

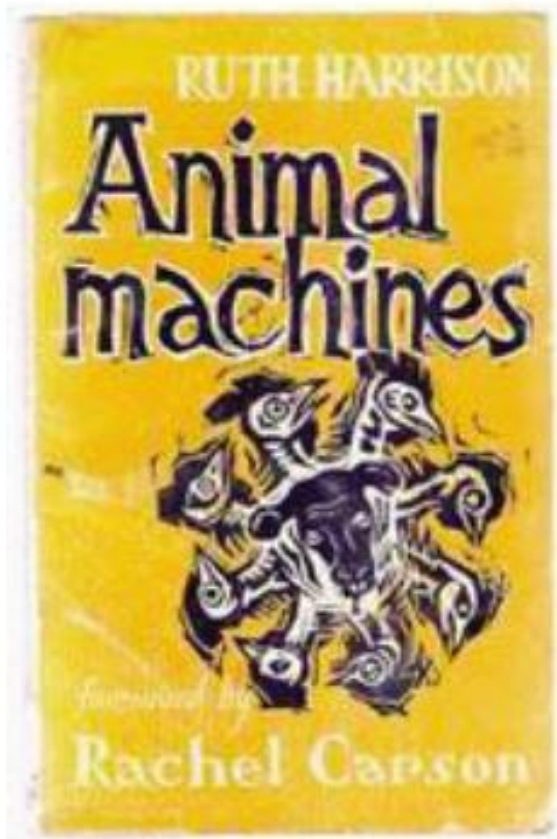
Much still to do: Ruth Harrison's *Animal Machines* and the state of animal welfare science

Marian Stamp Dawkins
University of Oxford

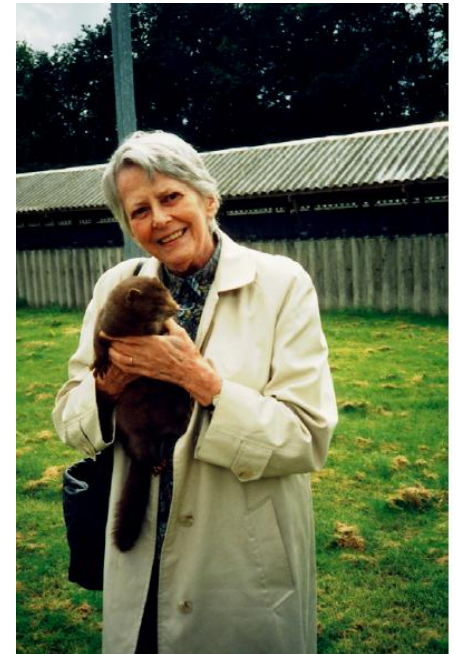
WAFL 3rd September 2014, Clermont-Ferrand, FRANCE



“dropped a bomb on industrialised animal production” - D. Fraser (2008)



1964



Ruth Harrison
(1920-2000)

Outline of talk

- *Animal Machines* and animal welfare
- *Animal Machines* and animal welfare science
- Lessons we can still learn
- Automated assessment of animal welfare

“The New Factory Farming Industry”

- “Rapid turnover, high density stocking, a high degree of mechanisation and efficient conversion of food into saleable products”.



“ ...animals are being taken off the fields and the old lichen covered barns are being replaced by gawky, industrial type buildings into which animals are put, immobilised through density of stocking and often automatically fed and watered. Mechanical cleaning reduces still further the time the stockman has to spend with them, and the sense of unity with his stock which characterises the traditional farmer is condemned as being uneconomic and sentimental. Life in the factory farm revolves entirely round profits, and animals are assessed purely for their ability to convert food into flesh, or ‘saleable products’.”

- Ruth Harrison (1964) *Animal Machines*
Introduction

Ruth Harrison's charter:

- 1. Abolition of battery cages
- 2. Abolition of intensive veal production
- 3. Banning of deficiency diets
- 4. Banning of permanent tethering
- 5. Banning of slats
- 6. Banning of animals kept in dim light or darkness

Ruth Harrison knew how to get publicity!

- Asked Rachel Carson to write foreword:
 - “.....public-spirited person, with patient scholarship and steadfast courage, presents facts that can no longer be ignored.”
- Serialisation of the book in a major UK national newspaper
- Publicity abroad especially Germany
- Questions in UK Parliament
- UK Government Commission (‘Brambell Report’)

The importance of *Animal Machines*

- Drew public attention to farm animal welfare
- Need for legal and political action
- Need for education and information
- Need for scientific research
 - Farm Animal Care Trust (FACT) started 1967
 - “ The promotion of research and the dissemination of results to those who are able to effect change.”

