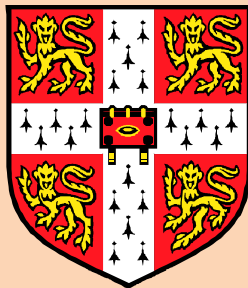


# The impact of cloning on animal welfare



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I am an animal welfare scientist.

I represent no organisation and have never been a member of any animal user or animal protection organisation.

I was was Chairman or Vice-Chairman of the EU scientific committees reporting on animal welfare from 1990 to 2009 and a member of the EFSA Panel that contributed to reports on the welfare of cloned and genetically modified animals 2008-2012.

The welfare of an animal is its state as regards its attempts to cope with its environment.

Welfare varies from very good to very poor and can be assessed scientifically. Health is an important part of welfare.

The question: “Is it right to alter natural processes?” is not a welfare issue.

Papers and books on the welfare of cloned animals, including some written by me, are listed at the end of this presentation

## **Cloning procedures have been used for many years**

Cloned amphibians were produced by Gurdon in the 1950s. (Gurdon 1974).

Mammals were cloned in 1986.

Cloning does not involve putting new genetic material into the genotype so it is not GM. However, perpetuation of GM lines often involves cloning.

Somatic cell nuclear transfer (SCNT) is the main technique used for cloning.

## **The effects of cloning procedures themselves and other effects of cloning on animal welfare**

### **Negative**

- 1.** Effects on mother animals after new material inserted into oocytes (egg cells).
- 2.** Effects on offspring when egg cells develop into an individual animal:  
**(a)** when juvenile  
**(b)** when adult.
- 3.** Effects on welfare of individual descendants in later generations:  
**(a)** coping with an unchanging environment  
**(b)** coping with changes in farming conditions or new diseases.
- 4.** Effects on welfare of other animals when some or many animals are cloned.

**Positive** Reduction in number of animals required for breeding programmes.

## **All animals**

### **3a coping with an unchanging environment**

After passing the juvenile stage, most individual cloned animals and their descendants should cope normally with their environment.

However, if the strains that are cloned are high producing, the risk of poor welfare is higher in these animals than in lower producing animals.

This is contrary to Articles 20 and 21 of Directive 98/58/EC.

For example:

fast-growing broiler chickens have worse welfare because of ascites, leg disorders and consequently more hock-burn and breast blisters,

cows that produce much milk have more mastitis, leg disorders and reproductive disorders (EFSA 2009, Oltenacu and Broom 2010).

Mean welfare worse if cloned high-producing chickens or cows produced.

## **All animals**

**Positive** Reduction in number of animals required for breeding programmes.

Farm animals used for breeding often have poor welfare, one reason being that they are from a fast-growing strain but are food-restricted because they cannot be allowed to grow too fast.

Cloning could reduce the number of breeding animals needed, but only if the efficiency of cloning improves.

## **All animals**

**3b** coping with changes in farming conditions or new diseases.

If there is any new aspect of the environment, the likelihood that strains well-adapted to this new aspect will arise will be lower if the animals are genetically uniform than if they are more diverse.

The most likely new challenge is a new disease. Genetic uniformity increases the risk that new diseases will spread.

New diseases have been arising quite frequently in recent years.

Another new challenge could be increased temperature or other climate change.

**4** If there is spread of a new disease because of reduced adaptability in clones, animals other than those cloned may be affected.

## **All mammals**

### **1 and 2a**

SCNT (somatic cell nuclear transfer) cells are grown from a tissue sample in a laboratory and injected into an egg cell. The resulting embryo is transferred into a surrogate dam. Many embryos do not survive.

SCNT leads to some placental abnormalities (EFSA 2008, 2012).

SCNT leads to some foetal abnormalities (EFSA 2008, 2012).

Both of these effects result in poor welfare, often substantial pain, in some mothers and offspring.

In cattle, Watanabe & Nagai (2011) reported that the frequency of harms to cloned mothers and offspring showed no improvement in their laboratory during the decade from 1998 to 2007.

What can be used instead of SCNT?

Induced pluripotent stem cells (iPSCs) have been tried but in pigs the embryo survival is worse than for SCNTs (West et al 2011).



## **Cloned cattle**

### **1 and 2a**

Bovine clones: (i) high level of mortality *in utero* (27% of pregnancies survive to term - mean of 10 published studies on cattle 2008-2012, 7 publications on water buffalo reported worse survival)

(ii) High level of mortality in early life (78% of calves survived to weaning despite intensive neonatal care)

and (iii) high rates of deformities (Whitworth and Prather 2010).

Common problems in sheep and cattle include:  
hydroallantois (increase of fluid in the birth sac),  
increased birth weight leading to large offspring syndrome,  
respiratory problems,  
contracted tendons,  
enlarged umbilical vessels,  
persistent urachus (a neonatal urinary tract problem).

**2b** If they survive the juvenile period: usually no welfare problems but some studies report reduced lifespan.

## **Cloned pigs, sheep and goats**

**1** in pigs, sheep and goats, oocyte implantation involves surgery so has more negative effect than the less invasive procedure in cattle.

### **1 and 2a**

Pig clones: foetal mortality (65% of pregnant sows gave birth)

some increased early mortality of piglets (75% survived to weaning),

**2b** life expectancy reduced (Shen et al. 2012 -few animal subjects.

### **1 and 2a**

Sheep clones: 42% of pregnancies maintained,  
50% of liveborn lambs survive to weaning  
there are some deformities, sometimes reduced lifespan.

### **1 and 2a**

Goat clones: 31% of pregnancies maintained,  
80% of liveborn kids survive to weaning.

## Cloned birds

Birds cannot be fully cloned at present.

Primordial germ cell transplantation (some cloned cells) in domestic chicks (Tajima 2011).

**2a**

Hatching rate

mean of 3 studies

34%

**2a and 2b**

Survival of hatched chicks to sexual maturity

75%

## Cloned fish

The cloning procedures for fish usually involve removing the fish from water which is very stressful (Robb and Kestin 2002).

Cloned common carp and rainbow trout: more variability among individuals and many do not survive well.

A proportion of cloned fish offspring are haploid and non-viable:

2a	Hatching rate	Deformed
for meiotic gynogenesis (DNA from egg)	36%	38%
for mitotic gynogenesis	9%	48%
for androgenesis (DNA from sperm)	2%	12%

Diploid hatchlings appear to have normal survival.

General references Komen and Thorgaard (2007) Dunham (2011).

## **Conclusions**

1. The scientific evidence for poor welfare in mothers and offspring after cloning procedures is substantial. The evidence concerns mammals, poultry and farmed fish.
2. No alternative methodology to replace SCNT is available or seems likely to be developed in the near future.
3. There are other adverse effects on animal welfare of increasing genetic uniformity by cloning. One is reduced capacity to adapt genetically to new challenges, such as new diseases.
4. The negative effects of cloning on animal welfare greatly outweigh any possible positive effects.

## Conclusions

5. The fact that food from cloned animals is not known to pose a hazard to people, will not stop the public from viewing it as unacceptable because of the negative effects on animal welfare.

Compare this situation with meat from pigs whose mothers were kept in close confinement in stalls and tethers or seal-skins from animals killed using inhumane methods.

The product may not directly harm consumers but its sale may be banned on public morality grounds (WTO seal-skin case).  
People will avoid buying all generations of clones and will expect labelling.

6. At present 2013/0433 refers to specified mammals but 2013/0434 refers to animals and would therefore include fish.

Given the similarity of the scientific evidence about poor welfare in mammals, fish and probably poultry it would seem most logical for both measures to refer to all farmed animals.

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