SOLUTION OR STUMBLING BLOCK?: BIOLOGICAL ENGINEERING AND THE MODERN EXTINCTION CRISIS

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> "The loss of biological diversity is the loss of a library that contains answers to questions that we have not yet learned how to ask. Our descendants will grieve for information incinerated when forests were burned and habitats clearcut."
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> —Lynn Caporale[1]

I. INTRODUCTION

January 2001 marked yet another breakthrough in biotechnology: Bessie, a cow, will give birth, not to a calf, but to another species—a gaur.[2] The gaur is a type of wild ox native to southern India that currently faces extinction. The gaur does not breed well in captivity, and hunting and habitat loss have greatly reduced its wild population.[3] In an effort to preserve the guar, scientists decided to experiment with newly developed cloning technology. A team of scientists at Advanced Cell Technology Inc., a biotechnology company, replaced the nucleus of a cow's egg cell with the nucleus from a gaur's skin cell.[4] This transplanted nucleus contains all the genetic material needed for the gaur to grow and develop inside Bessie the cow.[5]

Although considerable advances have been made in cloning technology since the 1997 birth of Dolly, the first animal cloned from a fully developed adult cell, the process is by no means perfect. In fact, scientists made hundreds of attempts to successfully implant the cloned guar embryo into Bessie; the process often was unsuccessful, and at other times when the process was successful, scientists aborted the clones for research.[6] Still,

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[1] Lynn Caporale, Feature Article DEFENDERS MAGAZINE, Summer 1995, *available at* http://www.defenders.org/case03.html.

[2] *See* Ann Kellan, *Scientists await birth of first cloned endangered species*, CNN, Jan. 5, 2001, *at* http://www.cnn.com/2001/NATURE/01/05/cloned.species/index.html.

[3] *See id.*

[4] *See id.*

[5] *See id.*

[6] *See id.*

despite the low success rate in attempting to bring a cloned animal to term, some scientists now suggest that cloning may be a viable means of replenishing endangered species such as the guar, and possibly even resurrecting species that are already extinct.[7] But does this birth mark progress in the fight to preserve endangered species, or a smoke and mirrors deception that merely masks the problem?

The purpose of this note will be to discuss Earth's pending biodiversity crisis and the steps various nations have taken toward preserving endangered species. More specifically, this note shall explore the significance of biodiversity and the most critical threats to species extinction in the new millennium. It will analyze the effectiveness of various treaties and legislation currently in place that purport to combat these threats. Finally, it will explore biological engineering and the cutting edge cloning technology that has been developed over the past century, and the role that it may play in curtailing the extinction rate. Since some modern scientists have begun to advocate cloning as a potential means of preserving earth's biological diversity, this note shall pay special attention to various laws regulating such technology, as well as the moral, scientific, and legal ramifications of cloning.

II. THE MODERN BIODIVERSITY CRISIS

As science and mankind bound into a new millennium, hungry for progress and dominion over new frontiers and armed with new biotechnology, perhaps we ought to pause and reflect on the scars left by the past thousand years' appetite for "advancement." In his quest for technology and civilization, man has too long approached the natural world as something to be conquered rather than preserved, leaving a trail of pollution, deforestation, and species extinction in his wake.

One of the most devastating and potentially irreversible consequences of man's abuse of nature is the extinction of thousands of the earth's species. Recent estimates indicate that one species is lost every fifteen minutes, which translates into a startling extinction rate of ninety-six species per day, six-hundred seventy-two species per week, and thirty-five thousand species per year.[8] The World Wildlife Fund further estimates that as many as one fifth of the earth's species may be lost to extinction by the year 2025.[9] Such rapid and

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[7] *See id.*

[8] C.C. Mann, *Extinction: Are Ecologists Crying Wolf?*, 253 SCI. 736 (1991).

[9] World Wildlife Fund, *Endangered Species; A Few of the Many: A Partial Listing of Endangered Species*, *at* http://www.worldwildlife.org/species/ (last visited Oct. 14, 2000).

widespread disappearance of the earth's species has triggered a modern biodiversity crisis that, in the past quarter-century, has caught the attention of both scientists and legislatures.

The latter half of the twentieth century has seen increased concern with the earth and her resources, leading to the birth of hundreds of organizations seeking to preserve the environment. Popular concern for the environment has also heightened scientific and legislative interest in the conservation of earth's natural resources, including preservation of what may be her greatest resource: the genetic diversity manifested by the vast array of species populating the earth.

In June of 1992, world leaders responded to the modern extinction crisis, gathering in Rio de Janeiro for the first Convention on Biodiversity, seeking to implement a landmark treaty that recognized the critical importance of each of the earth's species.[10] In preparation for this convention, an Ad Hoc Working Group of Experts on Biological Diversity and an Ad Hoc Working Group of Legal and Technical Experts met to assess the world's biodiversity crisis and to prepare to advise international lawmakers on appropriate measures for combating species extinction.[11] These meetings were followed by the establishment of an Intergovernmental Negotiating Committee for a Convention on Biological Diversity (INC) that held five sessions from June 1991 to May 1992, culminating in the text of the Convention on Biological Diversity, which opened for signature in Rio de Janeiro on June 5, 1992.[12]

The convention purports to focus the international effort to conserve Earth's biodiversity.[13] While acknowledging each nation's sovereignty to exploit its own resources and pursue its own environmental policies, the Convention calls on each of the signing Parties to develop internal programs for the conservation of biodiversity.[14] Under the Convention, preservation of biodiversity is encouraged through internal establishment of protected habitats,

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[10] Convention of Biological Diversity, June 4, 1993, S. Treaty Do. No. 103-20, *available in* 1993 WL 796847 (Treaty) (1993).

[11] *See id.* at 1.