Animal welfare: a proper subject for science?

- *Animal Machines* raised questions that biology could not and *would* not answer
- Behaviorism still dominant
- W.H. Thorpe (Brambell Committee, 1965) set an agenda for an ethology of animal welfare

“What is required is to examine the incidence of those expressive movements which are known to be associated with damaging situations in order to assess whether animals brought up with a certain degree of deprivation “suffer” from deprivation and stress in adulthood. It is obvious that this would be a major experimental undertaking.”

Animal welfare: a proper subject for science?

- Thorpe's agenda and Ethology's 4 questions
 - Adaptation, Mechanism, Development, Evolution
- However, Ethology losing interest in mechanism and development
- Rise of Sociobiology and Behavioural Ecology emphasizing adaptation
- Split between Pure and Applied Ethology

Animal welfare science

Origins in diversity

- David Wood-Gush (UK), J-P Signoret (FRANCE), Paul Siegel (USA), K. Vestergaard (DENMARK) Rolf Beilharz (AUS), Ron Kilgour (NZ)
- Society for Veterinary Ethology became ISAE
- Split only partially healed even now

Lessons we can still learn from *Animal Machines*: use all available evidence

- Food safety:
 - “Unhealthy animals cannot make healthy food for humans” (p. 152 of reprint)
 - “...the dangers associated with resistant bacteria in animals: firstly that the bacteria can be passed direct from animals to man, and secondly, that they can be passed on in the food so produced” (p. 155).
- Food quality: taste and quality of eggs and milk
- Animal health
 - “Conditions are so crowded that any disease can sweep through the house very rapidly” (p.49)

Humanitarian arguments plus.....

- Effect on the environment:
 - “...because of intensive rearing methods so much farmyard manure is fed down public sewers that local authorities are having to impose quite a heavy charge to cover the costs of dealing with it.” (p.198)
- Economics (hints at):
 - “One begins to wonder whether it might not be cheaper to eliminate the labour shortage in this field by raising the status of the agricultural worker.” (p. 196)

Moving on from 'Animal Machines'

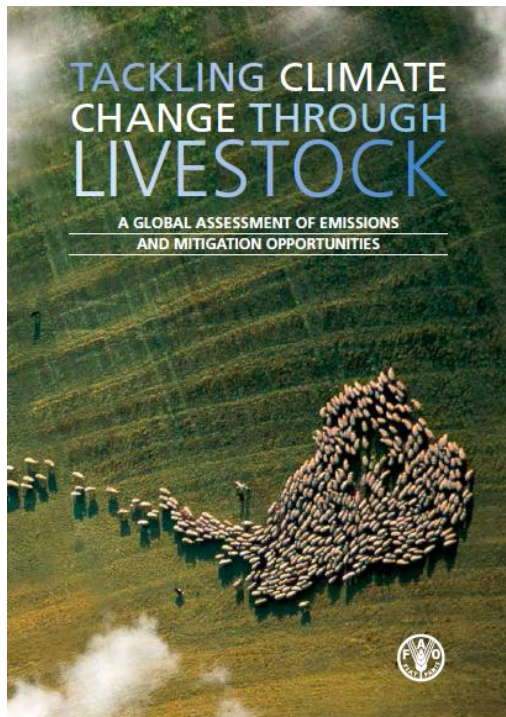
- Farming conditions have changed (often because of her)
- New research (often because of what she identified and promoted)
- Public attitudes have changed (her book was a landmark)
- Animal welfare now accepted as a science
- A more integrated approach (that she pioneered)

Economics *versus* animal welfare?

“ The arguments against factory farming are essentially based on humanitarianism and quality; the arguments for factory farming, such as they are, are economic arguments.” *Animal Machines* (p. 194)

Or economics *and* animal welfare?

“Agriculture will need to produce more food from the same or less land, using less water, energy and other inputs and reducing waste and adverse environmental impacts including greenhouse gas emissions”. (2013)
<http://www.un.org/millenniumgoals/>



- Limiting land for livestock
- Greater efficiency
- Sustainable intensification
- More technology
- **No animal welfare**

To carry weight, animal welfare needs

- Integration of with other priorities such as environmental protection, food safety and human health (as RH argued)
- Integration with economics and commercial viability

Can animal welfare learn from conservation?

