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Climate Engineering in Contemporary EU Environmental Law**

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Towards a Law of the Mammoth? Climate engineering in contemporary EU environmental law

Han Somsen*

I. Outline of the General Idea

In an article that made waves when it was first published in 1996, judge Easterbrook scorned the idea that the technological reality of cyberspace justified talk about or a need for ‘Cyber Law’.¹ Just as there is no need for a ‘Law of the Horse’ merely because horses give rise to legal claims, he argued, conventional legal principles and reasoning are sufficiently accommodating to absorb new legal challenges that arise in the wake of cyberspace. We may likewise doubt the need for a ‘Law of the Mammoth’, even though technologies emerge that harbour the prospect of bringing back the woolly mammoth from extinction, reversing climate change, and creating new life forms. Cyber Law is now firmly established, of course, and Easterbrook also appears to have lost the academic debate from the likes of Lawrence Lessig.² That fact notwithstanding, the onus to show that the time has come for a Law of the Mammoth clearly is on those staking the claim.

The purpose of this short article essentially is to prepare the ground for that argument, with particular but by no means exclusive reference to climate engineering. Instead of framing the question as one of a confrontation between environmental law and climate engineering, a multitude of technologies instrumental in intentionally enhancing the environment suggests that it is appropriate more generically to consider the introduction of a novel concept in environmental law that captures the essence of such efforts. In the same vein as ‘human enhancement’ has come to be distinguished from ‘medical therapy’, in view of novel environmental policy uses of technologies it is submitted that we should consider the virtues of distinguishing environmental ‘enhancement’ from environmental ‘improvement’. Whereas the mere prospect of *human* enhancement has spurred profound academic and public debate about core principles and base-lines that can serve the purpose of regulating human

* Professor of EU Law, Tilburg Law School. I wish to express my gratitude to Charlotte Somsen, for directing me towards Easterbrook’s article and for commenting on earlier versions of this paper. Any mistakes remain the exclusive responsibility of the author.

¹ Frank H. Easterbrook, *Cyberspace and the Law of the Horse*, (1996) *U. CHI. LEGAL F.* 207–16

² See L. Lessig, ‘The Law of the Horse: what cyberlaw may teach’, (1999) 113 *Harvard Law Review* 501–45.

enhancement,³ the phenomenon of *environmental* enhancement has done little more than to unleash a flood of publications regurgitating the possible environmental and health risks of practices such as genetic modification, nanotechnology and synthetic biology. In fact, the term ‘environmental enhancement’ does not feature in the vocabulary of environmental scholars or generate hits in search-engines, at least not until this essay finds its way to cyberspace. Yet, just as there is at least conceptual mileage in distinguishing human enhancement from medical therapy, there undoubtedly is value in differentiating between ‘improving the environment’ as mandated by Article 191(1) of the Treaty on the Functioning of the European Union (TFEU), and ‘enhancing the environment’, for which environmental law currently offers few principled constraints other than risk. Water purification projects aimed at improving environmental quality to levels that are supportive of animal species such as salmon that have long disappeared from many of our rivers (improvement), may be a qualitatively different intervention in the natural environment from genetically engineering salmon so as to allow them to survive rising water temperatures (environmental enhancement). Bringing back the Pyrenean ibex after its extinction in 2000 somehow feels different from doing the same for the woolly mammoth that also disappeared due to human activities, but some 6.000 years ago. Dyeing the oceans to counteract the greenhouse effect seems more radical than assisted migration of species to colder climates in aid of their survival. Cooling down the planet to pre-industrial revolution levels is an altogether different ambition than endeavouring to replicate prehistoric climates.

Somewhere along the line, if only instinctively, we feel that these are differences that ought to matter, and this is so even despite the fact that none of these examples should arouse feelings of potential catastrophic risk. Although those differences almost certainly cannot be caught in simple dichotomies or couched exclusively in legal terms,⁴ the ambition of this article indeed

³ ³ For a useful attempt to introduce a taxonomy of human enhancement see G. Cohen, ‘What (if anything) is wrong with human enhancement? What (if anything) is right with it?’ (2013) 49 *Tulsa Law Review*, 645.

