Harvard Journal of Law & Technology
Volume 19, Number 2 Spring 2006

ECONOMICS AND ETHICS IN THE GENETIC ENGINEERING OF ANIMALS

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I. INTRODUCTION

It is a cold November morning — so cold that your breath seems like it could freeze. You sit in a tree, the bottom of your bow resting on your knee, and await the buck with the biggest rack of antlers you have ever seen. You saw him yesterday near the fence line, and you just know he will appear at any moment. In the breaking daylight, as the sun begins to rise above the tree line, he steps out from the edge of the woods. His white tail, distinctive spots, and thirteen majestic points are a sight to behold. But wait! Another buck with the exact same spots and the exact same rack is following him! There is a third, a fourth, and a fifth buck, all exactly like the first. As you blink your eyes to make sure you are awake, you recall hearing that the ranch owner had ordered several clones of a perfect buck a few years back. These, evidently, are the clones.

The genetic engineering of animals is here.[1] Animal genetic engineering is already producing scientific breakthroughs in human healthcare and food production. Genetic engineering can mean huge profits for these industries, as well as for the sporting and pet retail industries. Additionally, genetic engineering may assist in preventing the extinction of endangered species. But, because of all the scientific and economic benefits of animal genetic engineering, its ethical implications risk being overlooked. Thorough evaluation of the merits of genetic engineering requires consideration of both the ethical and economic interests at stake.

This Note discusses the various benefits of animal genetic engineering, considers some of the ethical dilemmas raised by such genetic manipulations, and proposes that society deems all economically justifiable animal genetic engineering to be ethically acceptable. It also acknowledges societal interests in avoiding the extinction of species and unnecessary harm to animals. In light of these interests, this Note argues that free market environmentalism, coupled with aggressive protection of endangered species, is the best approach for dealing with the yet unregulated realm of animal genetic engineering and for resolving the economic and ethical tensions therein.

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1. Genetic engineering, as used herein, is restricted to cloning, genetic experimentation, and genetic enhancements. *See* MCGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS 892 (6th ed. 2003) (defining genetic engineering as "[t]he intentional production of new genes and alteration of genomes by the substitution or addition of new genetic material"). The term does not contemplate selective breeding. *Contra* ENCYCLOPEDIA OF GENETICS 834 (Sydney Brenner et al. eds., 2002) (defining genetic engineering as genetic manipulation through molecular biological or selective breeding techniques).

II. USES OF ANIMAL GENETIC ENGINEERING

Scientists have the ability to use, and in many cases are already using, animal genetic engineering to benefit humans in several ways, including: (1) advancing healthcare research and treatment, (2) satisfying the food production needs of the growing population, (3) increasing profits in the pet retail industry, and (4) bolstering the trophy-hunting and horse-racing industries. Researchers are also using genetic engineering — specifically, cloning — to preserve endangered species.

A. Healthcare

Healthcare research is the most well-known purpose for which animals are genetically engineered. Through animal genetic engineering, scientists have made major breakthroughs in organ transplantation, cancer research, and other areas. Similarities between the genomes of humans and other animals also suggest that future genetic research on animals will yield additional benefits for humans.

In the future, kidney-, heart-, and lung-failure patients will likely benefit from animal organ transplants.[2] Xenotransplantation is the procedure of transplanting organs from one species to another.[3] Although xenotransplantation is not new,[4] scientists have only recently begun to solve immunological problems such as transplant rejection.[5] Some experts believe that animal organ transplantation may be able to solve the organ shortage problem.[6]

Animal genetic engineering can also help in developing human gene therapies. In one experiment, scientists used gene therapy to cure 70 percent of mice implanted with one kind of human ovarian cancer.[7]

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2. *See* Press Release, Imperial Coll. London, Transplanting Animal Organs Could Soon Be a Reality (Sept. 9, 2005), http://www.imperial.ac.uk/P6812.htm [hereinafter Transplanting Organs]; *see also* Rebecca D. Williams, *Organ Transplants from Animals: Examining the Possibilities*, FDA CONSUMER, June 1996, at 12, *available at* http://www.fda.gov/fdac/features/596_xeno.html.

3. *See* Wikipedia, *Xenotransplantation*, http://en.wikipedia.org/wiki/Xenotransplantation (as of Apr. 11, 2006, 00:10 GMT).

4. *See* Williams, *supra* note 2, at 14 (noting that "[s]ix baboon kidneys were transplanted into humans in 1964, a baboon heart into a baby in 1984, and two baboon livers into patients in 1992").

5. S*ee* Bruce Murray, *Making a Pig of Yourself: The Promise and Problems of Xenotransplantation*, FACSNET, Apr. 3, 2001, http://www.facsnet.org/tools/sci_tech/biotek/pig.php3; *see also* Williams, *supra* note 2, at 14 (indicating that pigs and baboons are favored xenotransplant donors because their organs are similar to human organs).

6. *See* Murray, *supra* note 5; *see also* Transplanting Organs, *supra* note 2.

7. Press Release, Univ. of Tex. M.D. Anderson Cancer Ctr., Powerful Stem Cells Harnessed to Search for Cancer Spread Metastasis (Mar. 29, 2004), http://www.mdanderson.org/departments/newsroom/display.cfm?id=cce37c96-6cf1-418b-9700c0bd721f2e20&method=displayfull.

Michael Andreeff, a professor in the departments of blood and marrow transplantation and leukemia at the University of Texas M.D. Anderson Cancer Center, conducted the engineering.[8] Dr. Andreeff and his research team removed a small number of stem cells from bone marrow, and after growing the stem cells in culture, altered their DNA to include a variety of therapeutic genes.[9] When injected into tumor-bearing mice, the millions of engineered stem cells acted as "seek-and-destroy" missiles by finding the cancer and activating their "genetic payload," which then attacked the cancer.[10]

Since sequencing the human genome, researchers at the Human Genome Project and elsewhere have expanded their research to map the genetic codes for creatures other than humans.[11] Scientists are hoping to use this information to learn more about humans and possible gene-based treatments.[12]

> It took Stanford University researcher David Kingsley [three] years to find the gene responsible for producing the pelvic fins of the stickleback fish, a finding that helps [scientists] understand how human limbs develop. But now that the stickleback genome is being sequenced, Kingsley hopes to begin finding other important genes in a matter of weeks and months.[13]

Researchers at the University of California, San Diego identified a fruit fly gene that triggers wound repair.[14] These biologists hope to gain an understanding of the genetic signals that direct human cells to close around and begin healing a wound.[15] Such insight might "lead to novel approaches for accelerating healing, preventing scars and even

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8. *Id.*

9. *Id*.

10. *Id*. For another example of the use of animal genetic engineering in healthcare, see *Give Livestock the Omega-3 Gene*, 2433 NEW SCIENTIST 18 (2004), *available at* http://www.newscientist.com/article/mg18124332.000.html (discussing how genetically modifying the genome of farm animals with a nematode worm gene could enable these animals to produce omega-3 oils; omega-3 is believed to reduce heart attacks in humans and improve disease resistance in animals).

11. *See Human Genome Project Looks Beyond Man*, GENOMICS & GENETICS WKLY., July 2, 2004, at 52 [hereinafter *Human Genome Project*].

12. *See id*.; Richard Willing, *Animal DNA Helps Hunt Criminals*, USA TODAY, Dec. 14, 2005, at 3A, *available at* http://yahoo.usatoday.com/tech/science/genetics/2005-12-13-animal-dna_x.htm (noting that "Stephen O'Brien, head of the Laboratory of Genomic Diversity at the National Cancer Institute, has analyzed the genome of cheetahs, tigers and other wild cats looking for clues to cancer").

13. *Human Genome Project*, *supra* note 11, at 52 (paragraphs joined).

14. Kimberly A. Mace et al., *An Epidermal Barrier Wound Repair Pathway in* Drosophila *Is Mediated by* grainy head, 308 SCIENCE 381 (2005).

15. *See id*. at 384.

fighting skin cancer."[16] Flies, like other creatures, share many common genes with humans.[17] Indeed, of the more than 2000 human genes that scientists have identified as disease-related, 75 percent have counterparts in flies.[18] Commonalities such as these demonstrate why genetic research on animals is relevant and useful.