Conservation (and its monetary value)

- ‘Natural capital’ and ecological services
 - Climate regulation
 - Water regulation, water supply
 - Erosion control and sediment retention
 - Soil formation
 - Waste treatment
 - Pollination
 - Raw materials, genetic resources
 - Recreation and culture

R. Constanza et al 1997 *Nature*

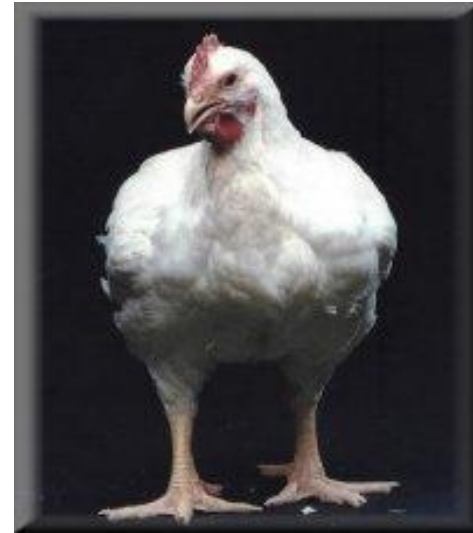
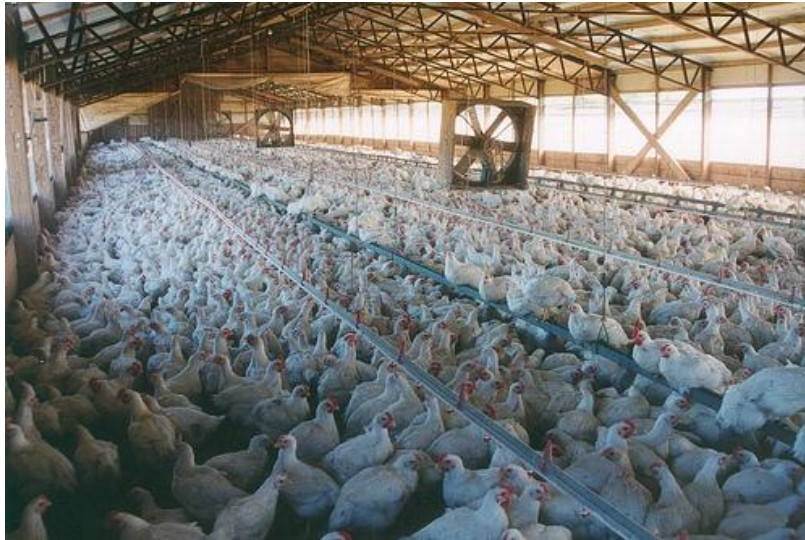
Animal welfare (and its monetary value)

- Animal welfare (and its monetary value)
 - Services and utility
 - Reduction in human disease
 - Improved food quality and security
 - Less use of medication
 - Better conditions for farm workers
 - Ethical and cultural benefits
 - More likely to carry weight in countries where animal welfare is currently less valued
 - More likely to be adopted by producers worldwide

Monetary value of poultry welfare

- Lower mortality (less waste/more to sell)
- Lower hockburn and pododermatitis (higher quality product)
- Fewer lame birds (fewer culls/ less waste)
- Lower disease levels (higher quality product)
- Lower risk human infection
- Less medication

Broiler (meat) chickens are already highly 'efficient' at converting food to meat



In 1960, it took 63 days and 3.7 kg of food to grow a chicken to 1.52 kg (Feed Conversion Ratio of 2.5)

In 2013 takes 35 days and 2.25 kg of food to grow a chicken to 1.5 kg (FCR of 1.5)

Some predict chicken with an FCR of 1.2

Efficiency in poultry production

- Achieved by breeding, diet and environment
- In many peoples' eyes, efficiency has already adversely affected welfare (lameness, pododermatitis, hockburn)
- What will happen to poultry welfare with greater efficiency and more intensification?
- We need to make the economic case for good animal welfare