⁴ For an ethical approach, see S.M. Gardiner, ‘Some Early Ethics of Geoengineering the Climate: A Commentary on the Values of the Royal Society Report’, (2011) 20 *Environmental Values* 163–88; S.M. Gardiner, “Is Arming the Future” with Geoengineering Really the Lesser Evil? Some Doubts about the Ethics of Intentionally Manipulating the Climate System, Policy Responses to Climate Change in S.M. Gardiner et al (Eds.) *Climate Ethics* (Oxford: Oxford University Press, 2010), 284 -312. For a legal approach towards adaptation see R.K. Craig, “‘Stationarity is dead ’ – Long live transformation: five principles for climate adaptation law’, (2010) 34 *Harvard Environmental Law Review*, 10-73. P.G. Harris, *World Ethics and Climate Change: From International to Global Justice* (Edinburgh: Edinburgh University Press, 2010); T. Hayward, ‘Human Rights Versus Emissions Rights: Climate Justice and the Equitable Distribution of Ecological Space’ (2007) 21 *Ethics & International Affairs*, 431-50; E. Posner and D. Weisbach, *Climate Change Justice* (Princeton: Princeton University Press, 2010); P.E. Taylor, ‘From Environmental to Ecological Human Rights: A New Dynamic in International Law?’, 10 (1997) *Geo. Int’l Envtl. L. Rev.*, 309-98.

extends not much further than to argue that (i) the environmental improvement/environmental enhancement dichotomy is productive, and (ii) the arrival of a plethora of enhancement technologies implies a need for a fundamental overhaul of environmental law, to the extent even that it calls for a Law of the Mammoth.

Paramount in that assessment must be the realization that environmental enhancement more often than not is in pursuit of agreed environmental and health goals. The important implication of that observation is that ‘risk’ in itself cannot serve as a useful divider between acceptable and unacceptable environmental enhancement policies, at least not when conventional policy alternatives pose equal or greater risks of compromising those imperatives. Recently, for example, successful large scale open field trials were conducted with genetically modified male *Aedes Aegypti* mosquitoes, offering prospects to control dengue fever in realization of the right to health.⁵ This purposeful enhancement of the living environment in pursuit of health goals undoubtedly carries (uncertain) risks, but those are understandably deemed inferior to proven health risks associated with dengue fever.

Yet, the preoccupation in the literature remains squarely with risk and risk governance and the question of principle whether enhancement initiatives such as climate engineering more fundamentally fit the paradigm informing conventional environmental law is mostly ignored. Scholarly fixation on risk is premature, however, for as long as there remains doubt whether, more fundamentally, environmental enhancement policies are compatible with the values and principles codified in the law. All things considered, it is as unfortunate as it is baffling that to this day this high-order question of principle has been allowed to remain obfuscated by the dominance of the risk paradigm.

To engage the question if environmental enhancement initiatives, including climate engineering, can be productively assessed and regulated within the confines of the prevailing logic of conventional environmental law, what we need is a deontological framework transcending risk. To this end, it is necessary to strip environmental law of its paraphernalia, including risk, until only its constitutive paradigm remains. If we engage in such an exercise, it will be shown, what emerges is a simple trilogy of state duties to ‘preserve, protect and improve’ the environment. The negative duty, first, is to refrain from compromising the integrity of environments that satisfy pre-agreed standards (duty to preserve). Second, states have positive duties to protect environments against external threats (duty to protect) and to

⁵ See the deliberate release in the Cayman Islands, Malaysia, and Brazil of genetically modified mosquitos in attempts to put an end to dengue fever without recourse to hazardous pesticides, with promising results. <http://www.theatlantic.com/health/archive/2014/09/engineering-mosquitoes-to-stop-disease/379247/>.

remedy any damage that has been allowed to materialize (duty to improve). On the basis of this three-tiered system, climate engineering may be simultaneously perceived as *prohibited* by virtue of duties to preserve and protect, or *mandated* by duties to improve. That legal muddle of course is little short of existential, which would suggest that contemporary environmental law may be unfit to respond to climate engineering. In short, it appears that humankind is embarking on an unprecedented project to enhance the planet, and beyond the highly ambiguous precautionary principle addressing ‘risk’ environmental law is at a loss as to how to respond to this reality.