B. Food Production Techniques

Farm animals, such as cattle, are important to human sustenance. Genetic engineering offers the potential to increase this food supply. Recently, Australian scientists have begun selling clones of top breeding bulls, whose offspring should produce more meat.[19] Proponents feel that cloning will revolutionize the multi-billion dollar beef and dairy markets.[20] Cloning a bull costs around $100,000, while the market price for an original elite Holstein is between $250,000 and $1,000,000.[21]

Fish, like cattle, are considered essential food resources. Congress has formally recognized the importance of fish in food and resource production, noting that fisheries "contribute to the food supply, economy, and health of the Nation."[22] Because the fishing industry is so important, Congress may exercise sovereign rights "for the purposes of exploring, exploiting, conserving, and managing all fish [within certain zones]."[23]

Genetic engineering in the fishing industry could greatly enhance the food supply. Scientists are working to improve fish growth rates and disease resistance through genetic enhancement, and producers have begun to push for approval of genetically-engineered (or transgenic) fish.[24] The United States Food and Drug Administration ("FDA") received an application for the production of genetically-engineered Atlantic salmon from A/F Protein, Inc., making them "the first regulatory agency in the world to receive an application to ap-

16. Bruce Lieberman, *Same Gene in Fly, Human Heals Skin: UCSD Scientists Study the Process*, SAN DIEGO UNION-TRIB. ONLINE, Apr. 15, 2005, http://www.signonsandiego.com/uniontrib/20050415/news_7m15fly.html.

17. *Id*.

18. *Id*. (citing Ethan Bier, a UCSD biologist).

19. *Cloned Cattle Set to Revolutionize Beef, Milk Markets*, TAIPEI TIMES, August 25, 2001, http://www.taipeitimes.com/News/biz/archives/2001/08/25/100125.

20. *Id*.

21. *Id*. Prices indicated in the article have been converted from Australian dollars into their approximate U.S. dollar equivalents according to the exchange rate given in the article.

22. *See, e.g.*, Fishery Conservation and Management, 16 U.S.C. § 1801(a)(1) (2000).

23. *Id*. § 1801(b)(1).

24. *See* Union of Concerned Scientists, Genetically Engineered Salmon (Feb. 1, 2001) http://www.ucsusa.org/food_and_environment/genetic_engineering/genetically-engineered-salmon.html.

prove the commercial development of genetically-engineered fish."[25] A/F Protein, Inc. reported in 2003 that it had fifteen million back orders of transgenic salmon eggs.[26]

With the world population increasing, it is important for the fishing industry to adapt to changing food supply needs. To meet these needs, scientists have looked beyond salmon and have mapped the genes of at least thirty other aquatic species, including flounder, lobster, carp, and shrimp, for both commercial production and scientific study.[27]

C. Pet Retail Industry

The U.S. pet industry is enormous, with nearly $5.5 billion in sales in 1997.[28] Many people love their pets like family members and have difficulty dealing with their deaths. Consequently, some owners desire to clone their pet dog or cat.[29] To capitalize on this opportunity, the company that funded the first successful domestic cat cloning has gone commercial.[30] In February 2004, Genetic Savings & Clone, Inc. ("GSC"), a company based in Sausalito, California, offered clients the opportunity to order cloned cats for $50,000 each.[31] Ben Carlson, the company's vice president for communications, said that four clients

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25. Rose M. Williams, *Health Risks and Environmental Issues: "Frankenfish" Await FDA Approval*, TOWNSEND LETTER FOR DOCTORS & PATIENTS, May 2003, *available at* http://www.townsendletter.com/May2003/environissues0503.htm. Williams also provides background on how these transgenic Atlantic salmon came about:

> Flounder and other fish from the icy waters of Canada have genetically adapted to thrive in their cold environment. Researchers found a protein that prevents these fish from freezing, and it became known as the "antifreeze" gene. Canadian scientists attempted to splice the antifreeze gene into Atlantic salmon with the idea that salmon farms could be developed in colder waters. The antifreeze splicing was not successful. However, scientists learned this gene also controls growth. The genetic material is injected into salmon eggs and alters the fish's growth hormones, enabling those hormones to be produced by the liver and pituitary gland. That change greatly accelerates growth, causing [genetically-engineered] fish to grow two to three times faster and much larger than normal.

Id. (paragraphs joined).

26. *Id*.

27. Union of Concerned Scientists, *supra* note 24. The FDA has indicated that it will not seek to regulate transgenic animals as food, but will instead regulate them through the substances used to produce them. *Id*. Since the growth hormone the "salmon will produce is considered a drug, the salmon will be regulated under the FDA's veterinary drug statutes." *Id*.

28. U.S. CENSUS BUREAU, INDUSTRY STATISTICS SAMPLER: NAICS 45391 PET AND PET SUPPLIES STORES (1997), http://www.census.gov/epcd/ec97/industry/E45391.HTM.

29. *See* Maryann Mott, *Cat Cloning Offered to Pet Owners*, NAT'L GEOGRAPHIC NEWS, Mar. 25, 2004, http://news.nationalgeographic.com/news/2004/03/0324_040324_catclones.html.

30. *Id*.

31. *Id*.

took advantage of this offer and ordered duplicates of their cats.[32] Since its initial cat cloning offer, the company has increased its efficiency with cat cloning and has reduced the price per cat to $32,000.[33]

GSC is also attempting to duplicate dogs.[34] John Sperling, an Arizona entrepreneur, has invested millions of dollars into GSC's efforts to clone his former pet Missy, a husky mix.[35] Missy died in 2002 at age fifteen, but GSC saved her tissue samples for cloning purposes.[36] Although the company has had a difficult time cloning dogs, Carlson said GSC is making progress and hopes to clone Missy in the future.[37]

GloFish™ — genetically-engineered fluorescent red Zebra Danio fish — are also breaking ground in the pet retail industry.[38] "Since their initial availability in limited markets beginning in early December [2003], ornamental fish distributors and retail locations report unprecedented consumer demand."[39] At least one state — California — banned GloFish™ sales, noting that the GloFish™ researchers used genetic engineering on fish for frivolous purposes, and the risks were not all identified.[40] However, the FDA approved GloFish™ sales, finding no evidence that the fish "pose any more threat to the environment than their unmodified counterparts which have long been widely sold in the United States."[41]

D. Sporting Industries

Sport hunting and horse racing are two popular American pastimes. Hunting provides an inexpensive means to control animal populations and provides substantial economic benefits to small towns, restaurants, hotels, gas stations, and sporting goods stores.[42] It

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32. *Id*.

33. Genetic Savings & Clone, Inc., Cat Cloning, http://www.savingsandclone.com/services/cat_cloning.html (last visited Apr. 29, 2006).

34. Mott, *supra* note 29.

35. *Id*.

36. *Id*.

37. *See id*.

38. Press Release, GloFish.com, GloFish™ Fluorescent Zebra Fish Now Available in Most U.S. Markets (Jan. 5, 2004), http://www.glofish.com/pressreleases/pr.AvailableMostUSMarkets.pdf.

39. *Id*. National distributors have stated that consumer interest in fluorescent fish is unlike anything they have experienced in over forty years in the business. *Id*.

40. Dan Bacher, *California Ban on GloFish Ignites Debate Over 'Frankenfish,'* DISSIDENT VOICE, Dec. 29, 2003, http://www.dissidentvoice.org/Articles9/Bacher_Frankenfish-CA.htm.

41. Press Release, FDA, FDA Statement Regarding Glofish [sic] (Dec. 9, 2003), http://www.fda.gov/bbs/topics/NEWS/2003/NEW00994.html.

42. *See* E-mail from Ron Schara, Host, *The Outdoor Beat*, ESPN (Nov. 16, 2005, 20:34 CST) (on file with author); s*ee also* E-mail from Dale Grandstaff, Game Warden, Tenn. Wildlife Res. Agency (Dec. 7, 2005, 23:28 CST) (on file with author) (noting that hunting is important for controlling populations of big game animals such as white-tailed deer, black bears, and Eastern wild turkey).

also allows families to participate in a pastime "that has become ingrained in American society as much as going to a high school football game on Friday night."[43] The National Shooting Sports Foundation estimates that there are 20.6 million active hunters in the United States.[44]

White-tailed deer represent the most widespread big game in North America.[45] Some deer, however, are far more valuable than others: "An affluent hunter, or maybe just a passionate one, might pay $20,000 for the privilege of shooting a fine buck. A superlative buck, a giant-antlered prince of the species, can be worth $100,000 as a full-time professional sire."[46]

In Texas, the white-tailed deer industry accounts for $2.2 billion annually. Open hunting on public land in Texas is virtually nonexistent because most land is privately owned.[47] Most Texas deer hunts therefore "occur on private ranches behind high fences, allowing landowners to maintain — and to improve, if they wish — their deer populations as proprietary assets."[48]

Seeking robust bucks, many ranchers practice aggressive breeding techniques. Ranchers buy and sell breeder deer and "select[] male and female whitetails that 'exhibit superior genes' and mate[] them to produce big-antlered, trophy-caliber bucks."[49]

While breeding is an effective and relatively safe method of increasing the size and quality of a controlled deer population, what should a rancher do when his prize sire buck dies? This is where genetic engineering enters the picture.

