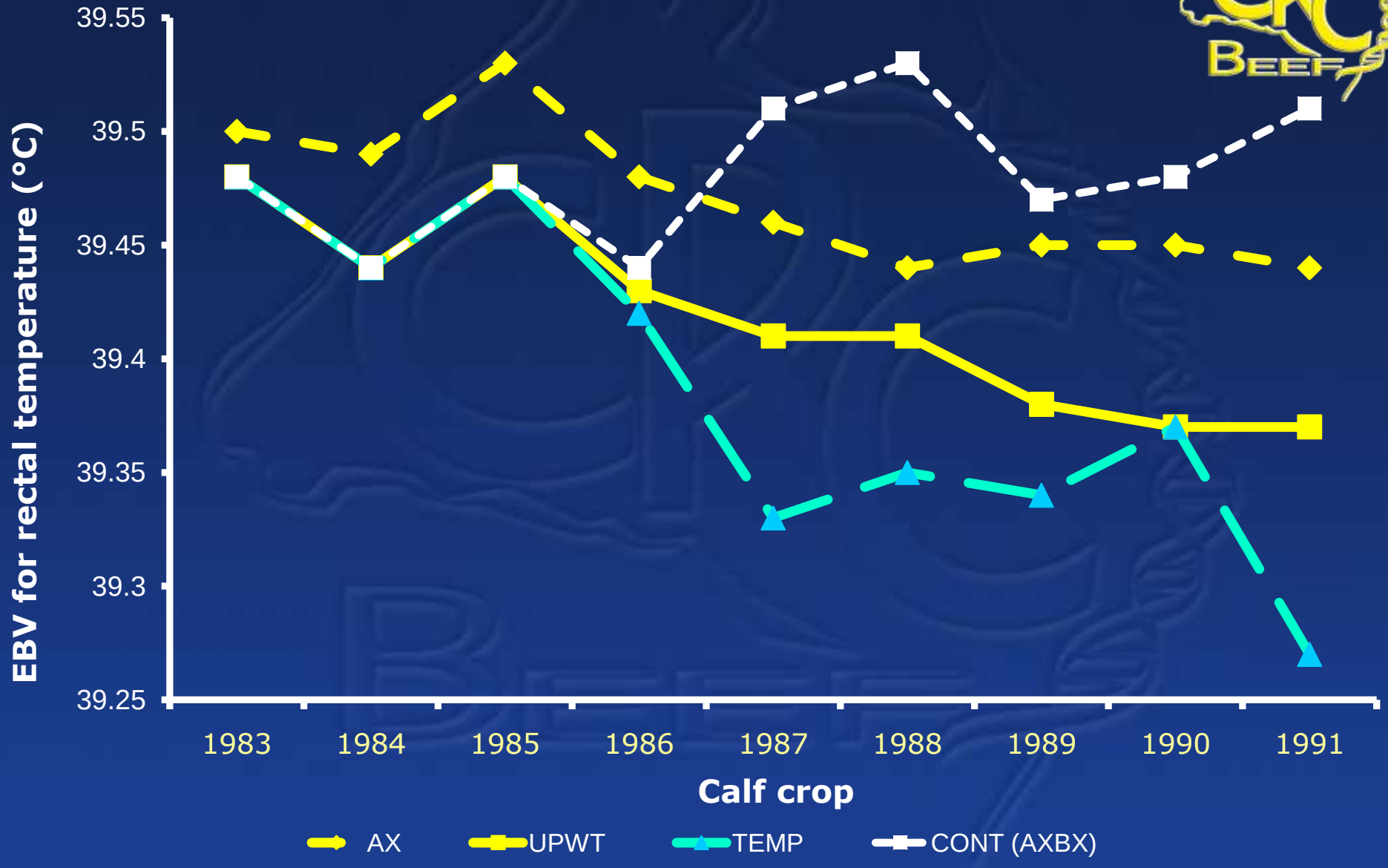


Results from Selection Experiments

Belmont Research Station; Tropical Composites