Whilst I am not optimistic about the chances to prove the case for a Law of the Mammoth in this short contribution, let alone about articulating its guiding principles, at the very least it should become clear that climate engineering and other enhancement technologies should set in motion fundamental legal change.

II. Regenesiis and Current EU Environmental Law

Our analysis is legally situated within the confines of Articles 191-194 TFEU. In conjunction with international law binding the EU, these provisions articulate the outer-limits of what is currently constitutionally imaginable in terms of environmental policy.⁶ For the sake of avoiding possible misunderstandings: even as an EU law scholar I do not sufficiently lack in humility to suggest that the future of climate engineering - let alone humankind’s future on our planet - should hinge on legal interpretations of four provisions in the TFEU. Clearly, man-made legal obstacles should not stand in the way of the right thing to do, regardless of what that means in the context of climate change, and if Articles 191-194 TFEU turn out to be such obstacles then a Law of the Mammoth may have to be constructed. Nonetheless, these provisions are formal and authoritative expressions of European values regarding humans’ relationship with the environment, and for climate engineering initiatives to pass muster they must fit the mould these provisions cast.⁷

The toughest and most fundamental legal challenge of environmental enhancement appears to reside in the absence of base-lines that clarify the point in time when it must be resorted to, and to which level it must be deployed. In essence, current EU environmental law operates on the basis of a trilogy of conditional state duties ‘to preserve, protect and improve’ the

⁶ Regarding the compatibility with international environmental law, see J. Reynolds, ‘Climate Engineering Field Research: The Favorable Setting of International Environmental Law’ (2014) 5 *Washington and Lee Journal of Energy, Climate, and the Environment* 417-86.

⁷ See A. Williams, *The Ethos of Europe: Values, Law and Justice in the EU* (Cambridge: Cambridge University Press, 2010)

environment. The duties are conditional, because a specific prior act is needed for them to be triggered and operationalized. Crucially, EU environmental law hence does not operate on the basis of a single overarching ecological standstill principle, related to a specific moment fixed in the past and on the basis of which states must preserve, protect and improve the environment. Instead, the point of departure is that humans are free to manipulate the environment unless a specific prior act has established a base-line for protection. The radical consequence is that Member States are free to enhance all those aspects of the environment that are not covered by specific legal acts (e.g. the colour of the oceans and skies, cloud formations, micro-organisms etc.). It is true that in actual fact the European environment is densely regulated, and also that this corpus of EU environmental law includes horizontal measures such as, in particular, environmental impact assessment.⁸ This means that an answer to the question if and to what extent EU environmental law leaves room for environmental enhancement requires a detailed analysis of secondary EU environmental law, which is an endeavour that quite obviously cannot be undertaken in this short article. After a brief exploration of primary EU environmental law to determine the scope for environmental enhancement measures, instead we focus on Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.⁹ That Directive set up a protective regime impacting on almost every aspect of the living and non-living environment and hence appears an ideal case study for our purposes.

A. ENVIRONMENTAL ENHANCEMENT IN PRIMARY EU ENVIRONMENTAL LAW

Article 191(1) TFEU provides that EU environmental policy must contribute to: (1) preserving, protecting and improving the environment, (2) protecting human health, (3) prudent and rational utilisation of natural resources, and (4) promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.¹⁰

⁸ Dir. 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, OJ [2014] L 124/1.

⁹ Dir. 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, OJ [1992] L 206/7.

¹⁰ Article 191 TFEU provides:

1. Union policy on the environment shall contribute to pursuit of the following objectives:
 - preserving, protecting and improving the quality of the environment, (emphases added)
 - protecting human health,
 - prudent and rational utilisation of natural resources,
 - promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.
2. Union policy on the environment shall aim at a high level of protection taking into account