According to Dr. Mark Westhusin, a researcher at the College of Veterinary Medicine at Texas A&M, a Pennsylvania man was offered around $250,000 for a prize buck.[50] The owner, however, did not sell the deer because he was making $300,000 yearly by selling that

43. E-mail from Dale Grandstaff, *supra* note 42.

44. National Shooting Sporting Foundation, Frequently Asked Questions, How Many Hunters Are There in the U.S.?, http://www.nssf.org/IndustryResearch/FAQ.cfm (follow "question 2" hyperlink) (last visited Apr. 29, 2006).

45. Press Release, Texas A&M Univ. Coll. of Veterinary Med. & Biomed. Sci., CVM Researchers First to Clone White-tailed Deer (Dec. 22, 2003), http://www.cvm.tamu.edu/news/releases/2003/deer_clone.shtml [hereinafter Texas A&M].

46. David Quammen, *Clone Your Troubles Away: Dreaming at the Frontiers of Animal Husbandry*, HARPER'S MAG., Feb. 2005, at 33, 34.

47. *Id*.

48. *Id*.

49. Paul Duggan, *Making Big Bucks on a Texas Ranch*, WASH. POST, Mar. 31, 2002, at A3.

50. Quammen, *supra* note 46, at 34.

buck's semen.[51] That buck, in Westhusin's opinion, was "clone worthy."[52]

In December 2003, Texas A&M announced that it had cloned a white-tailed deer in May of that year.[53] Researchers believed the fawn, named "Dewey," to be the first successfully cloned deer.[54] Dewey is the "genetic duplicate of a certain trophy buck" that was killed on a ranch in south Texas.[55] Dr. Mark Westhusin and his team at Texas A&M were sent the scrotum of the buck to try to harvest semen for artificial insemination.[56] When this proved unsuccessful, they began attempts to clone the buck.[57] To create the clone, the researchers used nuclei from the buck's fibroblast cells, which were isolated from a skin sample from the scrotum.[58] Westhusin said he was "particularly interested to watch as Dewey grows and witness how his antlers develop" since it is unclear how much of antler development is due to genetics versus the environment.[59] To further A&M's research into deer genetics, Westhusin implanted approximately twenty more recipient does with cloned embryos in the fall of 2003.[60] Westhusin hopes to use these experiments to learn how cloning might be used to improve the health of animals.[61] However, by improving the efficiency of the deer cloning process, Texas A&M may also be opening the door to numerous deer breeders' requests for cloned trophy bucks. Since the ownership of trophy bucks leads to huge profits for deer breeders, cloning would certainly be economically alluring.

Horse racing, like hunting, is also a popular American pastime. American-style Thoroughbred horse racing developed in England during the seventeenth and eighteenth centuries, although the roots of competitive horse racing date as far back as the Olympics of 666 B.C.[62]

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51. *Id*.

52. *Id*.; *see also* Texas A&M, *supra* note 45 (noting that cloning provides "a valuable tool for conserving the genetics of superior breeding animals").

53. Texas A&M, *supra* note 45.

54. *Id*.

55. Quammen, *supra* note 46, at 33.

56. Zoological Society Library, 2003 Briefs from October to December, World's First Deer Cloned, Dec. 22, 2003, http://www.library.sandiegozoo.org/News/2003_briefs4.htm.

57. *Id*.

58. Texas A&M, *supra* note 45.

59. Zoological Society Library, *supra* note 56.

60. *Id*.

61. *Id*.

62. JOAN S. HOWLAND & MICHAEL J. HANNON, A LEGAL RESEARCH GUIDE TO AMERICAN THOROUGHBRED RACING LAW FOR SCHOLARS, PRACTITIONERS AND PARTICIPANTS 1 (1998).

> A certain romance surrounds Thoroughbred racing — beautiful mounts, the excitement of victory balanced with the anguish of defeat, vast sums of money won and lost in a single afternoon and, perhaps most importantly, the mesmerizing symmetry of a talented, fiercely competitive jockey bringing a heroic horse, running with all its heart, across the finish line. It is this romance which has ensured that Thoroughbred racing — despite the vicissitudes of social, economic, and legal history — has survived since the 17th century, and will undoubtedly continue to endure.[63]

In 2004, when most professional sporting events experienced declines in attendance and television ratings, horse racing continued to set record highs: "According to Street & Smith's Sports Business Journal, more than 31 million people attended racing events in 2004."[64]

As is the case with hunting, genetic engineering could play a major role in the racing industry. Top racehorses are often castrated to improve racing performance or to limit the gene pool.[65] If these castrated stallions (known as geldings) win a championship, or simply perform well over time, horse owners may desire offspring.[66] "Funny Cide — the remarkable gelding that won both the Kentucky Derby and Preakness in 2003 — could never pass those genes on through offspring because he was castrated before his potential had been realized."[67] Cloning allows for progeny when typical reproduction does not.

While horse cloning is permitted in Europe, it is currently banned in the United States, at least in the Thoroughbred industry.[68] The Jockey Club, the organization that regulates American Thoroughbred racing, has banned horses born through cloning or embryo transfer from entering any Thoroughbred registries or events.[69] Still, some believe that progressive technologies, coupled with a greater public

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63. *Id*. at 11–12.

64. *See* Press Release, SUMMUS, Summus and Churchill Downs Incorporated Bring the 'Greatest Two Minutes in Sports' to the Mobile Phone (May 2, 2005), *available at* http://www.tmcnet.com/usubmit/2005/May/1139563.htm.

65. *World's Top Horses 'Could Be Cloned*,*'* BBC NEWS, Aug. 7, 2003, http://news.bbc.co.uk/sport1/hi/other_sports/horse_racing/3132887.stm [hereinafter *World's Top Horses*].

66. *See id*.; Mandy Gundlach, Cloning in the Livestock Industry — A New World of Creation and Litigation 16 (Dec. 12, 2005) (unpublished comment, on file with author).

67. Gundlach, *supra* note 66, at 15.

68. *Id*. at 15–16.

69. *Id*.; *see also World's Top Horses*, *supra* note 65.

acceptance of genetic engineering, will eventually alter the Jockey Club's policy.

> There will come a time when the ban on racing cloned horses will be lifted because breeders will realize that they will make a lot more money cloning and racing the clones rather than just breeding non-clones, which, after all, is nothing more than an expensive grand experiment that usually falls flat. . . . The public will not ignore that the inevitable horse races with clones will have faster times than regular horse races. Races between identical clones will be particularly interesting because the outcome will boil down to either the difference between the trainers and/or the jockeys. The breeders and racetrack owners will come to know that the public wants to see the fastest horses regardless of their origin.[70]

Peter Kagel, founder and president of www.horsecloning.com, is charging $367,350 plus the patent royalty fee (around 15%) to clone a horse.[71] For Kagel's fee, he will take DNA from a horse and impregnate one hundred mares.[72] Kagel's researchers estimate that each horse owner will receive between zero and sixteen clones for his or her investment.[73]

> So if the horse you are cloning is worth $100,000 you could end up with a tidy profit of over $1,000,000 or thereabouts. That's a lot more money than your stallion or mare is likely to produce over several breeding seasons, plus you don't know the quality of horse you will get from breeding.[74]

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70. *World's First Horse Cloning Opportunity Opens to the Public*, MED. NEWS TODAY, July 28, 2005, http://www.medicalnewstoday.com/medicalnews.php?newsid=28227 (quoting Peter Kagel) (internal quotation marks omitted).

71. *Id*.

72. *Id*.

73. *Id*.

74. *Id*. (quoting Peter Kagel) (internal quotation marks omitted). Kagel also commented about certain horses he deemed clone-worthy:

> Look at Cigar, who was the horse of the year for both 1995 and 1996, tied Citation's record of 16 consecutive victories and still is the all-time money winner for North America . . . . When he was turned out to stud they found out he was sterile. Steroids could have caused it. An Italian insurance company, which failed to require a simple sterility test, had to pay $25,000,000 to Cigar's owners.

Id. (quoting Peter Kagel) (internal quotation marks omitted).

Although cloning may offer greater chances for profits and racing success, breeders must still train and raise the cloned horses to reach their full potentials.[75] A clone's owner has continually evolving genetic pools to compete against and to cross his champion with, "so while the breeder is given an extraordinary opportunity, he is not necessarily given a champion. Other genetics will constantly evolve and could out perform [sic] the old champion even if the breeder handles the clone in the manner most conducive to success."[76]

E. Preservation of Endangered Species

Over the next one hundred years, as many as half of Earth's species could disappear.[77] The extinction crisis is due to several factors, including aquaculture, agriculture, climate change, deforestation, and unchecked animal trade.[78] Scientists have already adopted aggressive cloning practices in hopes of renewing Earth's lost and fading species.