[12] *See id.*

[13] *See id.* President William J. Clinton calls the convention a "comprehensive agreement" designed to conserve biological diversity, sustain the use of its components, and implement international plans for "the fair and equitable sharing of benefits arising out of the utilization of genetic resources." President Clinton describes various means for attaining these goals, and the environmental and economic benefits that will result from the successful conservation of endangered species.

[14] *See* Convention on Biological Diversity, *supra* note 10, art. 3, 6, at 18-19.

restoration of degraded ecosystems, and the development of internal legislation to protect endangered species.[15]

While the Convention discusses preservation of biodiversity in general terms, it does not specifically address what steps parties should take to combat the decline of the earth's natural resources.[16] Furthermore, the Convention fails to mandate that parties take affirmative measures to restore endangered species populations.[17] Accordingly, the Convention ultimately falls short of establishing an international framework for the preservation of endangered species.

III. WHY BIODIVERSITY SHOULD BE CONSERVED

As defined by the convention, "biological diversity" means "the variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part: this includes diversity within species, between species and of ecosystems."[18] More succinctly, it refers to the myriad species living on Earth—plants, animals, and microorganisms—the ecosystems they form, and the wealth of genetic information that they contain.[19] Evolutionary processes spanning hundreds of millions of years have created this dynamic "pool of living diversity" that expands and contracts as new species are born, and as species become extinct.[20] It is impossible to predict the ramifications of the loss of a single species, even a species as seemingly insignificant as a dung beetle or a bread mold.[21] Each species is interrelated, contributing to the biological processes that regulate Earth's delicate environment, and the loss of even seemingly insignificant species can trigger consequences that reverberate through entire ecosystems, and may ultimately have an unanticipated impact on man.[22]

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[15] *See id.* art. 8, at 19-20.

[16] *See id.*

[17] *See id.*

[18] *See id.* art. 2, at 17.

[19] *Biodiversity and its value*, *at* http://www.ea.gov.au/biodiversity/chm/publications/op1.html (last modified Nov. 19, 1997).

[20] *Id.*

[21] May Berenbaum, DEFENDERS MAGAZINE, Summer 1995, *available at* http://www.defenders.org/case02.html (last visited Oct. 14, 2000).

[22] *See Biodiversity and its value*, *supra* note 19, at 5.

Earth's vast array of species provides invaluable services to the ecosystem that protect, maintain, and restore the environment.[23] Natural vegetation is vital to the protection of Earth's water resources, maintaining hydrological cycles and water runoff, preserving aquatic habitats, slowing erosion, and acting as purifying systems.[24] Living organisms form and maintain soil, and are necessary to protect the soil's moisture and nutrient levels. Vegetative root systems introduce organic materials into the soil, and make water penetration possible.[25] Ecosystems recycle nutrients, facilitating mineral exchange between the air and the soil, a process necessary to the maintenance of life and the establishment of food chains.[26]

Various species, from microorganisms to sophisticated mammals, preserve the environment by breaking down, absorbing, and purifying many of the pollutants that man introduces into the environment.[27] Vegetation is essential to climate control and climate stability, and to the maintenance of healthy ecosystems that promote recovery from natural and human-induced disasters such as pollution, flood, fire, and severe weather storms.[28]

The consequences of species extinction extend beyond the immediate impact on the environment. Species that may have once seemed expendable have provided humans with life-saving information, new medicines, and useful knowledge about molecular structures.[29] Bread mold transformed modern medicine by giving humans penicillin.[30] In a fungus, scientists discovered a drug that prevents rejection of organ transplants; scientists rely on toxins provided by snails, spiders, and scorpions in researching treatments of human diseases ranging from stroke to asthma, and continue to derive valuable information by studying interspecies interactions.[31]

Finally, preservation of earth's species has social benefits.[32] Humans and human cultures have coevolved with the environment, and man appreciates wildlife for its inspirational, aesthetic, spiritual, and educational value.[33]

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[23] *See id.* at 5.
[24] *See id.*
[25] *See id.*
[26] *See id.*
[27] *See id.* at 6.
[28] *See id.* at 6-7.
[29] *See* Caporale, *supra* note 1.
[30] *See id.*
[31] *See id.*
[32] *Biodiversity and its value, supra* note 19.
[33] *See id.* at 10.

Nature has been a time-honored subject of art, literature, and photography; its diversity undoubtedly contributes to the richness of the planet.[34]

As man enters the twenty-first century, the Earth faces a global extinction crisis. In recent centuries, hundreds of species have disappeared every day, almost always as a consequence of human activities.[35] Some of the most immediate threats to Earth's ecosystems and biodiversity include expansion of human settlement, deforestation, pollution of water, soil, and air, unnatural climate changes stemming from extensive use of fossil fuels, and poaching to supply animal body parts for international trade.[36] All of these threats could be diminished through global conservation efforts, and yet, as of 2001, the international community has failed to promulgate laws or treaties capable of halting this extinction crisis.

IV. THE CONVENTION ON BIODIVERSITY

The objectives of the Convention on Biodiversity, as expressly stated in its Article 1, are:

> the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.[37]

However, while the Convention subsequently makes general suggestions as to how individual states may preserve species found within their own territory, it does not implement any comprehensive, global plans to promote species preservation.[38] In fact, the remainder of the Convention focuses primarily on preserving individual nations' authority over species within their own territory.[39] It is, therefore, difficult to ascertain what the convention actually accomplishes.

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[34] *See id.* at 9.
[35] *See* World Wildlife Fund, *supra* note 9.
[36] *See id.*
[37] Convention on Biodiversity, *supra* note 10, art. 1.
[38] *See generally id.*
[39] *See generally id.*

While the Convention ostensibly seeks to further an international effort to conserve biodiversity, its stated purpose is actually to formalize the sovereign right of states to "exploit their own resources pursuant to their own environmental policies."[40] Only the barest of limitations is placed on states' authority to exploit their own environments by the convention's exhortation that states act responsibly to "ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."[41] Essentially, this provision indicates that even states that are a party to the Convention on Biological Diversity may, at their sole discretion, destroy habitats, exterminate endangered species, and otherwise destroy biodiversity, provided that their destructive activities do not extend beyond their own borders.