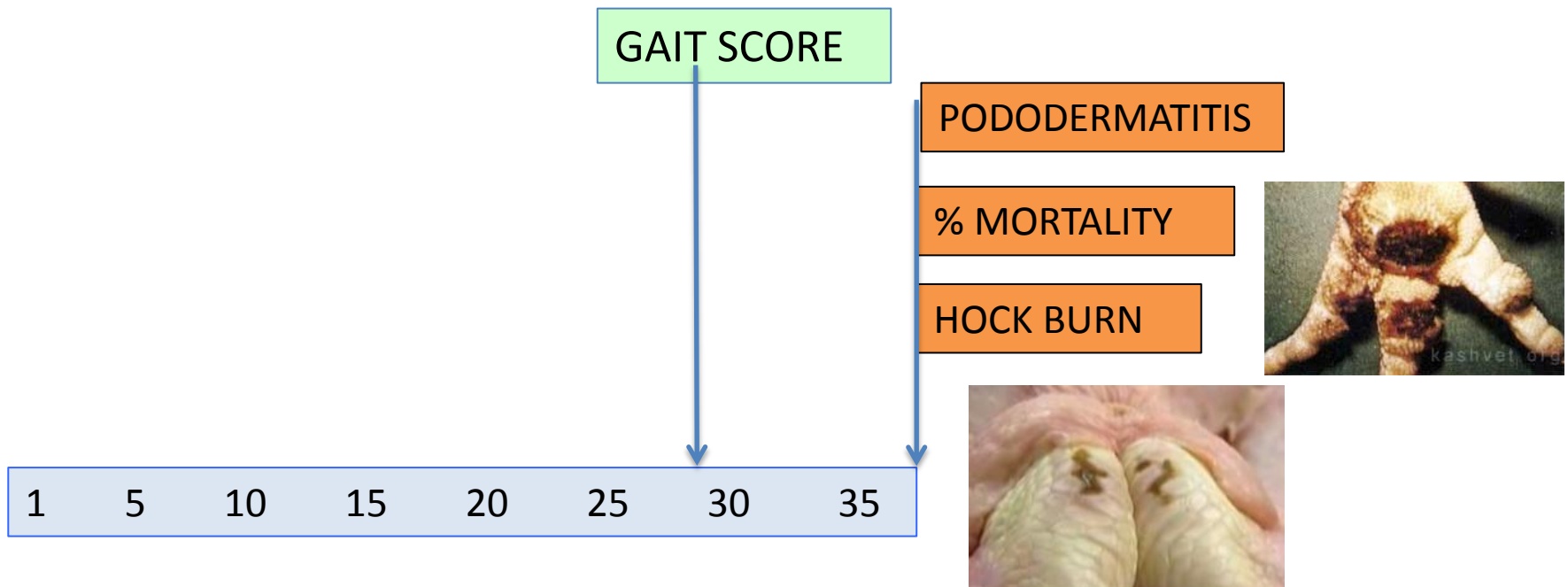
A practical definition of animal welfare

- Good welfare mean that an animal is healthy and has what it wants
 - Dawkins, (2008) Ethology
- Covers what most people mean by ‘good welfare’
- Clarifies other definitions (e.g. natural behaviour)
- Shifts the argument from what people think is good welfare to animals actually need
- Shows what evidence we need to collect to achieve good welfare in practice.

We have developed an automated way of assessing chicken welfare that

- Helps producers to manage their flocks for greater health, welfare *and* efficiency
- Gives early warning of problem flocks, enabling targeted interventions
- Provides an inexpensive and easy to use way of integrating many different sorts of information.

Current methods of assessing broiler welfare are mainly post-mortem



We aim to assess welfare throughout life and so anticipate and intervene to achieve healthier flocks

The system uses a smartphone camera

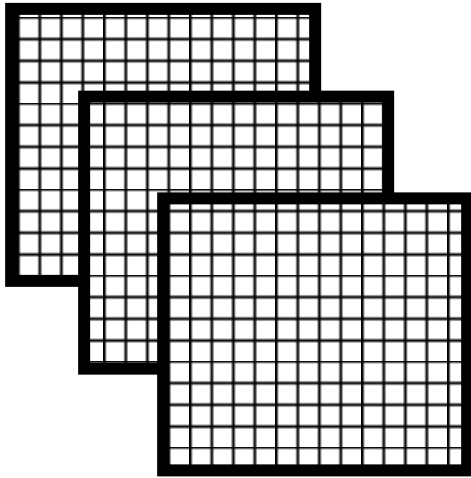


The smartphone camera analyses the data continuously

The problem is analysing the data

- Putting up cameras is the easy part
- Most automated analyses of video track individual animals
- We use analysis of whole groups with 'optical flow'
- Much simpler, delivers measures every 15 min
- Doesn't store images (no invasion of privacy)
- Runs for months at a time