Selection for growth & resistance to heat

Genetic trends for rectal temps



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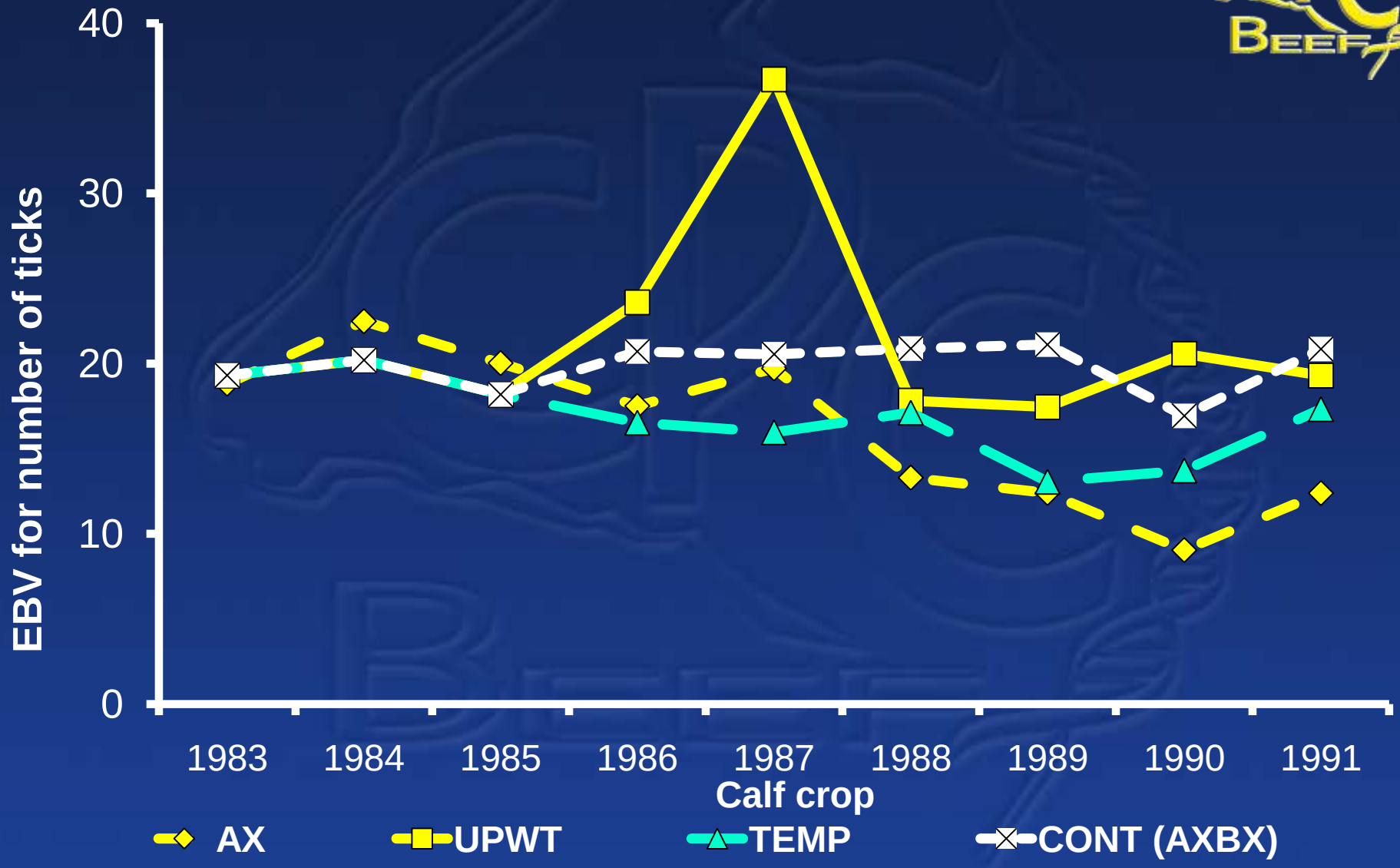
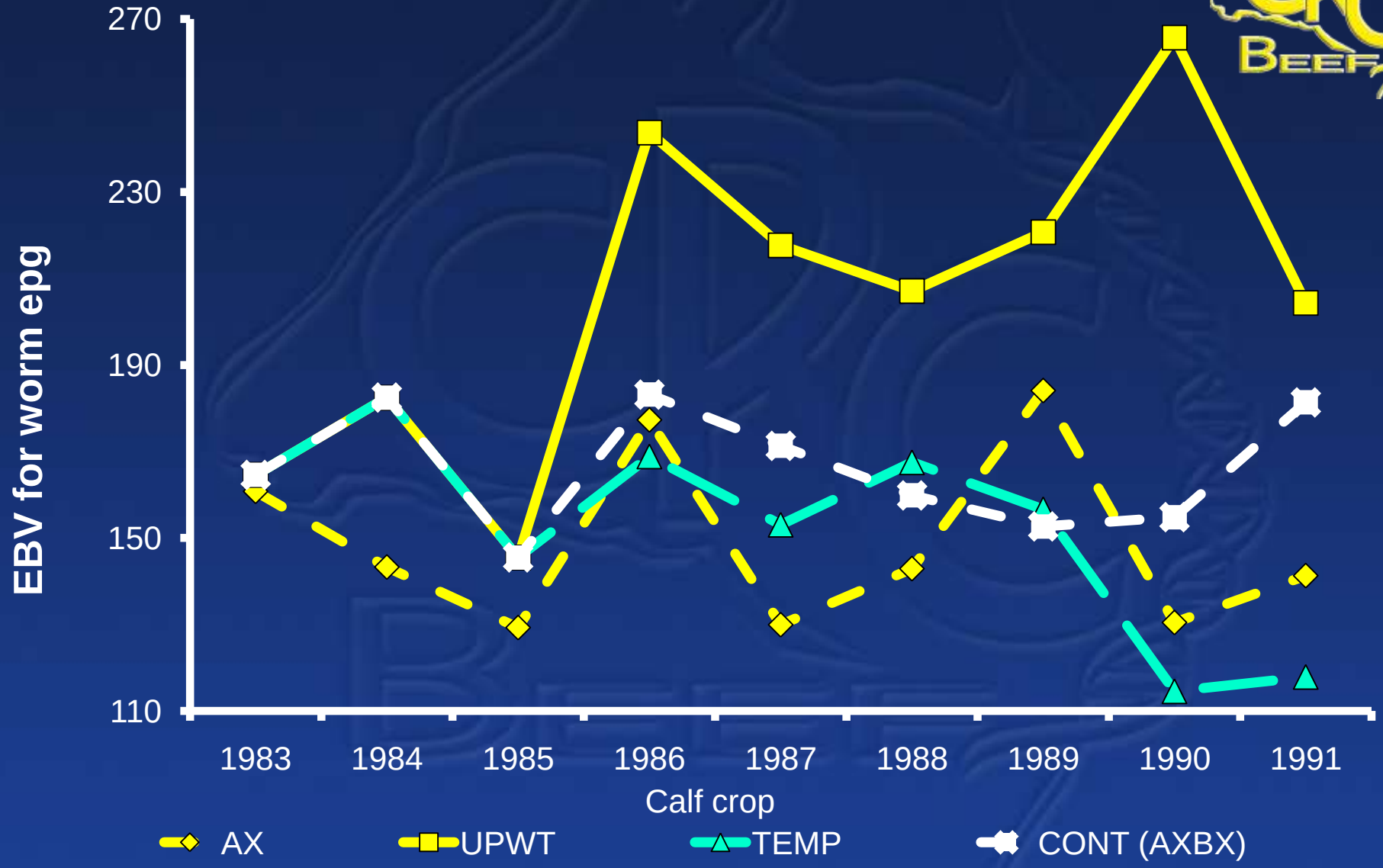
Genetic trends for tick count