Although the Convention on Biological Diversity does not expressly forbid a party nation to destroy habitats or otherwise jeopardize endangered species, it does, in Article 6, urge signing states, "in accordance with [their] particular conditions and capabilities," to develop domestic programs for the conservation of biodiversity, and to integrate conservation efforts into appropriate programs and policies.[42] While such language may represent a positive step toward species conservation, it is overly generalized. Furthermore, the provision that states are only bound to implement such policies in accordance with their capabilities provides a large loophole. While some party states may well seek to implement conservation policies to the greatest extent of their capabilities, the provision might also easily be used as a justification for inaction in many lesser developed countries based on an argument that exploitation of natural resources, such as deforestation, are necessary to that nation's economic development. Unfortunately, it is in the very nations that might raise such an argument, including many less-developed African and South American nations, where conservation efforts are most desperately needed.

The Convention does advise party nations to identify and monitor "components of biological diversity important for its conservation," referring, most specifically, to endangered plant and animal species, and proposes some in-situ measures for protecting and rehabilitating degraded ecosystems.[43] Unfortunately, these provisions are qualified with the provision that they are to be undertaken only "as far as possible and appropriate," again providing a

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[40] *See id.* art. 3.
[41] *See id.*
[42] *See id.* art. 6 at 18-19.
[43] *Id.* arts. 7 & 8 at 5-7.

loophole whereby many nations may be able to avoid implementing any internal conservation policies.[44]

Perhaps the most glaring omission from the Convention on Biological Diversity is the absence of any provision requiring more affluent parties, such as the United States or members of the European Union, to provide monetary or technological support that would aid less affluent nations in implementing conservation policies.[45] Such a provision would likely have made it more difficult for these poorer states to circumvent the provisions limiting their conservation efforts via the "as far as possible and appropriate" loopholes. If all party nations were encouraged to work together in developing and funding conservation programs, it is far less likely that any party state could continue to exploit its own resources to the detriment of biodiversity on the grounds that it lacked sufficient resources to implement its own conservation programs.

The biodiversity crisis is global and will ultimately impact every nation. By allowing loopholes through which any nation may continue to destroy habitats and exacerbate the existing threats to endangered species, the convention fails to meet its stated aims. In order to effectively combat growing extinction rates, global cooperation must be actively encouraged.

V. CURRENT LAWS PROTECTING EARTH'S SPECIES

Plant, animal, and other living species are dying out in every corner of the world, and no nation working alone has the authority, resources, or ability to stop the rapid extinction of Earth's species. To date, the most universal international response to the extinction crisis has been the Convention on Biological Diversity. This treaty calls on all signing parties to take measures to promote species conservation and encourages passage of domestic legislation to protect habitats and endangered species.[46] However, as noted above, the Convention is painfully limited. Under its terms, each nation retains "the sovereign right of states to exploit their own resources," and the Convention leaves the making and enforcement of any laws to protect biodiversity solely within the prerogative of individual nations.[47] It establishes no international laws to protect ecosystems, nor does it impose any penalties

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[44] *Id.*
[45] *Id.*
[46] *See* Convention on Biological Diversity, *supra* note 10.
[47] *Id.* at art. 3.

for continued exploitation of the environment or endangered species.[48] In fact, the Convention accomplishes little more than establishing that the signing nations do consider biodiversity important, and encouraging parties to protect the ecosystems within their jurisdictions.[49]

Fortunately, the Convention is not the only international treaty recognizing the problem of species extinction. In 1973, in response to the devastating effects of poaching and international trade in the body parts of endangered species such as tigers, elephants, and rhinoceroses, many nations signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).[50] CITES recognizes that "international cooperation is essential for the protection of certain species of wild fauna and flora against over-exploitation through international trade."[51] CITES seeks to accomplish this goal via strict regulation of the international market for body parts of particular species whose survival is seriously threatened. Nevertheless, the treaty does not ban such trade outright; instead it merely requires that importers and exporters of such "commodities" meet requirements to obtain permits.[52]

While CITES represents a positive step toward protection of the Earth's biodiversity, it is insufficient even to meet its limited goal of preserving endangered species from exploitation through international trade in animal body parts, which is only one of the many threats currently facing endangered species. Such small measures are hardly sufficient to accomplish the much broader goal of protecting such animals from extinction. CITES only attempts to regulate international trade of endangered species, but has no bearing on the poaching or intrastate trade of those same animals.[53] Furthermore, the laws set forth in CITES are often ignored by many party nations, including China and India, which are two of the largest contributors to the illegal trade in tiger parts.[54] Poached animal parts often slip through customs, either because parts, such as bones, may be ground into untraceable powders, or because bribes encourage officials to look the other way.[55]

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[48] *See id.*

[49] *Id.* at art. 4.

[50] *See* Convention on International Trade in Endangered Species of Wild Fauna and Flora, with Appendices, Mar. 3, 1973, 27 U.S.T. 1087, 1976 U.N.T.S. 244 (entered into force July 1, 1975) [hereinafter CITES].

[51] *Id.*

[52] *Id.* at Art. III, IV.

[53] *Id.*

[54] *See* Craig Kansnoff, *Tigers in Crisis: Problems Facing Tigers: Part 2*, *at* http://www.tigersincrisis.com/problems_2.htm (last visited Oct. 14, 2000).

[55] *See id.*

The most serious of all threats to Earth's biodiversity is the loss of natural habitats that plants and animals need to survive. To date, no international law expressly conserves the environment or protects the natural habitats of endangered species. While many nations have passed domestic laws that prohibit ecological destruction in their own jurisdictions, species extinction is a world-wide crisis, and it is imperative that world leaders implement more decisive measures to address habitat preservation.