Optical flow: rate of change in image brightness



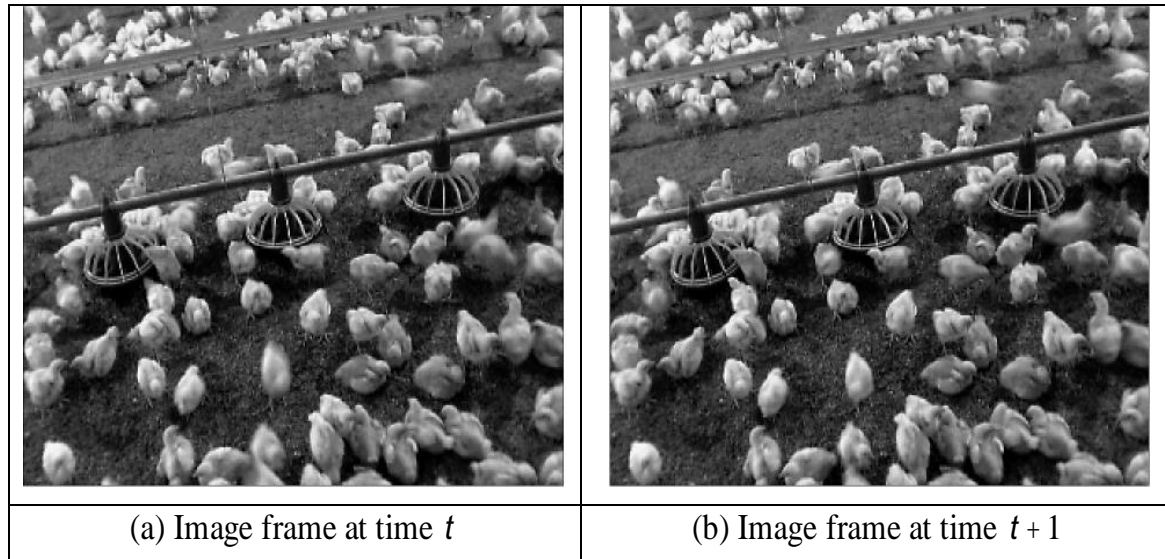
Each (320 x 240) video frame is divided into (8X8) pixel squares. If there is no movement between frames, the brightness of all squares remains the same

If movement occurs, there is a change from light to dark or *vice versa*.

optic flow



Optical flow compares the patterns of light and dark in successive images



Individual animals are not tracked, but the changing patterns over time (“flow”) give an indication of behaviour at flock level.

24 broiler flocks, each with 34,000 birds,
identical houses, one site, one manager

Company measures	On-site measures	Optical flow from video
Mortality Hock burn Podo- dermatitis Body wt.	Gait score	Mean Variance Skewness Kurtosis

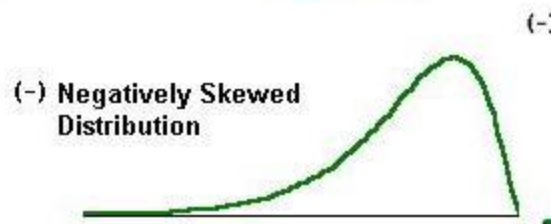
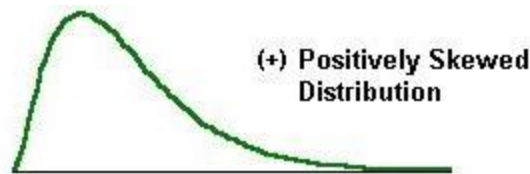
Lower welfare flocks had lower mean flow and more *unusual* movement (higher skew & kurtosis)

	Mean	Variance	Skewness	Kurtosis
% flock mortality	-0.42*	0.003	0.42*	0.45*
% hock burn	-0.36	0.09	0.57**	0.56**
% podo	0.05	0.27	0.33	0.32
% poor gaits	-0.33	-0.27	0.42*	0.48*

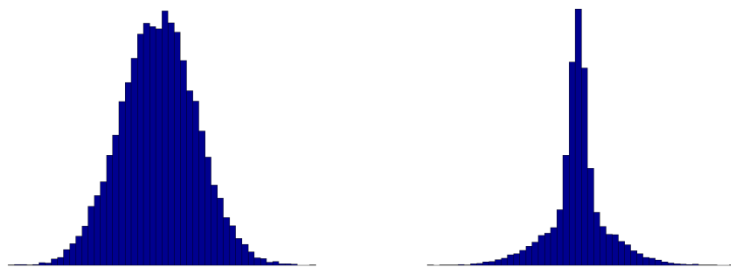
The figures shown are correlation coefficients; *= $p < 0.05$, **= $p < 0.01$

Dawkins et al (2012) Animal Behaviour

The statistics of welfare



Skewness shows whether there are many birds moving slower (or faster) than average.



Low
kurtosis

High
kurtosis

Kurtosis shows whether the distribution has 'tails' (whether there are birds moving extremely fast or extremely slowly)

A broiler flock with some unhealthy birds is a 'mixed ability' flock

- Broiler chickens do not all go lame at once
- In a poor welfare flock, some birds will walk well, some less well and some badly
- The lack of uniformity (high skew and kurtosis) in the flow is an indication that a high % are lame.