In Iowa, a host cow gave birth to a guar, an endangered species of ox native to India and Southeast Asia.[79] Cloning efforts began after the guar population dwindled to about 36,000 as a result of hunting and habitat degradation.[80] Australian and American scientists are also currently working together in an attempt to clone a Tasmanian tiger, a mammal that has been extinct for about seventy years.[81] The Tasmanian tiger was a large cat found throughout Australia and Papua New Guinea.[82]

Additionally, scientists are searching for an intact woolly mammoth DNA strand in hopes of reviving this lost species.[83] This project, however, may be fruitless.[84]

> The main reason is simple: To have any chance at a successful cloning, scientists must start with pristine,

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75. Gundlach, *supra* note 66, at 16.

76. *Id*.

77. Stephen M. Meyer, *End of the Wild*, BOSTON REV., Apr.–May 2004, at 20, 20, *available at* http://www.bostonreview.net/BR29.2/meyer.html.

78. *See* World Wildlife Fund, Global Challenges, http://www.worldwildlife.org/challenges/index.cfm (last visited Apr. 29, 2006).

79. *Endangered Animal Clone Dies*, BBC NEWS, Jan. 12, 2001, http://news.bbc.co.uk/1/hi/sci/tech/1113719.stm.

80. *Id*.

81. *See US Team Joins Effort to Clone Thylacine*, NAT'L NINE NEWS, Oct. 12, 2005, http://news.ninemsn.com.au/article.aspx?id=66955.

82. *Id*.

83. Bill Gasperini, *Mammoth Clone: Science, or Simply Fiction?*, Discovery Channel, *available at* http://geology.wcedu.pima.edu/~salmazan/Mammothus3.html (last visited Apr. 29, 2006).

84. *Id*. Some biologists who specialize in the ice age fauna and their extinction believe that "making an exact copy of a species that died off 10,000 years ago is possible only in science fiction movies." *Id*.

> complete DNA. But even in cold environments, cells quickly break down after an organism dies; entropy occurs, and bacteria and certain enzymes latch onto or destroy cellular material. All the DNA found from long-extinct animals (even those remains found in the Siberian permafrost) has been incomplete and fragmented.[85]

Even if there is no hope of bringing back long-extinct species, cloning may provide one method of saving species from extinction because intact DNA could be taken from these endangered species now.[86]

Cloning endangered species may provide many benefits. Cloning may enable population growth of currently endangered species and therefore permit their reintroduction into the wild.[87] It may also enhance genetic diversity within these species.[88] These benefits are particularly keen for animals, such as giant pandas and tigers, which are notoriously difficult to breed in captivity.[89]

III. THE RANGE OF ETHICAL CONCERNS IN ANIMAL GENETIC ENGINEERING

Animal genetic engineering can mean huge profits for the healthcare, food, and sporting industries, as well as possibly preserving certain endangered species. However, the technology also raises moral, ecological, and ethical concerns.[90]

To understand society's prevailing ethical view of animal genetic engineering, one must first determine what is considered environmentally ethical. All systems of ethics have rested "upon a single premise: that the individual is a member of a community of interdependent parts. His instincts prompt him to compete for his place in that community, but his ethics prompt him also to cooperate (perhaps in order that there may be a place to compete for)."[91] Humans must consider environmental ethics because our interactions with nature today impact the availability of Earth's resources tomorrow.

Since the seventeenth century, humans have recognized that they "hold Earth as a trust, and are not only responsible for its care, but

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85. *Id*.

86. *Cf*. *id*.

87. *See* John Cohen, *Can Cloning Help Save Beleaguered Species?*, 276 SCIENCE 1329, 1329 (1997).

88. *See id*.

89. *See id*.

90. The appropriate ethical limits of animal genetic engineering can be established through consumer trading and free market environmentalism. *See* discussion *infra* Part V.

91. Aldo Leopold, *The Land Ethic*, *in* ENVIRONMENTAL ETHICS 38, 39 (Andrew Light & Holmes Rolston III eds., 2003).

also answerable for the delivery of their role as stewards or trustees."[92] These beliefs have origins in the Old Testament.[93] The Bible recognizes that, although man has dominion over all the Earth and its non-human creatures, the Earth does not belong to man, but to God, and the land is simply held as a leasehold.[94] Therefore, man's dominion over all creatures is limited by ethical guidelines.[95]

Despite its ancient roots, environmental ethics did not emerge as a philosophical discipline until the early 1970s.[96] In that era, the public began to pay attention to the environment because of the nuclear arms race of the 1950s and 1960s, the use of pesticides and fungicides, and the ethical issues raised by the use of defoliants in the Vietnam War.[97] Since then, environmental ethics has branched into many different theories. Three of these theories seem to dominate most ethical discussions: (1) the animal welfare theory, (2) the anthropocentrism theory, and (3) the deep ecology theory. This Section considers animal genetic engineering in the context of each of these theories.

A. Animal Welfare

The animal welfare approach to environmental ethics "considers the moral worth of animals in themselves as individuals."[98] Under this approach, when animal and human interests are equal, they must be given equal weight.[99] "[W]here human and nonhuman animals share an interest — as in the case of the interest in avoiding physical pain — we must give as much weight to violations of the interest of nonhumans as we do to similar violations of the human's interest."[100]

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92. ROBIN ATTFIELD, ENVIRONMENTAL ETHICS 21 (2003). Proponents of anthropocentrism may feel that humans are not stewards of the Earth because all of Earth's resources should be used to maximize human benefits. However, a renunciation of the human responsibility to nature could be disastrous. *Id.* at 23. "Human beings cannot help drawing their food, clothing and shelter from the natural world, and if in doing so they attempt to throw off all ethical constraints . . . the outcome is likely to be the exercise of power without any pretence at responsibility." *Id*.

93. *Id*. at 21.

94. *See id*. at 21–22.

95. Attfield provides an in-depth analysis into man's dominion over the Earth and its creatures, concluding that man's dominion over Earth is ultimately conditional on man acting ethically. *Id*. at 22. *But see* Leopold, *supra* note 91, at 38 (suggesting that man's disposal of property has always been in the interest of expediency, without regard for what is right and wrong).

96. *See* ATTFIELD, *supra* note 92, at 37. Attfield credits Richard Routley, Arne Naess, Holmes Roston III, and John Passmore with bringing environmental ethics into the public spotlight. *Id*.

97. *Id*.

98. Eric Katz, *Is There a Place for Animals in the Moral Consideration of Nature?*, *in* ENVIRONMENTAL ETHICS, *supra* note 91, at 85, 89.

99. Peter Singer, *Not for Humans Only: The Place of Nonhumans in Environmental Issues*, *in* ENVIRONMENTAL ETHICS, *supra* note 91, at 55, 58.

100. *Id*.

Many proponents of animal welfarism therefore wish to ban cosmetic and drug testing on animals.[101] They also believe that sport hunting, as well as the commerce and use of animal skins and furs for the purposes of human vanity, are wrong.[102] Analogously, many animal welfare theorists have moral objections regarding animal genetic engineering.

One fundamental moral objection to the genetic modification of animals is that it can fail to respect animals' genetic integrity because it mixes genetic material between different species.[103] Some commentators have noted that "[a]nxiety, distaste, or even revulsion, may be expressed about the 'unnatural' mixing of kinds — about creating chimeras, . . . about crossing the species barrier, and about the mixing of genes between humans and other animals."[104] Do animals, whether wild or domestic, have an inherent right to have their genetic codes intact and untouched? Animal welfarists assert that animals "are conscious beings deserving not only of protection, but deep respect and thoughtful consideration."[105]

At least one extreme animal welfarist, in an attempt to prove that genetically engineering animals is morally wrong, describes graphic and potentially worrisome scenarios:

> The super pig, a product of genetic engineering, is a sick animal, fattened artificially by human growth hormone. This super pig must endure side effects including crippling arthritis and distorted vision caused by the human growth genes that makes them cross-eyed. . . . Soon, in addition to factory pig farms, there will be pig organ farms. . . .
>
> And then there is the case of the ordinary chicken. The modern bird has been bred to grow at twice its normal rate. Its legs can no longer carry its massive body weight, and the animal suffers leg pain and deformities as well as an enormous strain on its heart and lungs. . . .

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101. *See, e.g.*, Tom Regan, *Animal Rights: What's in a Name?*, *in* ENVIRONMENTAL ETHICS, *supra* note 91, at 65, 70.

102. *Id*. Peter Singer is particularly disgusted with hunting, noting that "hunting makes animals suffer," and invites readers of his article "to think about the assumptions behind the use of such images as the 'cropping' of 'surplus wildlife' or the 'harvesting' of seals." Singer, *supra* note 99, at 61.

103. The Boyd Group, Genetic Engineering: Animal Welfare and Ethics (Sept. 1999), http://www.boyd-group.demon.co.uk/genmod.htm.

104. *Id*.

105. Andrew B. Perzigian, *Genetic Engineering and Animal Rights: The Legal Terrain and Ethical Underpinnings*, Animal Legal & Historical Center, pt. III(A)(b), ¶ 2 (2003), http://www.animallaw.info/articles/ddusgeneticengin.htm.