Even in nations that have passed domestic laws seeking to conserve natural habitats, such laws are often met with both popular and political opposition, and exceptions are liberally granted. In 1973, the United States passed the Endangered Species Act, the first Congressional action that actively sought to "conserve to the extent practicable the various species of fish or wildlife and plants facing extinction."[56] However, "conflicts quickly arose between Constitutional property rights and provisions of the Act prohibiting harm to the habitats of imperiled species."[57] Naysayers predicted "economic catastrophe" because "animals" were given preference over "humans,"[58] particularly following a controversial Supreme Court decision holding that, with the enactment of the ESA, Congress intended to halt species extinction, "whatever the cost."[59]

Domestic laws do, however, play an important role in providing a framework for species conservation. Currently, because no international laws sufficiently address habitat and species conservation, domestic law is perhaps the only weapon available in the fight to preserve Earth's biodiversity. The United States and the European Union have both passed legislation specifically aimed at conservation of endangered species.[60] While this legislation, standing alone, is insufficient to effectively combat species extinction, it provides both a starting point from which the United States and the European Union may begin to work toward conservation of biological diversity, and workable models that other nations may follow in seeking to implement their own internal policies for the preservation of endangered species.

The Endangered Species Act provides that the Secretary of the Interior shall review all federal actions and programs and use them in the furtherance

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[56] Endangered Species Act, 16 U.S.C. § 1531(a)(4) (1973).

[57] Denis D. Murphy. Feature Article, DEFENDERS MAGAZINE, Summer 1995, *available at* http://www.defenders.org/case10.html (last visited Oct. 14, 2000).

[58] *See* Thomas Michael Power, Feature Articles, DEFENDERS MAGAZINE, Summer 1995, *available at* http://www.defenders.org/case12.html (last visited Oct. 14, 2000).

[59] Tenn. Valley Auth. v. Hill, 437 U.S. 153, at 184 (1978).

[60] *See* 16 U.S.C. § 1536 (1973); European Union Council Directive 86/609/EEC, 1986 O.J. (L358) 1.

of Chapter 35 of Title 16 of the United States Code, which was passed to conserve endangered species.[61] Under the provisions of the Act, each federal agency must consult with the Secretary to ensure that any federally authorized or funded 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 which is determined . . . to be critical."[62] Through such provisions, the United States seeks to ensure that, at a minimum, no federal actions exacerbate species extinction problems.

Constraints on any federal action that may jeopardize threatened species are, again, a positive step toward ameliorating the earth's biodiversity crisis. Unfortunately, this legislation still contains significant loopholes. First, the statute only inhibits federal actions that threatened endangered species that are deemed "critical."[63] The statute, however, neither defines the term "critical," nor enumerates which species should be considered "critical." Accordingly, insertion of the word "critical" into the statute provides the Secretary with significant discretion in determining whether a proposed federal action may go forward.[64]

In addition to the "critical" species loophole, the statute inadequately protects endangered species within the United States since it is applicable only to federal actions.[65] The statute has no bearing on private uses of land, or private projects that may have the effect of adversely impacting endangered species.[66] Accordingly, the private sector still has largely unfettered discretion to exploit endangered species and their habitats to promote its own objectives.

Current international and domestic legislation is clearly insufficient to protect endangered species or to combat the earth's biodiversity crisis. Accordingly, scientists and environmentalists have begun to look elsewhere for potential solutions to the problems presented by the rapid loss of endangered species. One potential remedy for rapid extinction rates and depletion of biodiversity that has been recently proposed is whole-organism cloning of endangered species.

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[61] 16 U.S.C. § 1536(a)(1) (1973).
[62] 16 U.S.C. § 1536(a)(2) (1973).
[63] *Id.*
[64] 16 U.S.C. § 1536 (1973).
[65] *Id.*
[66] *Id.*

VI. THE NEW MILLENNIUM AND THE ADVENT OF BIOLOGICAL ENGINEERING

Recently, modern scientists and scholars have begun to advocate whole-organism cloning as another means of preserving endangered species.[67] Cloning technology, which has developed over the past hundred years, has now reached a point where it is possible to scientifically replicate adult animals.[68] The first steps in biological engineering were taken in the late nineteenth century when scientists began splitting animal embryos in an attempt to create genetically identical organisms.[69] In the early twentieth century, scientists began to focus on genetics as a means of cloning, and sought a method for switching the development process during differentiation, the developmental stage during which cells adapt to perform specific functions within the body.[70]

The development of a nuclear transfer procedure in 1952 marked a major breakthrough in animal cloning that enabled scientists to clone species from embryonic nuclei. However, attempts to create a clone from a fully differentiated adult cell using this method were unsuccessful and, until 1997, believed by many scientists to be impossible.

In 1997, Scottish scientists announced the first successful clone created from fully differentiated adult cells when they introduced the sheep, "Dolly," to the world.[71] The birth of Dolly proved that it was scientifically possible to genetically replicate a mature mammal. This breakthrough led some scientists to believe that this new technology might be a means of preserving endangered species, and further attempts to replicate Dolly's Scottish creators' success immediately followed.[72] In fact, several such projects are already underway:

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[67] *See* Robert F. Blomquist, *Cloning Endangered Animal Species*, 32 VAL. U. L. REV. 383, 411-14 (1998).

[68] *See id.* at 390.

[69] *See* Marie A. DiBerandino & Robert G. McKinnell, *Backward Compatible*, THE SCIENCES, Sept./Oct. 1997, at 32.

[70] *See id.*

[71] *See* I. Wilmut et al., *Viable Offspring Derived from Fetal and Adult Mammalian Cells*, NATURE, Feb. 27, 1997, at 810-13.