Whereas no hierarchy is readily discernible from Article 191(1) TFEU, there are sound legal arguments in favour of the proposition that, in common with global articulations of environmental law, the backbone of EU environmental law consists of instructions to ‘preserve, protect and improve’ the environment. In particular, both ‘energy’ (Title XI) and ‘health’ (Title XVI) constitute discrete EU policies in their own right. In view of the principle of conferral articulated in Articles 4 and 5 of the Treaty on European Union (TEU), in conjunction with the ‘centre of gravity’ approach employed by the Court of Justice of the European Union (CJEU) for determining the boundaries between policies, this means that Title XX confers powers to pursue environmental goals. To be sure, concerns about ‘health’ and ‘prudent and rational utilization of resources’ (e.g. energy) can trigger environmental policy, but environmental policy cannot be used as a disguise for health or energy policies. To do so would upset the institutional balance pertaining to those policies, and would undoubtedly lead the CJEU to invalidate such measures.¹¹

This conclusion is significant for our purposes, as it means that enhancement measures primarily targeting human health, as is the case with the genetically engineered *Aedes Aegypti* mosquitoes, cannot be based on Article 192 TFEU as a matter of environmental policy. For that purpose Article 168(5) TFEU specifically exists, which in all likelihood leads to the conclusion that the EU possesses no such powers.¹²

the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.

In this context, harmonisation measures answering environmental protection requirements shall include, where appropriate, a safeguard clause allowing Member States to take provisional measures, for non-economic environmental reasons, subject to a procedure of inspection by the Union.

3. In preparing its policy on the environment, the Union shall take account of:

- available scientific and technical data,
- environmental conditions in the various regions of the Union,
- the potential benefits and costs of action or lack of action,
- the economic and social development of the Union as a whole and the balanced development of its regions.

4. Within their respective spheres of competence, the Union and the Member States shall cooperate with third countries and with the competent international organisations. The arrangements for Union cooperation may be the subject of agreements between the Union and the third parties concerned.

The previous subparagraph shall be without prejudice to Member States' competence to negotiate in international bodies and to conclude international agreements.

¹¹ Most recently, the centre of gravity test was applied in Case C-81/13 *United Kingdom v Council* (judgment of 18 Dec. 2014, not yet reported). The Court repeated that ‘[a]ccording to settled case-law, the choice of the legal basis for a European Union measure must rest on objective factors amenable to judicial review, which include in particular the aim and content of the measure.’ (Para. 35).

¹² Article 168(5) TFEU provides:

The European Parliament and the Council, acting in accordance with the ordinary legislative procedure and after consulting the Economic and Social Committee and the Committee of the Regions, may also adopt incentive measures designed to protect and improve human health and in particular to combat the major cross-border health scourges, measures concerning monitoring, early warning of and combating serious cross-border threats to

One might argue that climate engineering, likewise, amounts to health policy rather than environmental policy, which hence also cannot be pursued as a matter of EU environmental policy. Fact of the matter is that Article 191(1) TFEU explicitly mentions climate change, and that EU climate policy thus far has often been based on the predecessor of Article 191 TFEU, Article 175 EU.¹³ The well-established centre of gravity principle therefore does not rule out climate engineering as a matter of EU environmental law. Since it is uncontroversial to regard climate engineering as part of climate policy in the same way as current mitigation and adaptation policies are, we can conclude that climate engineering techniques that satisfy the conditions set forth in Articles 191-194 TFEU are legally acceptable manifestations of EU environmental policy. Significantly of course, the same conclusion applies to any other environmental enhancement initiative that falls within the ambit of EU environmental law, such as genetically modified salmon and the regenesi s of mammoths. This means that we can now turn to a more substantive analysis of the potential for environmental enhancement in regulated spaces, for which we turn to Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.¹⁴

B. ENVIRONMENTAL ENHANCEMENT IN REGULATED SPHERES: THE EXAMPLE OF THE HABITAT DIRECTIVE

As observed, the single most important instruction flowing from EU environmental law is that the EU and its Member States have assumed duties ‘to preserve, improve and protect’ the environment. Yet and surprisingly, EU environmental law scholarship thus far has attached little or no significance to the difference between ‘preservation’ ‘protection’ and ‘improvement’.¹⁵ In the age of environmental enhancement this may turn out to amount to a serious oversight. The fundamental importance of this trilogy for environmental enhancement initiatives can be usefully illustrated by a cursory analysis of Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.¹⁶

The general purpose of the Directive, according to Article 2, is ‘to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of

health, and measures which have as their direct objective the protection of public health regarding tobacco and the abuse of alcohol, excluding any harmonisation of the laws and regulations of the Member States.