> Someday, chickens might be engineered with genes from centipedes, giving the birds more than two legs, so we can have more drum sticks for our dinner table. Or the chicken may be further modified into a kind of tube, without head, wings or tail, but with many legs, so it will produce more meat for us and be easier to manage for commercial exploitation.[106]

While society, through the FDA and consumerism, is unlikely to permit any genetic engineering processes extreme enough to produce tubular chickens, the point is an important one: How far should humans be allowed to go in genetically engineering animals?

One activist group, Voice of Irish Concern for the Environment ("VOICE"), specifically targets the transgenic Atlantic salmon as an example of how science acted immorally and exceeded ethical boundaries.[107] VOICE notes that, while the genetically-increased size of the salmon will deliver huge economic benefits to salmon producers, "the cost to the salmon is horrendous."[108] "[T]he experiment produces 'profound morphological abnormalities' in the transgenic salmon. These include[] 'disproportionate growth of the head and operculum cartilage, disimproving appearance and leading ultimately to respiratory problems.'"[109]

B. Anthropocentrism

Another approach to environmental ethics is the anthropocentrism (human-centered) approach, which, unlike the animal welfare approach, puts human interests first.[110] While this approach recognizes that humans may have some responsibilities to natural ecosystems, our responsibilities to the ecosystems are only in place to protect the Earth for human survival.[111] In other words, humans "have no obligation to promote or protect the good of non-human living things" unless the end goal is to promote human life.[112] Given the nature of this approach, an anthropocentrist would likely have no difficulty with

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106. Mira Fong, *Genetic Trespassing and Environmental Ethics*, http://online.sfsu.edu/~rone/GEessays/GENETIC%20TRESPASSING.htm (last visited Apr. 29, 2006).

107. Sean McDonagh, Chair of VOICE, *Ethics and Genetic Engineering: A Response to the Department of the Environment's Consultation Paper — Genetically Modified Organisms and the Environment*, pt. III, ¶ 6, http://www.voice.buz.org/genetic_engineering/ethicsandge.html (last visited Apr. 29, 2006).

108. *Id*.

109. *Id*.

110. Paul W. Taylor, *The Ethics of Respect for Nature*, *in* ENVIRONMENTAL ETHICS, *supra* note 91, at 74, 74.

111. *Id*.

112. *Id*.

the genetically engineering of animals as long as it was performed with human interests in mind.

C. Deep Ecology

A third prevailing environmental ethics theory is deep ecology. The fundamental focus of deep ecology "is the whole, not the part — the ecosystem, not the individuals who comprise it."[113] Deep ecologists believe that healthy ecosystems are "diverse, sustainable, and balanced," while unhealthy ecosystems lack one or more of these characteristics.[114] Hunting, for example, is acceptable as long as wildlife management programs are in place to prevent over-hunting, which would throw the ecosystem off balance.[115] Most deep ecologists would support the genetic engineering of animals as long as its possible effects on Earth's ecosystems as a whole are analyzed, and the ecosystem remains at the forefront of society's interests.

Deep ecologists would not support animal genetic engineering where the overall ecosystem is harmed, as it could be if transgenic salmon are allowed to interbreed with Atlantic salmon. Activists have asserted that the FDA's drug laws are inadequate to manage the Atlantic salmon population because they provide the environment and humans with insufficient protections from the risks posed by transgenic fish.[116] They fear that the transgenic fish present a great "environmental threat since penned fish cannot be fully contained and frequently break out, mixing with wild stock."[117] And, as the salmon "industry exploded, so did the numbers of increasingly specialized fish that, while neither bred nor fit for life in the wild, retained two important attributes of their wild cousins: the urge to ascend rivers and the ability to reproduce."[118] When the salmon-farm escapees mate with wild salmon, the gene pool of the wild fish is severely compromised, and the offspring may not have the genetic capacity to survive in the natural ecosystem.[119]

Fortunately, scientists have recognized the containment issues and are attempting to meet the problems head-on.[120] One method being used to prevent breeding between transgenic and wild salmon is triploidization, a relatively simple procedure whereby hundreds of

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113. Regan, *supra* note 101, at 69. Regan notes that "[w]ithin a healthy ecosystem, individuals are expendable." *Id*.

114. *Id*.

115. *Id*.

116. *See* Williams, *supra* note 25.

117. *Id*.

118. Pete Bodo, *Genetic Engineering Comes to the Rescue*, N.Y. TIMES, Mar. 31, 2002, § 8, at 10.

119. *Id*.

120. *See id*.

thousands of the genetically modified fish eggs can be rendered sterile at one time for a fraction of a penny per egg.[121]

Because the deep ecology approach is a pragmatic one, it does not recognize a moral responsibility to animals beyond the responsibility to protect the overall ecosystem. While laws and court decisions suggest that society usually values human interests and rights above those of animals, there are situations where animal rights have trumped those of humans and the overall ecosystem. Part IV discusses the narrow circumstances where animal rights prevail and uses this to suggest whether and how the use of animal genetic engineering should be promoted or limited.

IV. SOCIETY'S ETHICAL AND ECONOMIC VALUES AS REFLECTED IN CURRENT ANIMAL RIGHTS AND REGULATIONS

The Animal Welfare Act, the Endangered Species Act, federal and state fish and game regulations, state animal cruelty statutes, and court decisions all establish that animals have rights. While statutory and case law have generally allowed animals to be harmed, killed, or engineered for human benefit, there are exceptions. Society has exhibited an interest in preventing *unjustifiable* harm to animals and a desire to protect endangered species.

A. State Laws

1. Animals as Property

The law essentially treats animals as human property. They are goods to be bought, sold, and managed. Indeed, some of the first cases law students read in Property class indicate that "animals have the potential and perhaps the purpose of serving humanity."[122] Arguably, animals cannot serve humanity if they are given rights equal to those

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121. *Id*.

> The fertilized eggs are put into an enormous, high-tech version of a pressure cooker, and subject to a shock that so disrupts cell development that each cell in the fish will subsequently have three . . . sets of chromosomes . . . . These triploid fish will then grow normally . . . . [But] [t]he fish is unable to generate sperm or egg cells.

Id. While shrinking fish prices and triploid development problems have kept fish farmers from fully embracing triploid salmon, researchers are working to diminish these drawbacks. *Id*.

122. Joseph Lubinski, *Introduction to Animal Rights*, Animal Legal & Historical Center, pt. II(B) (2d ed. 2004), http://www.animallaw.info/articles/ddusjlubinski2002.htm (citing Pierson v. Post, 3 Cai. 175 (N.Y. Sup. Ct. 1805) and Keeble v. Hickering, (1707) 103 Eng. Rep. 1127 (Q.B.)); *see also* Gary L. Francione, *Animals, Property and Legal Welfarism: "Unnecessary" Suffering and the "Humane" Treatment of Animals*, 46 RUTGERS L. REV. 721, 733 (1994).

of humans. The law thus treats animals as chattels, and humans can rightly direct their destiny.[123] As property, animals arguably have no interests independent of those humans assign to them.[124]

Property law, when observed alone, suggests that society has chosen the anthropocentric (human-centered) approach to ethics. Under this approach, all types of animal genetic engineering would be fair game for researchers since society places no limits on what humans can and cannot do to animals. Animal cruelty laws, however, suggest that society has not entirely adopted an anthropocentric approach to animal rights.

2. Animal Cruelty Laws

While humans can own animals as chattels, the law prevents humans from treating animals like other types of property, such as land or consumer goods. In a great majority of cases, courts have ruled in favor of protecting animals where humans have burned,[125] beaten,[126] or neglected[127] them. These courts were primarily concerned with humans inflicting unjustifiable harm on the animals.

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123. Lubinski, *supra* note 122.

124. *Id*.

125. *See, e.g.*, Anderton v. State, 390 So. 2d 1083 (Ala. Crim. App. 1980) (affirming a trial court decision finding the defendant guilty of torturing, tormenting, or causing unnecessary cruelty on animals for pouring an inflammable substance on four dogs and igniting it); Turner v. State, 566 S.E.2d 676 (Ga. 2002) (upholding a verdict finding a defendant guilty of animal cruelty because the defendant left a dog in a mobile home that he later burned); *In re* William G., 447 A.2d 493 (Md. Ct. Spec. App. 1982) (holding that a juvenile defendant's kicking, and later burning, of a dog constituted a violation of Maryland's animal cruelty statute). The statute provided that "any person who tortures, torments, cruelly beats, mutilates, or cruelly kills an animal is guilty of a misdemeanor," and defined "torture," "torment," and "cruelty" to mean "every act whereby unnecessary or unjustifiable physical pain or suffering is caused or permitted . . . ." *Id*. at 495.