[72] *See* Blomquist, *supra* note 67. *See also* Corey A. Salsberg, *Resurrecting the Woolly Mammoth*, 2000 STAN. TECH. L. REV. 1 (2000) (scientists are currently seeking DNA that can be used to clone an adult woolly mammoth), Ellen Goodman, *Can animal cloning stop the 'flood tide of extinction'?*, ATHENS DAILY NEWS, Oct. 13, 2000, at 8A., *Bringing the Tasmanian Tiger back to life*, NEWS IN SCIENCE, May 5, 2000, *available at* http://www.doc.net/au/science/news/stories/s123723.htm (last visited Aug. 21, 2000) (scientist have recently found complete DNA of an extinct animal, the Tasmanian tiger, and are attempting to clone an adult Tasmanian

as mentioned earlier, a cow in Iowa recently gave birth to a gaur, the first embryo cloned from an endangered species.[73] The next logical step may soon follow; Australian scientists believe they may have found viable DNA from a Tasmanian tiger that would allow them to clone this species that became extinct about one-hundred years ago,[74] and research teams around the world are searching for woolly mammoth DNA that would allow them to resurrect this behemoth from the ice ages.[75]

At first glance, cloning does seem consistent with the language and spirit of the Convention on Biodiversity, which calls on Parties to "develop new or adapt existing national strategies, plans or programs for the conservation and sustainable use of biological diversity."[76] Cloning would undoubtedly preserve and maintain the genes of species that might otherwise be lost to extinction by keeping such species alive, at least in laboratory and zoo settings.

Aggressive pursuit of whole-organism cloning as a means of combating extinction may thus prove a powerful weapon in combatting the current biodiversity crisis.[77] Such means would also be consistent with the United States' policy concerning endangered species as expressed both in the language of the Endangered Species Act of 1973, and in the landmark decision of *TVA v. Hill*, in which Chief Justice Burger expressly stated that the value of any endangered species is "incalculable."[78]

Through whole-organism cloning, scientists could reintegrate the DNA contained in frozen fibroblast cells of long-deceased members of endangered species that are currently maintained in American zoos.[79] Through such technological intervention, these animals, after being cloned, would be able to breed with other natural or cloned members of that endangered specie, and their "lost" genes could be reintroduced into the gene pool, contributing to overall genetic diversity.[80]

A federal policy of cloning endangered species could benefit biologists seeking to preserve species such as the Giant Panda and the tiger, neither of

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tiger from those cells).

[73] Goodman, *supra* note 72.

[74] *Bringing the Tasmanian Tiger back to life*, *supra* note 72.

[75] *See* Salsberg, *supra* note 72.

[76] Convention on Biodiversity, *supra* note 10, art. 6 (a).

[77] *See* Blomquist, *supra* note 67, at 411.

[78] Endangered Species Act, 16 U.S.C. §§ 1531-44 (1973); *see also TVA v. Hill*, 437 U.S. at 194; *see also* Blomquist, *supra* note 67, at 411-12.

[79] Blomquist, *supra* note 67, at 412.

[80] *See* Jon Cohen, *Can Cloning Help Save Beleaguered Species?*, 276 SCI. 1329, 1329 (1997).

which breed well in captivity.[81] Ordinarily, most of the genes of such species, which may only produce one or two offspring, are lost, but cloning might provide a means of conserving a greater percentage of each of these animal's genes.[82] Finally, a whole-organism animal cloning program for endangered species could mitigate the harsh effects of wildlife preservation laws that often include relocation of communities and restriction of economic activity, and that may, in some situations, be viewed as "takings" contrary to Due Process Clause of the Constitution.[83]

To date, there are no substantial legal barriers to an aggressive policy of cloning endangered species. No laws specifically address cloning of endangered species, and few address animal cloning at all. However, it is clear that regulation of the cloning of endangered species is plainly within the scope of new laws that address animal cloning in general.

Although cloning technology may be able to reproduce endangered species and even to resurrecting species that have died out, legal systems have been slow to respond to the moral, legal, and ethical issues presented by such technology.[84] Immediately following Dolly's birth in 1997, legislatures in the United States and the European Union recognized that this new technology mandated a legislative response.[85] That same year, President Clinton charged the National Bioethics Advisory Commission of the United States with preparing a report on the moral, scientific, and ethical ramifications of using such new technology to clone a human being.[86] Several European countries, including France, Denmark, the Netherlands, Germany, and Spain immediately passed legislation prohibiting research on human embryos, and Germany and Spain banned human cloning outright.[87] For its part, the United Nations quickly responded to the advent of cloning technology by adopting the Universal Declaration of Human Rights, which prohibits the use of biotechnology to clone a human being.[88]

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[81] *See id.*

[82] *See id.*

[83] Blomquist, *supra* note 67, at 414 (citing DANIEL STARER, HOT TOPICS 221 (1995)).

[84] *See* Stacy J. Ratner, *Baa, Baa, Cloned Sheep, Have You Any Law? Legislative Responses to Animal Cloning in the European Union and United States*, 22 B.C. INT'L & COMP. L. REV. 141-42 (1999).

[85] *Id.* at 146.

[86] Melissa K. Cantrell, *International Response to Dolly: Will Scientific Freedom Get Sheared?*, 13 J.L. & HEALTH 69, 72 (1999) (citing *Clinton Seeks Legal, Ethics Review of Issues Related to Human Cloning*, HEALTH CARE DAILY (BNA), Feb. 25, 1997, at D-8).

[87] *See id.* at 73 (citing *European Union Agrees with U.S. Human Cloning Should Be Banned*, Transplant News, June 30, 1997).