¹³ See for example Dir 2009/29/EC amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community, [2009] OJ L 240/63.

¹⁴ N. 9 above

¹⁵ The most detailed analysis is probably still by L. Kramer, *EC Treaty and Environmental Law* (London: Sweet & Maxwell, 1998).

¹⁶ N. 9 above.

Community interest.’ The duties to preserve and protect (in the language of the Directive reduced to the single concept of ‘to maintain’), as always, are conditional. What is needed to trigger the duties is an act that designates a specific Special Area of Conservation (SAC), which at the same time determines the substantive and temporal scope of those duties.¹⁷ Notwithstanding the fact that the CJEU and Commission have attempted to curtail the discretion to designate, it is this discretionary act from which duties flow.¹⁸

Article 6 of the Directive articulates the three levels of duties that are triggered by the designation of a SAC. In tandem with a general obligation of surveillance,¹⁹ the first paragraph engages the duty to preserve, by obliging Member States to establish the necessary conservation measures and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat type. Environmental enhancement, i.e. an intentional technological intervention in the SAC in pursuit of human interests, needs or rights that transcend agreed environmental base-lines at first sight would appear to have no role to play in the context of Article 6(1), and in fact would seem to amount to a breach of the duty to preserve. However, that conclusion may be premature in light of the way in which the Directive constructs the duty ‘to protect’.

The duty to protect a SAC is generically worded in Article 6(2), and implores Member States proactively to take appropriate steps to avoid the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, *in so far as such disturbance could be significant in relation to the objectives of this Directive* (emphasis by the author). This general obligation is further specified, *inter alia*, in Article 12 for the animal species listed in Annex IV(a), in Article 13 for plant species featuring on Annex IV(b), and in Article 14 for animal and plant species appearing in Annex V. Room for environmental enhancement appears to exist, at least to the extent this causes no disturbance which is ‘significant’ in relation to the objectives of the Directive. Hence, if animals featuring on Annex IV(a) are not affected by the colour of the ocean, then dyeing the ocean white is not *prima facie* incompatible with the Directive. Moreover and significantly, Article 16 contains a broadly worded derogation which allows Member States to derogate from Articles 12-15. This they can do in so far it is not detrimental to the maintenance of the populations of the species concerned at a favourable conservation status in their natural range:

¹⁷ See Art. 4 Dir. 92/43/EEC, *ibid*.

¹⁸ See Commission Note on the Designation of Special Areas of Conservation (SACs) Final Version of 14 May 2012, published on the internet at http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/commission_note.pdf.

¹⁹ Art. 11 Dir. 92/43/EEC, n. 9 above.

- (a) in the interest of protecting wild fauna and flora and conserving natural habitats;
- (b) to prevent serious damage, in particular to crops, livestock, forests, fisheries and water and other types of property;
- (c) in the interests of public health and public safety, or for other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment;
- (d) for the purpose of research and education, of repopulating and re-introducing these species and for the breedings operations necessary for these purposes, including the artificial propagation of plants;
- (e) to allow, under strictly supervised conditions, on a selective basis and to a limited extent, the taking or keeping of certain specimens of the species listed in Annex IV in limited numbers specified by the competent national authorities.

Surprisingly and counter-intuitively, even within the confines of duties to protect a SAC, environmental enhancement appears permitted as long as it is in support of the wide-ranging and broadly worded imperatives listed in Article 16. Moreover, the precautionary principle in Article 191(2) empowers the EU to take proactive action even before causal linkages between (private) activities and threats of environmental harm can be established beyond scientific doubt. Precaution in that sense blurs the divide between the duty to preserve and the duty to protect, and serves to migrate enhancement measures to the realm of preservation.

A duty ‘to improve’ a SAC, finally, arises if damage to the area has occurred because derogations to duties have to preserve and protect have been granted for imperative reasons of overriding public interest. In this vein Article 6(4) of the Habitats Directive provides:

If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, *the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected*. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. (author’s emphasis)

As with the duty to protect, there is a possible role for environmental enhancement, as long as those measures are to ensure the overall coherence of Natura 2000, are mandated by human health or public safety, have beneficial consequences of primary importance for the environment, or answer imperative reasons of overriding public interest. Climate engineering, for example, could rather easily be justified on any the basis of most of these counts.