Genetic trends for worm epg



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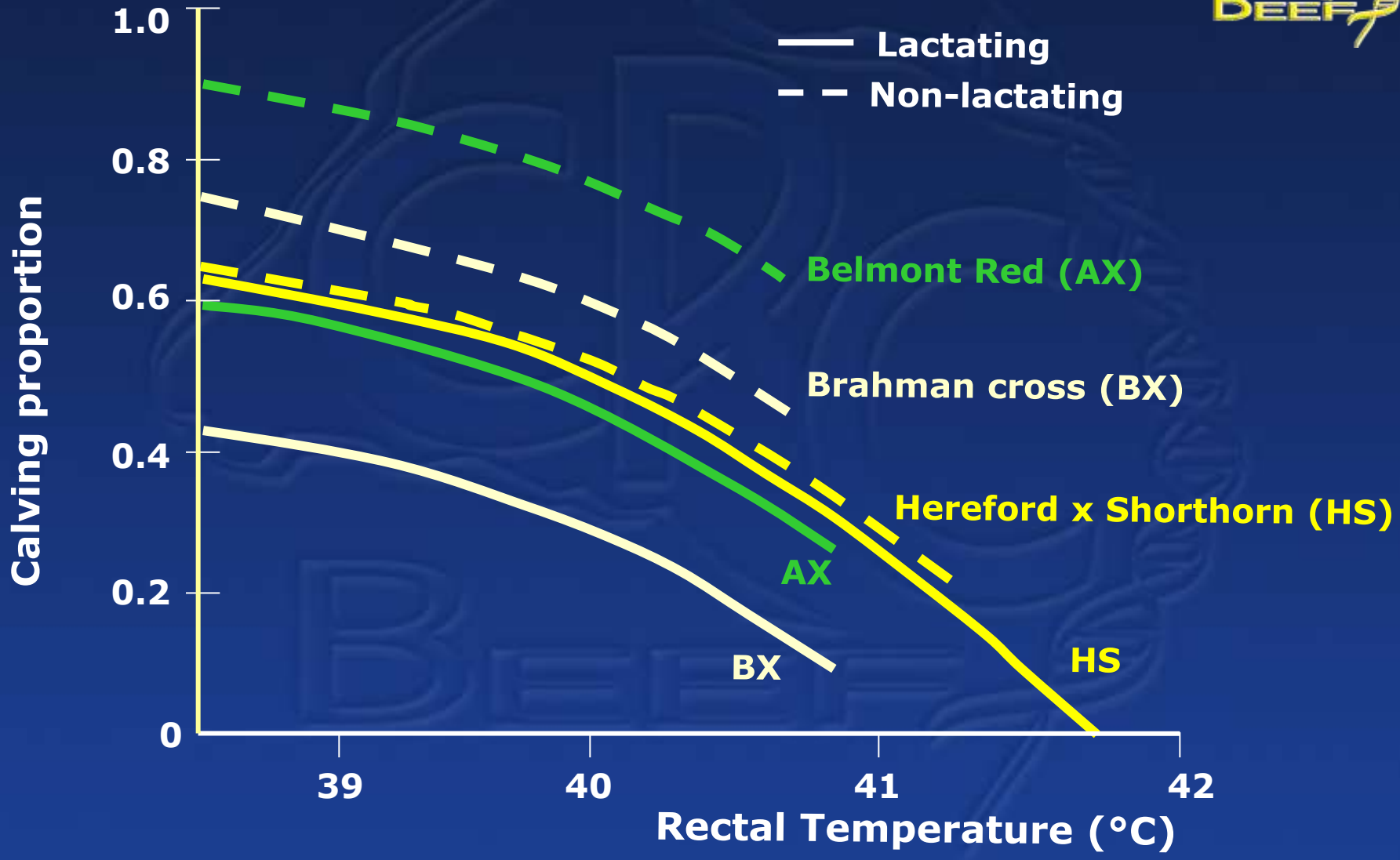
Genetic correlation between rectal temperature & calving %



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(Turner, 1982)

Genetic correlation between flight time and beef tenderness

Flight time : shear force -0.42

Flight time : MSA tenderness 0.33

Kadel *et al.* (Aust J. Ag. Res. 2006)

Options & Opportunities
Within-breed Selection

- **Most adaptive traits moderately to highly heritable (i.e. can be improved by selection)**
- **Productive & adaptive traits largely *genetically* independent in cattle that are moderately to highly adapted (i.e. it is possible to simultaneously improve adaptation and production in tropics)**
- **Similar rates of genetic gain for productive attributes *cf. Bos taurus* in temperate areas**
- **Main limitation: difficulty and expense of measuring all traits in breeding objective**

Options & Opportunities
Use of Indirect Selection

- **Selection for growth will decrease ticks, worms & heat stress, but increase flies (responses greatest in least adapted breeds)**
- **Selection for temperament will *phenotypically* improve productive traits in intensive production systems in all breeds**
- **Selection for temperament will indirectly *genetically* improve beef tenderness and eating quality**

Options & Opportunities
Within-breed Selection

- **Need to identify simple, cost-effective selection criteria (direct and/or indirect) to encourage wider use of selection**

- **Marker assisted selection will assist over next decade as more reliable DNA tests become available & cost of DNA technology becomes more affordable**

Options & Opportunities
DNA tests and MAS

- **No DNA markers associated with adaptive traits commercially available yet**
- **Size of effect of Beef CRC markers for adaptive (and most productive!) traits too small *cf.* total variance associated with traits**
- **When many DNA tests available for each trait & cost of testing more affordable, large gains likely from use of DNA tests (Goddard, 2003)**

Take-home messages

- Use appropriate breed type(s) to optimise production and adaptation
- Selection to improve adaptability traits is possible, but direct selection for resistance to parasites is only for the dedicated!
- Some opportunities for indirect selection (e.g. selection for growth in tropics improves adaptability; selection for calving rate improves resistance to heat - both more so in less resistant breeds)
- Magnitude of selection response in tropics similar to expectations in temperate areas
- DNA tests a promising alternative


VH-BFA