Skew and kurtosis are measures of lack of uniformity in the movement



Photo: l.dailymail.co.uk/prx

In a race where all the competitors are equally fit, the 'flow' will have a high mean and low skew & kurtosis.



Photo: 400mtogo.com

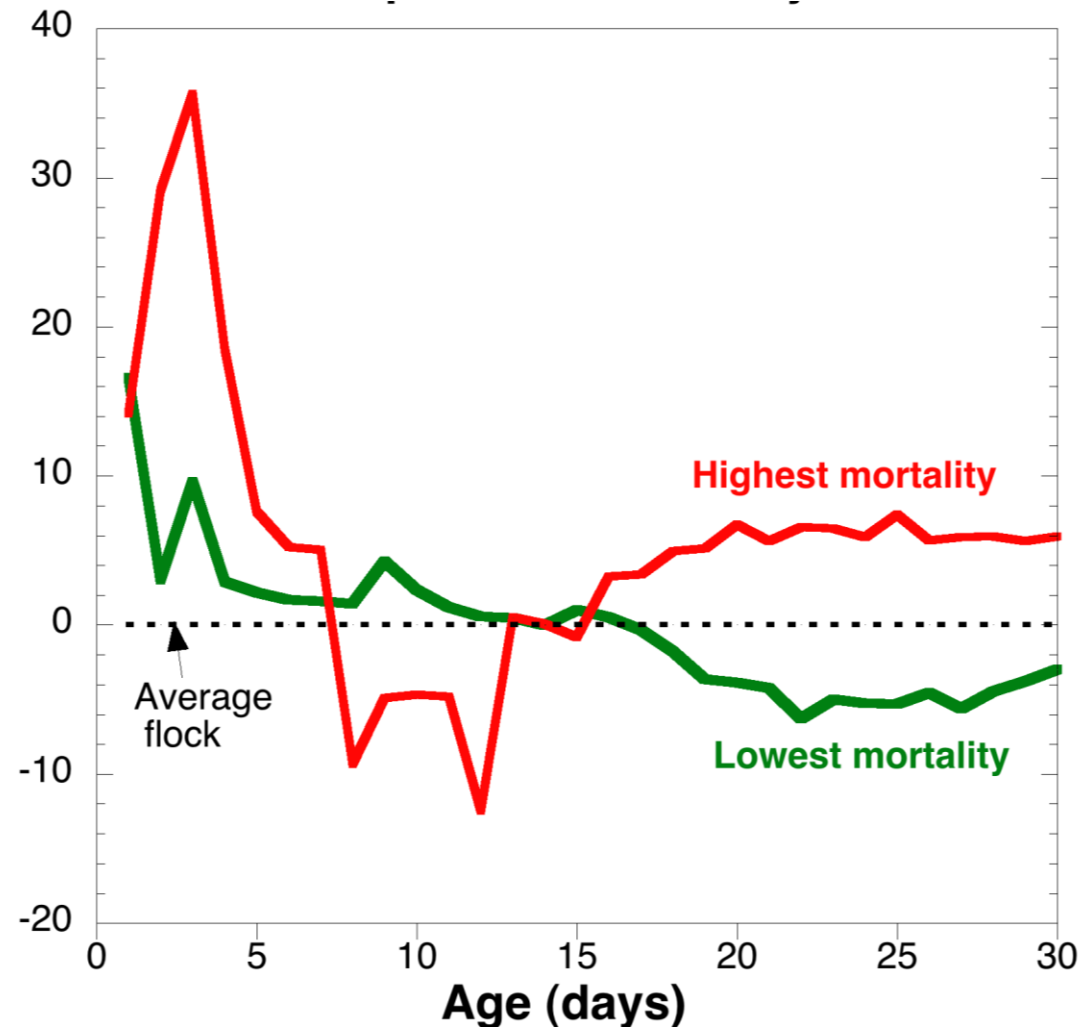
In a race where there is a greater spread of abilities, the 'flow' will have a lower mean and higher skew kurtosis

The statistics of welfare

- **Poor welfare:** lower mean movement but higher skew and kurtosis: **slower and more variable**
- **High welfare flocks:** higher mean movement but lower skew and kurtosis: **faster and more uniform**