[88] *Id.* (citing Mike Pezzella, *International Officials Adopt Rules Covering Cloning, Gene*

Although domestic and international legislatures almost universally sought to prevent the application of cloning technology to human beings, they were loath to block the path of modern science completely. The vast majority of laws directed at biological engineering were aimed solely at preventing the application of the new technology to humans, failing to prohibit, or even to address, animal cloning.[89]

A. The Legislative Response to Animal Cloning in the EU

The EU Council derives its power to regulate cloning research among its member states from Article 100 of the Treaty of Rome, which speaks most specifically to establishment and functioning of a common market.[90] However, the EU Council lacks authority to ban animal cloning outright and may only withhold funding for cloning research or 'ask' member states to pass their own legislation banning such technology.[91] At most, the council can refuse to issue patents for technology that furthers the advancement of cloning techniques, but it lacks direct power to regulate scientific research.[92]

European Union legislation further reflects the sense that, only three years after Dolly inspired scientists to press forward with whole-organism cloning, it may already be too late to interfere with this new technology inasmuch as it is capable of improving human life. As the director of the Roslin Institute, Dolly's birthplace, claims, "the genie [of animal cloning] is out of the bottle and nobody is going to stop it . . . the technology works and the knowledge explosion will happen."[93] Still, existing EU legislation of animal cloning reflects concern for animal welfare and the protection of animals who are the subjects of technological research.[94]

The EU's approach to legislation of biotechnology is characterized by an emphasis on ethics. The EU Parliament drafted its 1997 Resolution on

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Research, Biotechnology Newswatch, Nov. 17, 1997, at 1).

[89] *See* Ratner, *supra* note 84, at 148-54.

[90] *See* TREATY ESTABLISHING THE EUROPEAN COMMUNITY, Aug. 31, 1992, O.J. (C 224) art. 100 (1992), 1 C.M.L.R. 573 (1992).

[91] *See id.*

[92] *See* Robin Herman, *European Bioethics Panel Denounces Human Cloning*, WASH. POST. June 10, 1997, at Z19.

[93] Ratner, *supra* note 84, at 149 (quoting *Animal Cloning is "Out of the Bottle,"* IRISH TIMES, Mar. 22, 1997, at 11).

[94] *See* Parliament Resolution on Cloning Animals and Human Beings, 1997 O.J. (C 115) 93, 94; Opinion of the Group Advisers on the Ethical Implications of Biotechnology (GAEIB) to the European Commission on Ethical Aspects of Cloning Techniques, May 28, 1997, at 6 [hereinafter GAEIB Report].

Cloning Animals & Human Beings specifically to address the "new ethical ground" broken by cloning, and the EU-GAEIB firmly stated that, in spite of the potential benefits that man may derive from animal cloning, such research is ethically acceptable only when "carried out with strict regard to animal welfare," when "the aims and methods are ethically justified and when it is carried out under ethical conditions."[95] Such an approach keeps the well-being of the animals in mind, ensures humane laboratory conditions and is grounded in the belief that, while scientific progress may be important, no scientist should be permitted to conduct cruel and arbitrary experiments without regard for the welfare of his or her test subjects.

B. Animal Cloning Legislation in the United States

As compared with the European Union, the United States is markedly less concerned with animal welfare or the humane treatment of animals used in scientific research.[96] While the EU Parliament has drafted at least some legislation addressing the moral and ethical implications of animal cloning, the United States remains silent with regard to animals, writing legislation to ban only cloning of humans.[97]

In any case, the power of the U.S. government, like the EU Parliament, is limited. While Congress can withhold federal funding from proposed cloning projects, it has little power to regulate scientific research, conducted by private laboratories and supported by private funding.[98] Furthermore, the U.S., like the EU, has felt the inevitability of continued free progress involving cloning technology. Federal attempts to block animal, or possibly even human, cloning projects could be challenged on constitutional grounds as a violation of the First Amendment right to freedom of inquiry.[99]

The United States House of Representatives and Senate did introduce bills addressing cloning within a week of the Dolly announcement, but those bills addressed only human cloning. The bills sought to prohibit the use of federal

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[95] GAEIB Report, *supra* note 94, at 6.

[96] *See* Ratner, *supra* note 84.

[97] *Id.*

[98] *See* Andy Coghlan, *Cloning Report Leaves Loophole*, NEW SCIENTIST, June 14, 1997, at 7.

[99] *See* Cantrell, *supra* note 86, at 77 (citing *Cloning–Challenges for Public Safety: Hearing on S. 368 Before the Subcomm. on Public Health and Safety of the Senate Comm. on Labor and Human Resources*, 105th Cong. (Mar. 12, 1997) (statement of R. Alta Charo, J.D., Associate Professor of Law and Medical Ethics, University of Wisconsin–Madison), *available in* 1997 WL 128170 (F.D.C.H.)).

funds for human cloning research and to limit the use of human somatic cells, but neither bill even mentioned cloning research involving animals. In fact, the US-NBAC report dryly concluded that "research on cloning animals . . . does not raise the issues implicated in attempting to use this technique for human cloning, and its continuation should only be subject to existing regulations regarding the humane use of animals."[100]

Unfortunately, current US legislation addressing the humane treatment of animals used in scientific research is painfully limited as well. Title Seven of the U.S. Code is the primary legislation controlling use of animals in scientific research.[101] The statute states only that such animals are to be "provided humane care and treatment," but does not qualify "humane," leaving its interpretation to the Secretary of Agriculture.[102] These limited protections afforded by Title 7 are further restricted by the narrow scope of the Congressional definition of "animal." Under U.S. legislation, the term "animal" means only:

> [A]ny live or dead dog, cat, monkey (nonhuman primate mammal), guinea pig, hamster, rabbit, or such other warm blooded animal . . . intended for, use, for research, testing, [or] experimentation . . . but such term excludes . . . livestock or poultry used or intended for use for improving animal nutrition, breeding, management, or production efficiency, or for improving the quality of food or fiber.[103]

To date, the majority of cloning research has involved livestock, such as sheep and cattle, animals that specifically fall outside the explicit definition of "animal" under Title Seven. The statute, by its express terms, affords these animals no protection from abuse or inhumane treatment. Furthermore, the provisions of the statute exempting such livestock when used for improving "breeding, management, or production efficiency" may be particularly relevant for the use of cloning technology to preserve endangered species.[104]

If anything, the terms of Title 7 seem to authorize, rather than restrict, scientific efforts to clone endangered species. However, significant policy

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[100] NATIONAL BIOETHICS ADVISORY COMMISSION, CLONING HUMAN BEINGS: REPORT AND RECOMMENDATIONS, 63-86 (1997) [hereinafter NBAC Report].