Important for the future of the mammoth, finally, is Article 22 which concerns the deliberate re-introduction or introduction of species. Article 22(b) provides that Member States must ensure that the deliberate introduction into the wild of any species which is not native to their territory is regulated so as not to prejudice natural habitats within their natural range or the wild native fauna and flora and, if they consider it necessary, prohibit such introduction. As a matter of principle, there is nothing that stands in the way of reintroducing the mammoth or other genetically enhanced species, provided these species comply with relevant secondary EU law, such as Directive 2001/18/EC on the Deliberate Release on Genetically Modified Organisms,²⁰ and do not prejudice natural habitats within their natural range or the wild native fauna and flora.

The sympathetic stance of EU nature conservation law vis-à-vis environmental enhancement applies *a fortiori* to anthropocentric environmental law such as Directive 98/83/EC on the Quality of Water Intended for Human Consumption.²¹ Thus, Member States must ensure that ‘the measures taken to implement the Directive in no circumstances have the effect of allowing, directly or indirectly, either any deterioration of the present quality of water intended for human consumption so far as that is relevant for the protection of human health or any increase in the pollution of waters used for the production of drinking water’ (duty to preserve).²² They must take all measures necessary to ensure that the water available to consumers meets the requirements of the Directive (duty to protect),²³ and must take remedial action soon as possible to restore its quality if it no longer satisfies those requirements (duty to improve).²⁴ Environmental enhancement, in all likelihood, is permitted in so far as it does not impinge on the primary purpose of the Directive, which is to secure a minimum quality of water intended for human consumption.

²⁰[2001] OJ No. L 106/1.

²¹ [1998] OJ No. L 330/32.

²² Ibid., Art. 4(2).

²³ Ibid., Art. 7(1).

²⁴ Ibid., Art. 8(2).

In summary, we tentatively conclude that even eco-centric EU environmental law as epitomized by Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora leaves ample room for environmental enhancement. This, for those who cherish what Michael Sandel has termed ‘respect for the given’,²⁵ will come as an unpleasant surprise.

Some might retort that, if there is anything we should learn from the notion of the Anthropocene it is surely that humankind has been engineering the environment from the moment it laid hands on technologies.²⁶ Whilst this is true, the crucial point is that those anthropogenic impacts have been predominantly collateral, unplanned and deleterious, and it is in that respect that climate engineering is so fundamentally and crucially different. Recent examples of environmental engineering involve (a) *intentional* efforts (b) *directly* to engineer the living or non-living environment (c) in pursuit *human* ambitions, needs or rights and, crucially as a separator from conventional environmental improvement, (d) *divorced* from any benchmark or standard derived from the past.

To illustrate the difference between conventional environmental law and environmental enhancement, imagine the excavation of the remains of a Shakespearean theatre built around 1600 to premier Shakespeare’s plays. The theatre is a jumble of numerous (often ill-conceived) modifications made over the decades, reflecting different uses and architectural styles.. A post of curator is advertised, and two candidates are invited to present their vision.

Mrs Green proposes that a law be adopted that grants her powers to preserve the site by protecting it against souvenir hunters and as far as possible against climatological impacts, and instigate whatever restoration projects are necessary to repair damage occurred since the excavation. Any intentional change to the ruin, she insists, amounts to an act of state sponsored cultural vandalism. Mrs Red argues that the time has come and that technologies are available to set in motion a cultural renaissance. Her proposal envisages a new multi-storey virtual reality experience at the location where the ruins have been found, and in which visitors can actually feel, smell and hear what it was like to participate in a Shakespearean play in different periods. Mrs Red finishes her presentation imploring that preserving the ruins of an ancient architecturally compromised temple of cultural life will not turn the tide of

²⁵ See M. Sandel, *The Case Against Perfection*, (Cambridge (MA), Harvard University Press: 2009). But see the response by G. Kahane ‘Designing Children and Respect for the Given’, Proceedings of the 2012 Uehiro-Carnegie-Oxford Ethics Conference published on the Internet at http://www.practicaethics.ox.ac.uk/__data/assets/pdf_file/0006/29733/Kahane.pdf. See also G. Kahane: ‘Mastery without mystery: Why there is no Promethean sin in enhancement’, (2011) 28 *Journal of Applied Philosophy* 355–68.