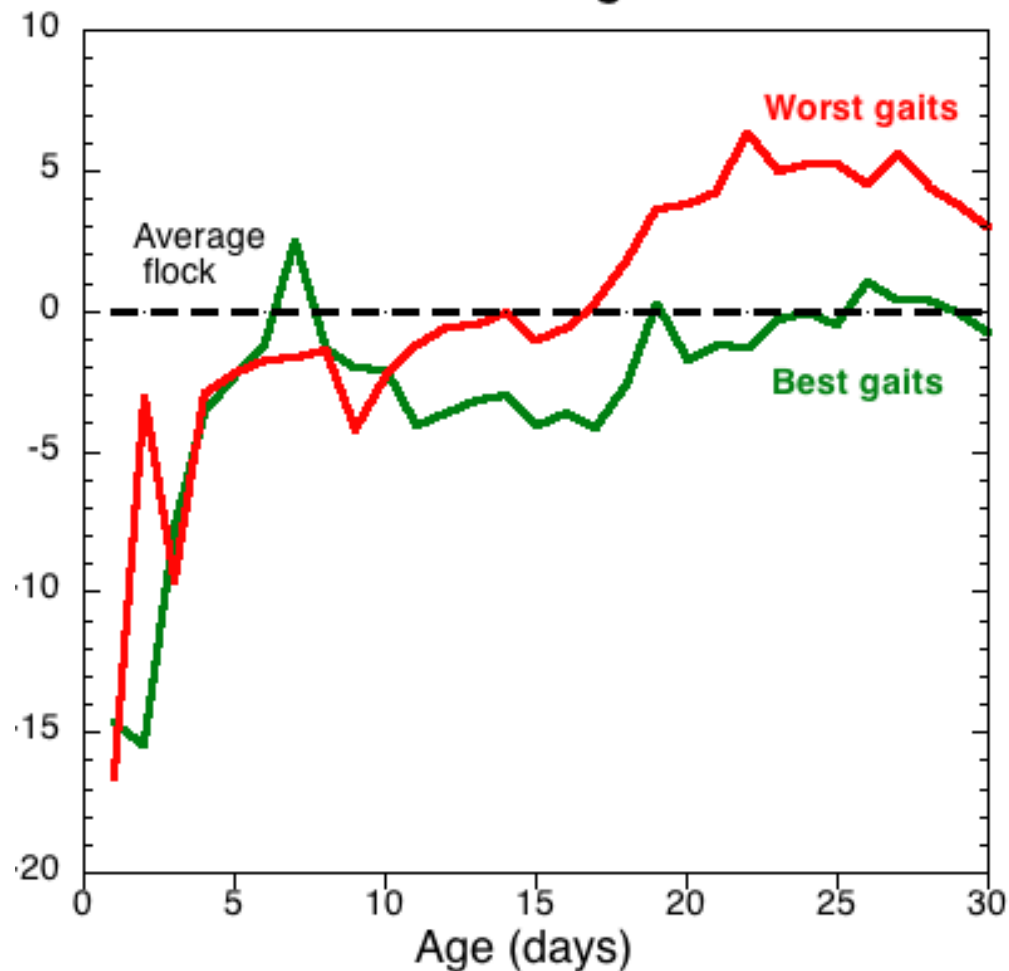
Our software can separate flocks with high final mortality from 15 days

Kurtosis
deviation
from mean



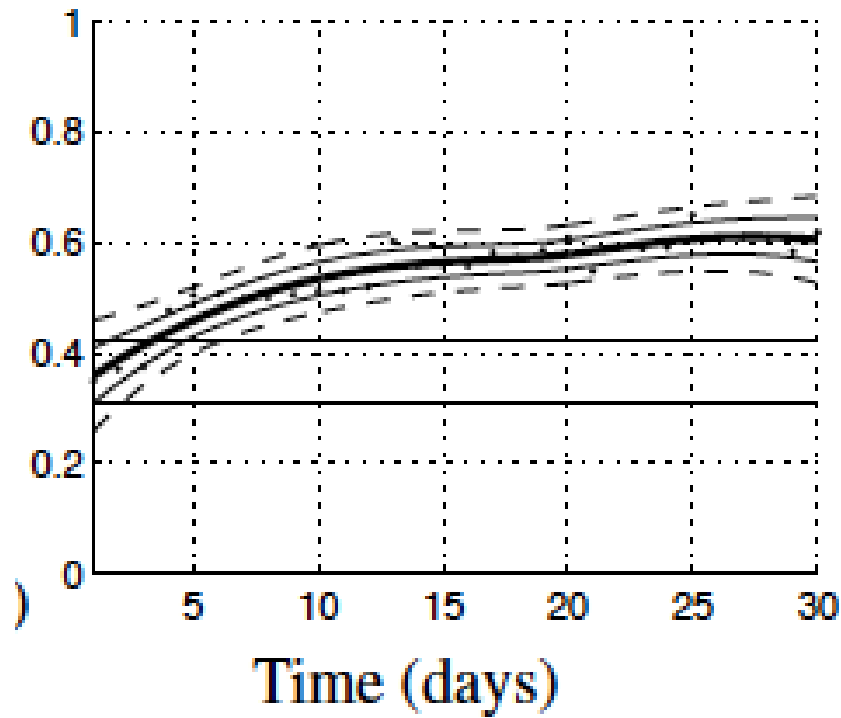
It can also distinguish flocks with poor gaits