[101] 7 U.S.C. §§ 2131 et. seq. (1992).

[102] 7 U.S.C. §§ 2131-2159 (1992).

[103] 7 U.S.C. § 2132(g) (1992).

[104] *Id.*

considerations mandate legislative restriction of scientists' authority to clone animals, particularly endangered species.

VII. THE CASE AGAINST CLONING ENDANGERED SPECIES

While cloning may, at first blush, seem an attractive solution to the pending biodiversity crisis, such a strategy is not an answer, but merely a "smoke and mirrors" deception.[105] In fact, channeling efforts to preserve endangered species into whole-organism cloning programs may ultimately hamper biodiversity conservation.[106]

Whole-organism cloning may present a limited means of preserving endangered species in the short run, but it should not be viewed as a solution. In fact, given the exorbitant costs currently involved in cloning even one organism, cloning may actually detract from overall efforts to save endangered species.[107] In fact, many conservation biologists contend that cloning efforts would be so expensive that they might interrupt other, more important conservation efforts such as habitat protection, which has been recognized as the "summum bonum" of biodiversity preservation.[108]

Even if whole organism cloning is capable of restoring endangered species populations, such efforts will be futile unless significant steps are taken to preserve the habitats these animals need to survive. Many conservation biologists insist that cloning of endangered species should be used only as a "last, desperate attempt to try and preserve a given species."[109] Advocates of this more conservative, approach argue that, as cloning remains extremely expensive and technically imperfect, it should be used only in efforts to preserve species whose populations have dwindled to less than one hundred known animals since, in most instances, breeding programs are far more cost-effective than cloning.[110]

As an asexual form of reproduction, cloning merely copies existing animals, circumventing evolution and the natural recombination of maternal and paternal genotypes.[111] Ultimately, the elimination of natural selection and

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[105] *See* Blomquist, *supra* note 67, at 414.

[106] *See* Cohen, *supra* note 80.

[107] *See id.* at 1329; *see also* Blomquist, *supra* note 67, at 414.

[108] Blomquiest, *supra* note 67, at 414; *see also* Cohen, *supra* note 80, at 1330.

[109] *Id.*

[110] Cohen, *supra* note 80, at 1329-30 (stating that "In the end, the very finite resources that conservation has are better directed elsewhere."); *See also* Blomquist, *supra* note 67, at 415.

[111] EUGENE P. ODUM, ECOLOGY AND OUR ENDANGERED LIFE-SUPPORT SYSTEMS (1989). *See*

evolution undermines, to some extent, one of the primary objectives of preserving biodiversity: maintaining an active pool of diverse genes that may be studied so as to gain insight into natural developmental processes.[112] Accordingly, while cloning may achieve the limited goal of preserving the genes of a few, individual animals, it fails to promote genetic recombination and the larger goal of promoting biodiversity.

VIII. TAKING THE NEXT STEP

Various legal scholars have proposed different types of regulation to address animal cloning and its potential impact on the fight to preserve the earth's biodiversity.[113] Judge Gilbert S. Merritt of the United States Court of Appeals has recently proposed that the United States should adopt a 'wait-and-see' approach to the legal and ethical questions raised by the advent of twenty-first century technology.[114] Rather than asking legislators to preemptively ban cloning, or other uses of biotechnology, Merritt argues that such issues should initially be decided by the courts.[115] In his opinion, cases should be decided "by inductive reasoning based on the particularized facts of each case—in other words, follow the common law method of close, contextual, particularized reasoning based on trial and error."[116] Merritt contends that courts should have the opportunity to 'flesh out' the complex issues presented by biotechnol-

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also Blomquist, *supra* note 67, at 406 (citing Michael Mautner, *Will Cloning End Human Evolution?*, FUTURIST, Nov. 21, 1997, at 68 (pointing out that cloning stops natural selection and evolution: "In sexual reproduction, some of the genetic materials from each parent undergoes mutations that can lead to entirely new biological properties. Vast numbers of individual combinations become possible, and the requirements of survival—and choices of partners by the opposite sex—then gradually select which features will be passed on to the following generations.

Cloning will, in contrast, reproduce the same genetic makeup of an existing individual. There is no room for new traits to arise by mutation and no room for desirable features to compete and win by an appeal to the judgment of the opposite sex.")).

[112] *See* UNITED NATIONS, AGENDA 21: THE UNITED NATIONS PROGRAMME OF ACTION FROM RIO, United Nations Conference on Environment and Development, ¶ 15.2, at 131 (1993). *See also* Blomquist, *supra* note 67.

[113] *See* Ratner, *supra* note 84; Gilbert S. Merritt, *From the Scopes Monkey Trial to the Human Genome Project: Where is Biology Taking the Law?*, 67 U. CIN. L. REV. 365 (1999); Cantrell, *supra* note 86.

[114] Merritt, *supra* note 113, at 372.

[115] *Id.*

[116] *Id.*

ogy over a period of years, allowing laws in this area to develop slowly, without asking legislators to 'reach for a lot of abstract rules and doctrines.'[117]

There is, however, a serious flaw in Judge Merritt's proposed method of legal response to biotechnology. While his 'wait-and-see' method may be the best means of allowing the law to adapt to suit many legal issues, the common law cannot move quickly enough to adequately address the legal concerns raised by the advent of biotechnology.