126. For example, in *People v. Bunt*, a New York court denied a defendant's motion for judgment declaring a New York animal cruelty statute unconstitutional after he was charged with brutally beating a dog with a baseball bat. 462 N.Y.S.2d 142 (Dutchess Co. Ct. 1983). The Maryland statute provided that a person who "overdrives, overloads, tortures or cruelly beats or unjustifiably injures, maims, mutilates, or kills any animal . . . is guilty of a class A misdemeanor." N.Y. Agric. & Mkts. Law § 353 (1965). *See also* Sonja A. Soehnel, Annotation, *What Constitutes Offense of Cruelty to Animals — Modern Cases*, 6 A.L.R.5th 733, 786–87 (2005); OHIO REV. CODE ANN. § 959.13(A)(1) (1994) (stating that no person should torture an animal, needlessly mutilate, or kill an animal).

127. *See, e.g.*, Norton v. State, 820 S.W.2d 272 (Ark. 1991) (affirming a defendant's conviction for animal cruelty because the defendant possessed multiple dead and malnourished rabbits and poorly maintained goats in violation of ARK. CODE ANN. § 5-62-101 (1987), which provided that a person is cruel to animals if he knowingly subjected the animal in his custody to cruel neglect). More recently, in Dongola, Illinois, a couple was charged with animal torture for allowing more than fifty animals (tame squirrels, horses, cats, dogs, and birds) to live in squalid conditions. *See* Julia Metelski, *Illinois Pair Charged with Animal Torture*, SEMISSOURIAN, Dec. 23, 2005, *available at* http://www.semissourian.com/story/1132534.html.

Also, courts deciding cases on organized fights between animals have ruled in favor of protecting the animals. These decisions have been applied consistently to dogs[128] and gamecocks.[129] At least one court has recognized the sporting aspect of cockfighting, but understood why the legislature banned it — for antigambling and humane purposes.[130] The court distinguished fishing and hunting from cockfighting, noting that those activities provide food as well as sport, and that hunting helps control species population levels.[131]

Not surprisingly, state laws relating to the humane treatment of wildlife, including deer, elk, and waterfowl, are virtually non-existent. This is primarily due to the fact that humans interact far less with wildlife than with domesticated species. Wildlife are not used for companionship, like pets, but for food and sport.

Some state courts have determined that animal cruelty laws do not apply to nuisance wildlife. In *State v. Lipsett*, a defendant was considered justified in drowning two raccoons because of a rabies problem in Connecticut.[132] Similarly, in *State v. Cleve*, the Supreme Court of New Mexico held that a defendant was not cruel to animals when he snared and killed two deer that were damaging his crops.[133] The court noted that if New Mexico's animal cruelty protection statute applied to wildlife, it would conflict with the state's fish and game laws.[134] Specifically, the lawful hunting of deer would subject a hunter to prosecution for cruelty to animals.[135] Therefore, the court limited the definition of "any animal" in the statute to domestic animals and to wild animals in captivity.[136]

These state laws and court decisions suggest that society recognizes an ethical responsibility to animals. However, this responsibility is limited only to preventing *unjustifiable* harm. Yet, because there is

128. *See, e.g.*, Rogers v. State, 760 S.W.2d 669 (Tex. Ct. App. 1988) (affirming a defendant's conviction for allowing dog fights on her property); Davis v. State, No. 30, 1991 WL 129221 (Tenn. Crim. App. July 17, 1991) (affirming defendants' convictions for encouraging two pit bulls to fight).

129. *See, e.g.*, Peck v. Dunn, 574 P.2d 367 (Utah 1978) (affirming the constitutionality of a law defining cockfighting as cruelty to animals); State v. Ham, 691 P.2d 239 (Wash. Ct. App. 1985) (affirming twelve defendants' convictions for violating a Washington state statute banning cockfighting).

130. *Ham*, 691 P.2d at 241.

131. *Id*.

132. No. CR9627114S, 1997 WL 187133, at *3 (Conn. Super. Ct. Apr. 9, 1997).

133. 980 P.2d 23, 27 (N.M. 1999).

134. *Id*. at 29.

135. *Id*. at 27.

136. *Id*. at 29. *But see* Boushehry v. State, 648 N.E.2d 1174, 1178 (Ind. Ct. App. 1995) (applying an animal cruelty statute to wildlife). In *Boushehry*, the defendant illegally shot and wounded a Canada Goose. Upon finding the injured bird, the defendant slit the goose's throat to ease its suffering. The court, using the Indiana statute on animal cruelty, determined that, while the defendant's shooting of the bird was not cruel, the subsequent slitting of its throat was. *Id*. The court's decision, however, seems based more on the illegal poaching of the hunter than on an ethical concern for the goose.

an ethical interest in protecting animals, however slight, researchers should be required to periodically justify their genetic engineering research.

B. Federal Laws

Federal laws also provide insight into the way society balances concerns about animal welfare against the economic and societal benefits of various uses of animals. Accordingly, this Section discusses the Animal Welfare Act and the Endangered Species Act.

1. Animal Welfare Act

The Animal Welfare Act ("AWA") is the primary federal legislation governing animal research and treatment in the United States.[137] In the 1960s, magazines containing graphic photos depicting the abusive treatment of dogs sparked public interest in the treatment of laboratory animals.[138] As a result, Congress received "more mail on the pending [animal rights] bills than on civil rights or Vietnam."[139] The Federal Laboratory Animal Welfare Act ("FLAWA") was the first federal legislation aimed at regulating animal research.[140]

Though the FLAWA only protected domestic pets from mistreatment in laboratories, later amendments shortened the Act's name to AWA and extended the protection to "any live or dead dog, cat, monkey (nonhuman primate mammal), guinea pig, hamster, rabbit, or any other warm blooded animal, which . . . is being used, or is intended for use, for research, testing, experimentation, or exhibition purposes or as a pet."[141] The amendments not only expanded the class of animals protected by the AWA, but also subjected additional classes of people to the Act's regulation — specifically, animal researchers and pet dealers.[142]

The AWA mandates the licensing of pet dealers and researchers,[143] dictates that research facilities purchasing dogs and cats do so

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137. Animal Welfare Act, 7 U.S.C. §§ 2131–59 (2000).

138. EMILY STEWART LEAVITT ET AL., ANIMALS AND THEIR LEGAL RIGHTS 48–49 (2d ed. 1970).

139. *Id*.

140. *See* Joshua E. Gardner, *At the Intersection of Constitutional Standing, Congressional Citizen-Suits, and the Humane Treatment of Animals: Proposals to Strengthen the Animal Welfare Act*, 68 GEO. WASH. L. REV. 330, 333 (2000).

141. 9 C.F.R. § 1.1 (2000) (defining "animal" for purposes of the AWA).

142. *See id.* Despite its expansion, the AWA is still widely criticized by animal rights activists. The primary criticism is that the AWA does not place limits on researchers regarding birds, rats, and mice "bred for use in research, and horses not used for research purposes . . . ." Perzigian, *supra* note 105, at pt. IV.A, ¶ 2 (quoting 9 C.F.R. § 1.1 (1977)). Deer, elk, waterfowl, and fish are also not covered by the AWA. *Id*.

143. 7 U.S.C. § 2134 (2000).

only from authorized dealers,[144] and authorizes inspections of dealer and research facilities.[145] Individuals who operate research or pet dealer facilities must provide their animals with adequate care and treatment in "housing, feeding, watering, sanitation, ventilation, shelter from extremes of weather and temperature, separation by species, and adequate veterinary care."[146]

The AWA, like state animal cruelty statutes, demonstrates that society has an interest in protecting animals from unjustifiable harm. By requiring inspections of animal research and dealer facilities and regulating animal treatment, the AWA acts to further this societal interest.

2. Endangered Species Act

The Endangered Species Act ("ESA")[147] is another law that is important to consider in analyzing societal values and establishing a system of guidelines for regulating animal genetic engineering. In 1973, Congress passed the ESA, pledging itself to aggressively "conserve to the extent practicable the various species of fish or wildlife . . . facing extinction."[148]

The ESA requires the Secretary of the Interior to ensure that all federal actions and programs are in furtherance of protecting endangered animals.[149] The Secretary has delegated this responsibility to the Fish and Wildlife Service and to the National Marine Fisheries Service.[150] Under the ESA's provisions, all federal agencies must consult with the Secretary to ensure that any federally funded or authorized action "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species."[151]

The program has been successful. Indeed, one scientific study indicated that 41 percent of species listed as endangered have improved or stabilized their population levels since the ESA was enacted. Other species, including red wolves and California condors, "might not exist at all without ESA protection."[152]

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144. *Id.* § 2137.
145. *Id.* § 2146.
146. *Id.* § 2143.
147. Endangered Species Act of 1973, 16 U.S.C. §§ 1531–44 (2000).
148. *Id.* § 1531(a)(4).
149. *Id.* § 1536(a)(1).
150. PATRICIA BALDWIN ET AL., LIBRARY OF CONGRESS, CONG. RESEARCH SERV., THE ENDANGERED SPECIES ACT: A PRIMER 5 (2005), http://www.ncseonline.org/nle/crsreports/05mar/RL31654.pdf.
151. 16 U.S.C. § 1536(a)(2) (2000).
152. BALDWIN, *supra* note 150, at 3.