Kurtosis
deviation
from mean



It can even predict hockburn in flocks as young as 3 days old

PREDICTION OF HOCKBURN



Correlation significant at $p < 0.01$

Welfare forecasting for broilers

- Can predict key welfare outcomes (mortality, hock burn, gait) days and even weeks ahead
- Welfare assessed in young birds while interventions still possible
- Flock management tool
- Research tool
- Veterinary tool

The team....

Steve Roberts (Engineering Science, Oxford)

Martin Maiden (Zoology, Oxford)

Adrian Smith (Zoology, Oxford)

Frances Colles (Zoology, Oxford)

Russell Cain (Zoology, Oxford)

Tom Nickson (Engineering Science, Oxford)

Marian Dawkins (Zoology)

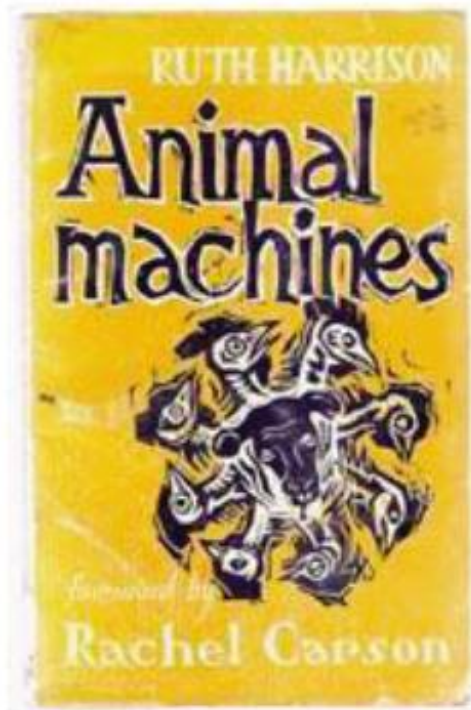


Greater efficiency *and* improved welfare

- Need to work with commercial producers
- Integrate behaviour, welfare, production & disease
- Technology to improve welfare
- Monetary value of animal welfare

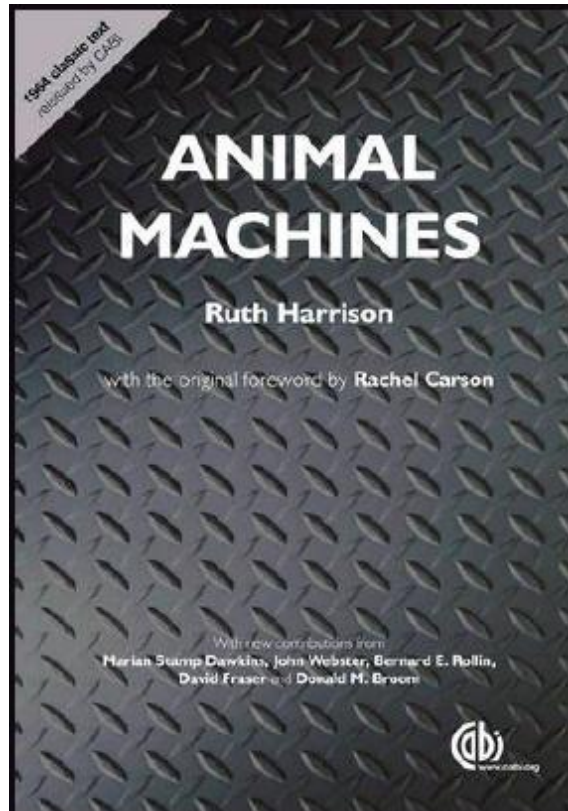


50 years on: looking back



- A landmark book for animal welfare
- Kick-started animal welfare science
- Changed public attitudes
- Legal changes and regulations

50 years on: looking forward



- Better collection and analysis of welfare data
- Leading to improved evidence basis for laws and regulations
- Better understanding of animal consciousness
- Research to make the economic and human benefit case for animal welfare