In the past ten years, developments in science have proceeded at a lightning pace. Researchers are continually making new developments in cloning technology, taking the processes to new levels. In contrast, the judicial process is typically very slow and often cumbersome. If Judge Merritt's proposal were adopted, it is possible that by the time the first cloning issue reached the courts the wrong complained of would already have been replicated in dozens of similar laboratories. Furthermore, once new technology has been developed, it is nearly impossible to rewind the clock and prevent its future use. If cloning research and experimentation continues to progress unregulated, new technologies will develop and shape future experiments. Accordingly, the judicial system is not nimble enough to meet many of the legal and ethical challenges presented by the rapid advancements in cloning technology.

Judge Merritt points out that "the key ethical values for resolving these new problems must remain the combination of the values that have served us well in the past—the mix of Aristotelian principles of moderation and balance with enlightenment philosophy . . . leavened with a healthy dose of American pragmatism."[118] While these may be the appropriate considerations to keep in mind when determining how new cloning technology can best be regulated, that does not necessarily mean that courts, rather than legislatures, are the appropriate body for formulating these regulations. In fact, legislatures often have greater means for calling experts to testify on the pros and cons of such new technology, and may be better equipped to make decisions relating to the regulation of cloning technology.

IX. THE NEED FOR LEGISLATIVE REGULATION OF ANIMAL CLONING IN THE UNITED STATES

As the United States has the resources to place it at the forefront of the development of cloning technology, it is important that it enact legislation

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[117] *See id.*

[118] Merritt, *supra* note 113, at 372-73.

pertaining to the ethical treatment of animals used in cloning research and experimentation.[119] Although the United States Congress initially chose not to erect any barriers to animal cloning, there is growing popular opposition to such legislative complacency.[120] Although the United States government seems to have concluded that the advantages of cloning outweigh its dangers, the general populace could still be satisfied if Congress chose to pass laws limiting the scope of cloning, as well as providing a more complete ethical framework for research and experimentation.

The United States might benefit from adoption of cloning legislation similar to that already in place in the European Union.[121] If such a proposal were adopted, Congress would first have to amend the definition of "animal" in connection with cloning research to extend protection to livestock, as they will almost certainly remain subjects of further cloning research and experimentation. Congress should further follow the European Union model of "ethics and genetic diversity" in drafting laws to address animal cloning. While it must be remembered that Congress has little power to effectively curtail any form of scientific research, it may withhold federal funding from any cloning project not carried out in accordance with strict ethical guidelines.

In drafting new legislation, Congress must be careful to craft a workable definition of "ethical" as it relates to animal cloning projects. The EU-GAEIB report's definition of ethical as "the duty to avoid or minimize animal suffering . . . the duty of reducing, replacing and when possible refining the experimentation adopted for the use of animals in research . . . [and] human responsibility for nature and the environment, including biodiversity" might provide a starting point for any such definition.

X. CONCLUSION

The 2001 birth of the first cloned endangered species, the gaur, will likely make it extremely difficult for legislatures to ban the use of biotechnology in the struggle to preserve biodiversity. In spite of its current shortcomings, such as its expense and technical falterings, cloning holds the potential to serve as a powerful weapon in the fight against species extinction. This new technology gives rise to an unprecedented power to revive and restore species that

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[119] *See* John T. Delacourt, *The International Impact of Internet Regulation*, 38 HARV. INT'L L.J. 207 (1997).

[120] *See* Cases 60 & 61/84, Cinetheque SA v. Federation Nationale Des Cinémas Francais, 1985 E.C.R. 2605; *see generally* Ratner, *supra* note 84.

[121] Ratner, *supra* note 84, at 155.

either have vanished completely, or are rapidly dying out in the wild. Still, this new power demands increased responsibility, and it is imperative that legislatures promulgate laws to ensure that cloning technology be used humanely, and only under rare circumstances in which the animal to be cloned would disappear completely but for such scientific intervention.

Although cloning may be used to curtail extinction, it is still important that scientists and legislatures remain aware that cloning is not by itself the answer to the extinction crisis. As previously noted, the exorbitant costs and technical complications inherent in current cloning technology prevent its widespread use as a means of combating extinction. More comprehensive measures, such as habitat conservation and poaching prohibitions, must be taken to prevent species depletion.

As scientists further refine biotechnology, it might be reasonable to believe that, in the future, cloning may become a viable means of restoring lost or depleted species. Accordingly, perhaps it would be best if, rather than viewing biotechnology as an immediate solution, preservation efforts focused on habitat conservation until cloning can be perfected. Meanwhile, scientists could establish a "genetic library," storing the genetic material of currently endangered species that could later be restored through cloning technology.

It must be remembered that, even if cloning technology becomes sufficiently advanced as to provide a reasonable framework for restoring endangered species, these species can never survive if their habitats are lost. Accordingly, it is imperative that international legislatures promulgate laws that will have a meaningful impact on deforestation, pollution, and other forms of environmental degradation.

The Convention on Biodiversity, as previously noted, does seek, in general terms, to provide a framework for habitat conservation and for the protection of endangered species. But, as also noted, the convention ultimately fails to meet this end. The convention fails, in part, because it relies on internal environmental policies, as developed by individual nations, to combat the extinction crisis. These nations, armed with only their own resources, are too often incapable of implementing the affirmative measures needed to protect habitats within their own borders.

Species extinction is a global concern, and while, in theory, each nation should be responsible for promoting positive, internal environmental policies, experience has proved that this is insufficient. Perhaps, instead, international resources should be pooled and allocated to imperiled habitats on a priority basis, rather than leaving their preservation to a "luck of the draw" based on location in a wealthy versus a poor nation. If a comprehensive, global strategy were implemented, wealthy nations could be compelled to cooperate with

poorer nations to preserve habitats that are at the most risk. A successful international environmental policy, combined with the use of cloning technology to restore the earth's lost and most critically endangered species, may ultimately reverse the modern biodiversity crisis.