Powerful legal tools exist to aid in the recovery of listed species and to protect their habitats.[153] These legal tools, however, have ignited quarrels when limited lands or resources have been involved.[154]

Economic interests exist on both sides of issues related to endangered species.[155] Because of this, the ESA has become a battleground for disputes.[156] For example, when the ESA was first enacted, it completely banned all activities detrimental to endangered species.[157] When a large dam project threatened to wipe out the only known population of the snail darter, the Supreme Court enjoined the completion of the dam, noting:

> Concededly, this view of the [ESA] will produce results requiring the sacrifice of the anticipated benefits of the project and of many millions of dollars in public funds. But examination of the language, history, and structure of the legislation under review here indicates beyond doubt that Congress intended endangered species to be afforded the highest of priorities.[158]

Following this decision, Congress amended the ESA to include a process for reviewing economic impacts and an allowance for restrictions to be waived if necessary.[159] Since that time, the agencies administering the ESA have used cost-benefit analyses to weigh the rights of endangered species against the public interest in economic development.[160] When basing decisions on cost-benefit analyses, the

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153. *Id*. at 1.

154. *Id*. at 1–2.

155. *Id*. at 2, 15–16.

156. *See id*.; *see also* GDF Realty Invs., Ltd. v. Norton, 326 F.3d 622 (5th Cir. 2003). *GDF Realty* was brought by land developers who were unable to develop a parcel because it was the habitat for six endangered species of "cave bugs." *Id*. After ten years of litigation, the Fifth Circuit held that the Commerce Clause allows the government to take lands for the protection of endangered species. *Id.*; *see also* BALDWIN, *supra* note 150, at 2 (noting that the ESA debate splits largely down demographic lines).

157. BALDWIN, *supra* note 150, at 19.

158. Tenn. Valley Auth. v. Hill, 437 U.S. 153, 174 (1978); *see also* BALDWIN, *supra* note 150, at 19.

159. *Id*.

160. *See generally* Ann K. Wooster, Annotation, *Designation of "Critical Habitat" Under Endangered Species Act*, 176 A.L.R. Fed. 405 (2005) (analyzing cases regarding the designation of a critical habitat for endangered or threatened species under the ESA); Tammy Hinshaw, Annotation, *Criminal Prosecution Under Endangered Species Act of 1973 (16 USCS §§ 1531–1543)*, 128 A.L.R. Fed. 271 (1995) (discussing cases involving the application of criminal penalties under the ESA); Nat'l Council for Envtl. Decision-Making Research, Cost-Benefit Analysis and Environmental Decision Making: An Overview, http://www.ncedr.org/tools/othertools/costbenefit/overview.htm (last visited Apr. 29, 2006) (discussing cost-benefit analyses in environmental decisions).

agencies must gather sufficient data from both sides of the debate, or risk litigation.[161]

Through laws and court decisions, society has expressed an interest in preserving endangered species whenever practicable. As discussed earlier, scientists can use genetic engineering — specifically, cloning — to preserve endangered species.[162] In regulating genetic engineering, decision makers should bear in mind the importance of preserving endangered species. The next Section considers how the goals of the current legislation should inform the regulation of genetic engineering.

V. RECONCILING ETHICAL CONCERNS AND ECONOMIC INTERESTS THROUGH FREE MARKET ENVIRONMENTALISM

Should the government regulate genetic engineering? Some people, free market environmentalists, believe that government entities are incapable of regulating the environment — including animals used in genetic engineering — effectively. Instead, they believe that limits on genetic engineering should be set by markets and consumer trading.

A. Free Market Environmentalism

Free market environmentalism, as described by economist Richard Stroup, is the theory that markets and consumer trading can provide better solutions to environmental issues than government enforcement and regulation can.[163] The traditional view is that the government is the better regulator. Private decision makers seeking cost reduction exacerbate environmental problems because they do not consider externalities, and thus pollute downstream.[164] These private decision makers also fail to adequately produce public goods, such as preservation of wild animal populations, since they reap no benefits from the users of these goods.[165] While these problems are not uncommon, there is growing evidence that governments also often

161. *See*, *e.g.*, Bob Marshall Alliance v. Watt, 685 F. Supp. 1514 (Mont. 1986), *aff'd in part, rev'd in part on other grounds sub nom.* Bob Marshall Alliance v. Hodel, 852 F.2d 1223 (9th Cir. 1988) (holding that the Department of the Interior violated the ESA by failing to gather species and habitat data sufficient to make an informed biological assessment of the effects of oil and gas leasing in a national forest area, effectively prioritizing development over endangered species); *see also* Bennett v. Spear, 520 U.S. 154, 176–77 (1997).

162. *See* discussion *supra* Part II.E.

163. Richard Stroup, *Environmentalism, Free-Market*, THE CONCISE ENCYCLOPEDIA OF ECONOMICS, http://www.econlib.org/library/Enc/EnvironmentalismFreeMarket.html (last visited Apr. 29, 2006).

164. *See id*.

165. *See id*.

fail to successfully cope with environmental externalities and public goods problems.[166] This failure, coupled with the ability of the private sector to respond quickly and economically to environmental affairs, has made people reconsider the traditional view.[167]

Under the free market environmentalism theory, markets can successfully regulate in the environmental field when rights to each critical resource are: (1) clearly defined, (2) easily defended against invasion, and (3) transferable between buyers and sellers.[168] A market is well-functioning only when all three conditions are fulfilled.[169]

> When rights to resources are defined and easily defended against invasion, all individuals or corporations, whether potential polluters or potential victims, have an incentive to avoid pollution problems. When air or water pollution damages a privately owned asset, the owner whose wealth is threatened will gain by seeing that the threat is abated, in court if necessary. In England and Scotland, for example, unlike in the United States, the right to fish for sport and commerce is a privately owned, transferable right. This means that owners of fishing rights can obtain damages and injunctions against polluters of streams. Owners of these rights vigorously defend them, even though the owners are often small anglers' clubs whose members have modest means. They have formed an association that is ready to go to court when their fishing rights are violated by polluters. Such suits were successful well before Earth Day and before pollution control became part of public policy.[170]

Once rights against environmental infractions are established by court decisions, as these were years ago, litigation is seldom necessary.[171]

Thus, liability for environmental infractions is a powerful motivator for private property owners.[172] On the other hand, "[g]overnment decision makers are seldom held accountable for broader social goals in the way that private owners are by liability rules and potential prof-

166. *See id*.
167. *Id*.
168. *Id*.
169. *Id*.
170. *Id*.
171. *Id*.
172. *Id*.

its."[173] While mistakes can be made by anyone, including private parties, "the decision maker whose private wealth is on the line tends to be more circumspect. The liability that holds private decision makers accountable is largely missing in the public sector."[174]

Free market environmentalism also asserts that government entities, unlike private property owners, do not have the "long-range view that property rights provide, which leads to protection of resources for the future."[175] When the third requirement, transferability, is present, property rights provide long-range incentives for owners to maximize their property value.[176] Because a landowner's wealth depends on good stewardship, owners have incentives to act with concern for the future usefulness of the resource.[177] According to free market environmentalists, this incentive and ability to engage in farsighted behavior is often lacking in the public sector.[178]

Free market environmentalism may provide boundaries for some areas of animal genetic engineering. Specifically, under free market environmentalism, the healthcare, food, pet retail, and sporting industries would develop their own ethics by considering resource preservation and consumer reaction to genetically-engineered products.

B. Balancing Economic and Ethical Concerns

The laws regarding property rights and animal protection suggest society's position on balancing animal welfare against human needs: economics and property rights trump ethical concerns for animal rights unless humans unjustifiably harm animals, except that endangered species require more protection than other animals. Society has therefore rejected the environmental ethical theories of animal welfare

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173. *Id*.
174. *Id*.
175. *Id*.
176. *Id*.
177. *Id*.
178. *Id*.

> Consider the example of Seattle's Ravenna Park. At the turn of the century, it was a privately owned park that contained magnificent Douglas firs. A husband and wife, Mr. and Mrs. W. W. Beck, had developed it into a family recreation area that brought in thousands of people a day. Concern that a future owner might not take proper care of it, however, caused the local government to "preserve" this beautiful place. The owners did not want to part with it, but following condemnation proceedings the city bought the park.
>
> But since they had no personal property or income at stake, local officials allowed the park to deteriorate. In fact, the tall trees began to disappear soon after the city bought it in 1911. The theft of the trees was brought to official attention by a group of concerned citizens, but they continued to be cut. Gradually, the park became unattractive. By 1972 it was an ugly, dangerous hangout for drug users.

