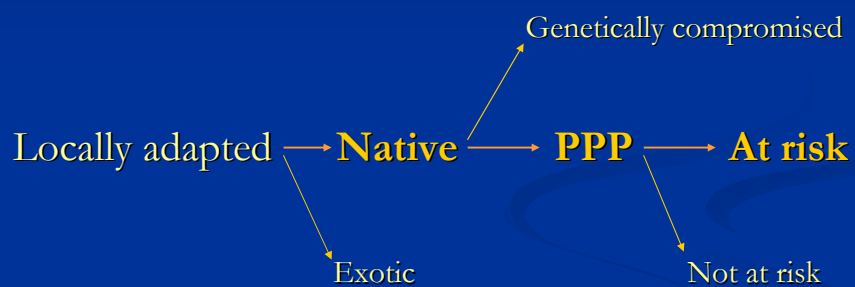# Native Breeds at Risk
criteria and classification

Lawrence Alderson
lawrence@clltd.demon.co.uk

Breed Categorisation

Genetically compromised

Locally adapted ⟶ **Native** ⟶ **PPP** ⟶ **At risk**

Exotic

Not at risk

Native **Breeds** at Risk

Definition

What is a breed?

- Two definitions – genetic or political/legal

Native **Breeds** at Risk

When is a breed not a breed?

Lacks PPP

(purebred pedigree provenance)
re-creations, recent creations,
composites, introgressed breeds)

Introgression: herd/flock book data

- ~ **Vaynol** (11.4% White Park)
- ~ **Dairy Shorthorn** – crossbreeding programme since 1970

<u>Native</u> <u>Breeds at Risk</u>

<u>Definition</u>

What is native?

- Originating and initially recognised in a particular country (i.e. country of origin); a breed existing in the countries where it originated

<u>Native Breeds</u> **at Risk**

<u>Definition</u>

How to define 'at Risk':

- Progress impeded by lack of harmonisation

Seminar convened in London 16-17 February

- ~ global delegates: FAO and RBI
- ~ regional delegates: ERFP, EAAP and ELA
- ~ national delegates: Defra and RBST
- ~ invited specialists

Harmonisation?

Four steps possibilities:

- **Basic definitions** – what is a breed?
- **Indicators of Endangerment** – which breeds are at risk?
- **Factors of Prioritisation** – which to support?
- Management of Breeds at Risk (not covered as policies and programmes of management are subject to national decisions)

Indicators of Endangerment

Four primary indicators –

- **Numerical** (size of population) essential
- **Geographical** (range or distribution) essential
- **Genetic** (genetic erosion; loss of alleles) modifying
- **Introgression** (threatens breed integrity) precursor

Other dangers are causal (they influence primary indicators) -

- Demographic – number/age of owners, etc
- Changing marketplace, disease threats

Numerical

Problem: e.g. threshold for pigs –
EU 15000 sows; UK 1000 sows

Questions:

- Population in **country of origin**,
  or global population
- **Registered animals** or total population

Options:

- **Effective population size** (N_e)
- Number of **breeding females**
- Number of **female replacements**

N_e

Definition:

N_e **50** generates a rate of inbreeding of
1% per generation

Limitations:

- Difficult to measure, e.g.: -
- ~ requires data on breeding males
- ~ females used for crossing or not breeding
- ~ varies with type of breeding programme -
  random , mass or intensive selection

Females

Number of breeding females used by most organisations

- ■ - does not account for barreners, crossbreeding, perinatal losses, and other wastage

Number of female replacements is a truer indication of the health of a breed

- ■ **- rolling 3-year average** of the number of female replacements also reflects trends

Numerical

- ■ **Thresholds for harmonisation** – **developed from FAO criteria**

number of females of breeding age

Category	Cattle	Sheep	Goats	Equines	Pigs	Poultry
Critical	150	300	300	200	100	100
Action	1500	3000	3000	2000	1000	1000
Warning	3000	6000	6000	4000	2000	2000

Example Breeds – UK sheep

Boreray

- **221** breeding ewes
- Numerically at risk (critical)

Rough Fell

- **15134** breeding ewes
- Not threatened numerically

Geographical indicator

- Most breeds evolved gradually in a locality to which they were adapted
- Many spread subsequently to other regions (commercial pressure, fashion or conservation policy)
- Some breeds, which may not be rare (i.e. not numerically scarce), remain in a restricted locality (**geographically concentrated**) and are at risk in the event of a disease epidemic.
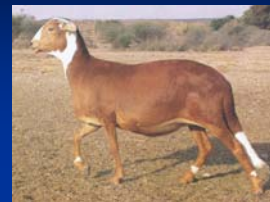
Geographical Concentration

Procedure:
- Based on GIS and herd/flock data
- Developed, tested and applied in the UK by the University of Worcester and CLL.

Criterion:

>75% of population found within **25 km** (action threshold) of the (MWC) mean weighted centre of the breed.

