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Cloned Puppies: Sure, They're Cute, But at What Cost?

 By Brandon Keim [✉](#) 3 hours ago


Bernann McKinney from the United States received five pit bull puppies -- copies of her late pit bull, Booger -- from South Korean biotech firm RNL Bio in what it calls the world's first commercial canine-cloning service.

Photo: Jin Han Hong/AP

When skin cells from a dead pit bull named Booger gave rise to five [healthy-looking puppies](#) with a \$50,000 price tag, it marked the formal beginning of a commercial dog-cloning industry.

But for all the attention given to these and other clones, little was paid to the behind-the-scenes science. For every successfully cloned animal thrust into the spotlight, how many failures were quietly ushered out of sight?

"What we're seeing with the clones they present are the ones that look good," said Jaydee Hanson, an animal-cloning analyst at the Center for Food Safety, a Washington, D.C.-based liberal nonprofit.

In March, the U.S. Humane Society and American Anti-Vivisection Society released a [report](#) castigating pet cloning for "serious animal suffering and disreputable activities." Critics point to the general tendency of animal embryos to fail before they're born, and for survivors to develop debilitating diseases. And dogs, it's widely agreed, are among the hardest of all animals to clone.

These are serious charges for a nascent industry comprising, for now, just two startup companies: the South Korea-based RNL Bio -- Booger's cloners -- and California-based BioArts International, who in July promised clones to four high bidders and a contest winner.

RNL Bio's charge of \$50,000 for Booger's clones was heavily discounted, and BioArts' bidders paid \$150,000 apiece, but prices could drop if the procedure becomes popular. That could make cloning an option for many of the United States' 50 million dog owners, but disfigured and diseased outtakes would turn the joy derived from copying their canine into horror. Yet defenders of the industry say that it's wrong to apply analogies taken from other species' clones: Despite the difficulties, they insist, cloned dogs tend to be healthy, not least because scientists have spent the last decade figuring out how to do it. "Clone enough dogs, and occasionally you have offspring that aren't perfect," said Lou Hawthorne, CEO of both BioArts and the late Genetic Savings and Clone. "But it's comparable to what you have through conventional breeding."

At cloning's root is a procedure called somatic cell nuclear transfer: Scientists scoop the nucleus out of a fertilized egg, then replace it with the nucleus of a cell taken from a pet. It's the same process used to generate genetically matched human embryonic stem cells for therapeutic purposes. But unlike those embryos, which are destroyed after a few days, the canine embryos are implanted in the hope of eventually becoming adults.

The developmental process magnifies any flaws, the most fundamental of which involve epigenetic programming -- patterns of genetic activation and inactivation that are acquired rather than inherited. A sperm cell involved in traditional reproduction undergoes extensive changes during development, but the donor cells used in cloning come from so-called adult sources, such as skin. They underwent completely different programming.

Though cloners try to reverse-engineer the original process, it often proves difficult, if not impossible. There's also a mismatch between the DNA of a cloned embryo's new nucleus and the DNA of its energy-regulating mitochondria, which come directly from the mother and are already present in the egg.

For these reasons, getting a cloned embryo to survive to birth is tricky and often results in failure. Among livestock, where animal-cloning efforts have been concentrated, many surviving clones die shortly after birth; if they live to adulthood, they often suffer from organ malfunction, metabolic disorders and cancer.

"Most of the animals die in utero," Hanson said. "Then another group dies within a few days right after birth. And of the ones that live 150 days, about half of those die."

"The biological abnormalities inherent to the cloning procedure will always make cloning inferior to natural breeding," said [Konrad Hochedlinger](#), a Harvard Medical School cloning expert. "I don't think we will ever be able to fix the biological problems. The process of fertilization is fundamentally different from sticking DNA into an egg and generating clones."

Adding to the challenges, dogs are notoriously hard to clone. Females ovulate rarely and randomly, and their eggs are fully mature for just a couple hours out of a six- to 12-month cycle, making them difficult to collect. The eggs are also coated in opaque fats that make them tough to work with.

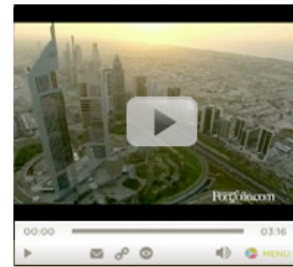
The first cloned dog, an Afghan hound named [Snuppy](#), was the end result of 1,095 implanted embryos, of which just three developed into pregnancies. One of these resulted in a miscarriage, and Snuppy's only brother died of pneumonia after three weeks.

But according to Hawthorne, there's a silver lining to the complications of canine cloning: Flawed embryos are miscarried

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or fail to develop altogether.

"The extreme sensitivity of the canine reproductive system means you have to have an absolutely perfect pregnancy," he said. "In other systems, you can just put a flawed embryo in, and get offspring out."

Hawthorne also headed [Genetic Savings and Clone](#), a pioneering company whose six-year run ended in 2006 after producing just three cats and no dogs.

Researchers at that company -- who'd already started canine-cloning work three years before the company's founding -- produced just a single canine pregnancy, and it ended in a naturally caused stillbirth.

"The idea that there's a holocaust of malformed offspring and all these miscarriages is false," said Hawthorne, who insisted that his researchers have learned from a decade of painstaking, often frustrated efforts.

Overseeing BioArts' cloning efforts is [Woo Suk Hwang](#), the former leader of [a South Korean research team disgraced](#) for its fraudulent human stem cell findings, but only after cloning Snuppy. Another member of that team was Lee Byeong-chun, who now directs science at RNL Bio.

Hawthorne cited unpublished data showing that 90 percent of his company's cloned dogs are born healthy, a figure comparable to traditional dog breeders. The dogs are given full veterinary exams after birth and again at eight to 12 weeks of age; if they're free of defects that long, said Hawthorne, they should stay healthy.

[Carol Keefer](#), a University of Maryland animal-cloning expert, said that safe dog cloning should be scientifically possible, though she cautioned that conclusive studies haven't yet been conducted.

"There are cases where something appears to go wrong later," she said. "You get that with natural breeding, too. The question is, what's the rate, the big picture? There haven't been that many clones made to get a true feel."

Indeed, cloners have only produced about 40 dogs to date, and all since 2005.

"It is still unknown how the surviving animals will do later in life," reads the Humane Society's report, "as no cloned cat or dog has lived long enough to assess."

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 This whole thing is just idiocy. First, genetically identical creatures do not have identical personalities. Just look at any set of twins. They are separate people, very different from each other. Second, this fails to address the millions of dogs...


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 Do you know that? The clone receives mitochondria from both of somatic cell donor and egg donor.

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