Id.

and deep ecology as imposing too many restrictions on humans' use of animals. Instead, federal and state laws support only a minimal level of protection for animals.[179] This position may be equally applicable in the context of genetic engineering.

Free market environmentalism suggests that the market provides the best forum for people concerned about the ethics of animal genetic engineering to voice their concerns. Rather than allowing all animal genetic engineering to be guided solely by laws and regulations, consumers can approve or disapprove of industry practices by refusing to purchase genetically-engineered products. Private individuals or groups can act to prevent genetic experimentation or the release of transgenic animals into the wild. Organizations that regulate sporting industries can ban genetically-engineered animals from those industries. Such market responses can influence legislation.

Remember the example of the headless, many-legged tubular chickens?[180] Many people cringe at the thought of animal genetic engineering being taken that far. Animal activist groups like People for the Ethical Treatment of Animals ("PETA") would certainly make efforts to inform the public of this type of extreme genetic manipulation.[181] Accordingly, informed consumers could opt not to purchase food products derived from tubular chickens. People who morally object to genetically enhancing animals can already exercise this objection by shopping at natural food stores, such as Whole Foods Market.[182] The availability of both genetically- and non-genetically-engineered animal products allows consumers to voice their preferences regarding this technology.

Lobbying and litigation can also address animal genetic engineering concerns related to deep ecology. Consider the transgenic salmon that escape into the wild and interbreed with regular salmon.[183] Fearing interbreeding and other harms to the native ecosystem, California, in late 2003, banned "aquaculture of salmon, exotic (non-native) and transgenic (genetically-engineered) fish in state waters, including the ocean from 0–3 miles offshore."[184] Several west coast fishery organi-

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179. *See* discussion *supra* Part IV.

180. *See* discussion *supra* Part III.A.

181. *See*, *e.g.*, About Peta, http://www.peta.org/about/ (last visited Apr. 29, 2006).

182. Whole Foods Market Natural Meat Program and Animal Compassionate Standards for Beef Cattle, Nov. 23, 2005, http://www.wholefoodsmarket.com/issues/animalwelfare/cattle.pdf. Whole Foods Market prohibits the sale of meats from genetically-engineered animals. *Id*. at § 2-a.

183. *See* discussion *supra* Part III.C; Bodo, *supra* note 118.

184. *California Bans Salmon, Exotic and Transgenic Species Aquaculture in State Waters*, 8 FISHLINK SUBLEGALS 14 (2003), http://www.mindfully.org/GE/2003/CA-Bans-Transgenic-Salmon17oct03.htm. The ecological rationales for banning aquaculture include reducing the spread of disease, pollution, habitat competition, and predation on native stocks. *Id*.

zations had actively lobbied for the ban, while others opposed it.[185] Though the opposing groups had substantial economic interests in blocking the bill's passage, the California legislature apparently considered the ecological concerns too important to overlook.[186] Specifically, the legislature considered both proposals by the National Marine Fisheries Service to promote ocean aquaculture and "problems that have arisen in other parts of the world, particularly British Columbia, with . . . aquaculture operations in ocean waters."[187] The legislature also considered past problems with non-native fish in California, and the concern surrounding the FDA's refusal to do extensive testing to determine the effects of genetically-engineered fish on the environment.[188]

This is a model success story for free market environmentalism because the combined efforts of several organizations influenced the California legislature. By each organization voicing its views, the environmental legislation was able to embody the society's optimal level of genetic engineering regulation. To limit animal genetic engineering in the future, organizations believing that ecological or ethical concerns outweigh economic benefits can take action and lobby for laws that would make genetic engineering unprofitable or illegal. In the fish industry, for example, this action should be more effective given the formation of the Commercial Fishermen of America in November of 2005.[189] Previously, fishing industry lobbyist groups only represented the interests of fish processors and distributors, but now fishermen also have an advocacy group.[190]

Free market environmentalism also suggests a great way for regulatory organizations to set genetic engineering boundaries in their industries, as illustrated by the Jockey Club. The Club has banned cloned Thoroughbreds from entering most U.S. races.[191] Regardless of the Club's motivations behind the ban — whether to protect the art of breeding or to protect more direct economic interests — this decision has likely reduced research in horse cloning since the ban limits opportunities to capitalize on such research.

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185. *Id*.

186. *See id*.

187. *Id*.

188. *Id*.

> California has spent millions wrestling with the problem of non-native Northern pike that have found their way into Lake Davis and that could threaten salmon and other native fish in the Delta if these pike escape the lake. More than a decade ago, the state nearly had the same problem with white bass.

Id.

189. Jeff Barnard, *Commercial Fishermen Form National Group*, ESPN OUTDOORS, Dec. 2, 2005, http://espn.go.com/outdoors/fishing/news/2005/1202/2245361.html.

190. *Id*.

191. *See supra* text accompanying note 69.

The trophy-hunting industry can also rely on the market to limit cloning. On the one hand, genetically-enhanced deer would economically benefit hunters and the trophy-hunting industry. If someone created a record-book-quality deer, the owner of the property on which the deer lived could sell hunts for around $10,000 each.[192] A hunter who shoots and kills a buck that scores as the new world record for rack size would receive a "great deal of money from replicas, seminars, endorsements, and by selling the original rack."[193]

On the other hand, hunting is part of many families' traditions.[194] Furthermore, the "big buck syndrome . . . is as old as hunting."[195] According to Ron Schara, host of ESPN's *Outdoor Beat*, "[t]o clone big bucks would destroy that tradition and cheapen the joy of bagging a large deer."[196] The Boone and Crockett Club, for example, already requires that deer be free-roaming to qualify for the registry.[197] To preserve the tradition of natural deer hunting, the Club will likely extend their guidelines to ban cloned deer from the registry.[198]

While some groups have only pecuniary gain in mind, others advocate animal rights. The operation of free market environmentalism, by permitting the expression of competing interests, can guide the regulation of animal genetic engineering to society's preferred level. It is important, therefore, for organizations like the Boone and Crockett Club, the Jockey Club, and the Commercial Fishermen of America to continue lobbying for their industries. For free market environmentalism to work, it is equally crucial that watch-dog organizations like the Sierra Club and PETA continue informing consumers about animal testing and engineering. That way, consumers can express their ethical opinions through marketplace purchases, thereby influencing economical incentives for animal genetic engineering.

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192. E-mail from Dale Grandstaff, Game Warden, Tenn. Wildlife Res. Agency (Dec. 17, 2005, 00:15 CST) (on file with author) (estimating the amount hunts are sold for on deer ranges depends on the quality of the deer).

193. *Id*.

194. E-mail from Dale Grandstaff, *supra* note 42.

> Families meet and come together on opening day of deer season just as if it were Christmas or Thanksgiving. Churches and Volunteer Fire Halls become gathering places for hunters to meet and have breakfast and fellowship before the days [sic] hunt. Some parts of the country shut down because of an opening day of hunting season . . . .

Id.

195. E-mail from Ron Schara, *supra* note 42.

196. *Id*.

197. *See* Boone & Crockett Club, General Policies of the Boone and Crockett Club's Records Committee: Zoo/Captive Animals, *available at* http://www.boone-crockett.org/bgRecords/records_policies.asp?area=bgRecords (last visited Apr. 29, 2006).

198. Although the Boone and Crockett Club has not formally banned genetically-engineered deer from its registry, it plans to do so in the near future. Telephone Interview with Jack Reneau, Dir. of Big Game Records, Boone & Crockett Club (Jan. 4, 2006).

Through the enactment of the ESA, society has also exhibited an interest in providing greater protection to endangered species than to other animals. Scientists should therefore be encouraged to use genetic engineering to maintain endangered species populations whenever economically practical. The ESA already implicitly reflects this policy by functioning to "conserve to the extent practicable the various species of fish or wildlife . . . facing extinction."[199] With this in mind, Congress could further society's goals by amending the ESA to include language expressly endorsing the use of genetic engineering to sustain endangered species. With regard to how much federal funding should be used for promoting endangered species genetic engineering, and who should pay for it, I leave that to Congress or a future article.

VI. CONCLUSION

Animal genetic engineering is here to stay. Genetic engineering plays essential roles in healthcare research and food production. It has resulted in huge profits for a variety of industries. Genetic engineering can also assist in sustaining species that are facing possible extinction. The current state and federal laws on animal rights suggest that all *justifiable* animal genetic engineering should be permitted. Free market environmentalism will test this hypothesis by allowing individuals, interest groups, and government agencies to use the market to indicate the optimal level for genetic engineering regulation.

199. 16 U.S.C. § 1531(a)(4) (2000).