Geographical Concentration
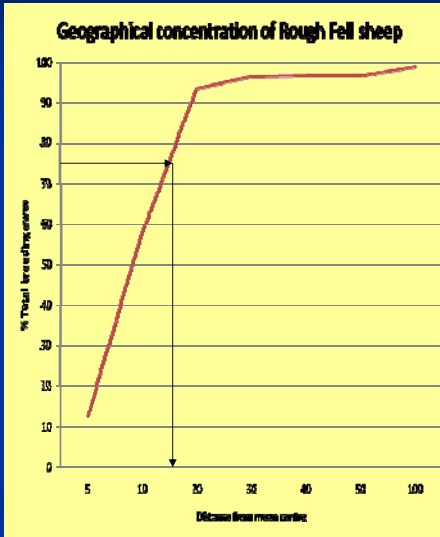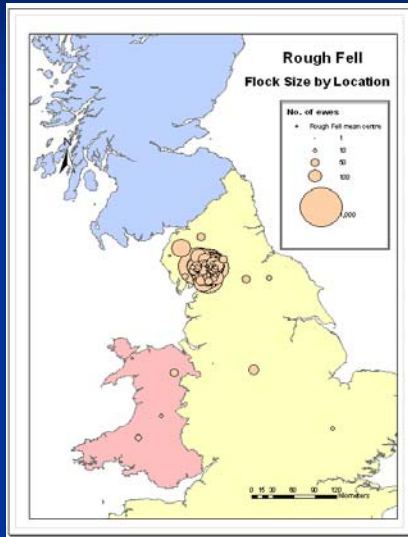
Procedure:

Based on GIS and herd/flock data

Developed, tested and applied in the UK by the University of Worcester and CLL.

Criterion:

- **>75% of population** found within **25 (50) km** (action threshold) of the (MWC) mean weighted centre of the breed; wider testing necessary.

Rough Fell sheep

Example Breeds – UK sheep

Boreray
- **221** breeding ewes; **180 km** radius
- Numerically at risk (critical)
- Not threatened geographically

Rough Fell
- **15134** breeding ewes; **15 km** radius
- Not threatened numerically
- Geographically at risk (action)

Genetic indicator

Genetic erosion –

- **Traditional Hereford**
  – loss of 18% alleles from 1960s to 1990s
- **Vaynol cattle**: (N_e 3.8); tested at 16 markers – homozygous at 7
- **Chillingham cattle**: tested at 23 markers – homozygous at 22

Inbred populations –

- **Holstein** cattle (N_e <100), **TB** horses (CGI 28.15)

Genetic Erosion

Linebreeding (selective inbreeding) used by some breeders to concentrate the qualities of an elite ancestor

Inbreeding a danger

- ~ deleterious genes in founder population become homozygous
- ~ homozygosity reduces diversity and ability to adapt

Warning threshold: rate of inbreeding of **1% per generation** (N_e 50)

Genetic Erosion

Introgression –

- The most serious cause of genetic erosion
- Results from official programmes (grading-up)
- - or from unofficial (illicit) crossing.

Warning threshold: **introgression of 2.5%** in any generation

---

Thresholds for
Indicators of Endangerment

The <u>first threshold</u> acts to identify 'breeds at risk'

Category	Numerical: breeding females"	Geographical: concentration^ km	Genetic: inbreeding* %	Genetic: introgression %
Warning	<2000-6000	<50	>1	>2.5

" varies according to species

^ radius of circle containing 75% of the breed

* rate of inbreeding per generation

Factors of Prioritisation

Probability of extinction

■ directly related to indicators of endangerment

Loss of genetic diversity

■ measured by population genetics

■ - or by molecular genetics

Other factors   (special traits, commercial, cultural, landscape, catastrophic events, socio-ecological)

Probability of Extinction

Prioritisation by

categorisation of indicators of endangerment

Category	Numerical: breeding females"	Geographical: concentration^ km	Genetic: inbreeding* %	Genetic: introgression %
Critical	<100-300	<12.5	>3	>12.5
Action	<1000-3000	<25	>2	>7.5
Warning	<2000-6000	<50	>1	>2.5

" varies according to species

^ radius of circle containing 75% of the breed

* rate of inbreeding per generation

Probability of Extinction

Prioritisation by
categorisation of indicators of endangerment

Numerical: breeding females	Geographical: concentration km	Genetic: inbreeding %	Genetic: introgression %
221	15	>3	>12.5

Genetic Diversity

	between-breed	within-breed
PigBioDiv1 BREED/LINE		
Local breeds	55.9	-1.9
International breeds	15.4	2.1
Commercial lines	28.7	-0.5
FRENCH BREED/LINE		
Local breeds		
FRBA01	14.86	-2.03
FRGA01	8.30	-0.50
International breeds		
FRLW12	1.24	0.67
FRPI02	3.57	0.22
Commercial lines		
FRLW08	5.62	-0.39
FRLA01	6.96	-0.17

Local Breeds

Special traits:
- Local adaptation (N'dama and North Ronaldsay)
- Product quality
- ~ White Park beef – Sir Loin
- ~ Basque pig – Oteiza business
- Landscape management – conservation grazing

Undesirable traits: VRQ scrapie allele

Historical value (many native breeds):
- Local tradition and history
- Tourism and local crafts

Factors of Prioritisation

Take all factors into account

- 1) **Probability of extinction** – essential

- 2) **Genetic diversity** across species (maybe based on index of between- and within-breed diversity) – modifying

- 3) **Special traits** of local breeds – modifying

Harmonisation in Europe

Breed definitions

- – harmonisation possible and agreed

Indicators of endangerment

- – harmonisation possible and likely

Factors of prioritisation

- – harmonisation possible but not in the immediate future

Lawrence Alderson

lawrence@clltd.demon.co.uk

www.lawrencealderson.com