²⁶ L. Lewis and M. Maslin, ‘Defining the Anthropocene’ (2015) 519 *Nature* 171..

unprecedented cultural nihilism and consumerism that has turned creative critical minds into shallow obedient zombies.

Mrs Green's vision is consistent with a conventional 'preserve, protect, improve' paradigm. Mrs Red, whilst guided by the same cultural imperatives as Mrs Green, does not accept the constraints imposed by the ruin, and proposes a technology-driven experience that generates greater benefit, and by implication accepts that the integrity of the ruin, which in any event has been violated by successive 'improvements', is not of primary importance.

In order to instil further structure in our thinking about the fit of visions such as those of Mrs Red with the prevailing 'preserve, protect, improve' paradigm, it is helpful to consider the fate of a particular European species of wild goat.

C. THE RETURN OF THE PYRENEAN IBEX: THE FUZZY DIVIDE BETWEEN 'IMPROVEMENT' AND 'ENHANCEMENT'

In 2009, a team of Spanish scientists used reproductive cloning techniques in efforts to bring back the Pyrenean ibex, a species of mountain goat that became extinct in 2000. This involved inserting the cell nuclei of the ibex's skin cells into egg cells of domestic goats which had their own cell nuclei removed, resulting in seven pregnancies. Although due to lung deformities the only clone carried to term died seven minutes after birth, the event remains monumental. As illustrated by figure 1, the significance of the story of the Pyrenean ibex resides in the fact that it marks a new phase in environmental policy in which technology-driven remedial (regeneration) policies are triggered once preventive (nature conservation laws) have failed.²⁷

Table 1: Regeneration of animal species under conventional environmental law

| Duty to Preserve → | Duty to Protect → | Duty to Improve |
|--|---------------------------------------|--|
| Designate SAC, list Pyrenean Ibex as protected | Protect SAC and Pyrenean Ibex threats | Reintroduce species, assist migration, <i>de-extinction of Pyrenean Ibex</i> |

²⁷ See 'Cloned goat dies after attempt to bring species back from extinction' *The Independent* 2 Feb. 2009. Available on the internet at <http://www.independent.co.uk/news/science/cloned-goat-dies-after-attempt-to-bring-species-back-from-extinction-1522974.html> (last visited 24 Feb. 2015). Attempts to bring back the Pyrenean ibex from extinction are ongoing.

Although the suggestion that states may find themselves under a duty to bring back species from extinction using cloning techniques is bound to raise eyebrows, table 1 suggests that de-extinction policies still fit the conventional ‘preserve protect improve’, trilogy as long as they are in support of and ancillary to specific pre-agreed standards articulated in conventional environmental law. Indeed, our brief analysis of Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, and in particular Article, 22 did not reveal a *prima facie* inconsistency with such a claim. This is not to downplay the fundamental temporal and substantive questions that arise. Temporal questions emerge, for example, because regeneration need not be confined to species that have become extinct during the recent era of conservation laws. Efforts to bring back the woolly mammoth thousands of years after its demise and which have produced first significant results prove that point.²⁸ Should we distinguish between the Pyrenean ibex (a species that featured on Annex IV(a) of Directive 92/43/EEC), the passenger pigeon (extinct prior to adoption of the Directive in 1914), and the woolly mammoth?²⁹ As for the scope of the duties, presuming we possess the technological capabilities, does de-extinction imply corollary duties to re-engineer habitats and climates in support of the survival of such species?

Climate policy likewise is at the brink of an era in which climate adaptation initiatives address shortcomings of climate mitigation policies, and climate engineering initiatives compensate for the limits of climate adaptation.

Table 2: Regeneration of the climate under conventional environmental law

| Duty to Preserve → | Duty to Protect → | Duty to Improve → |
|---------------------------|--------------------------|--|
| Climate Mitigation | Climate Adaptation | Climate Engineering in support of agreed |

²⁸ See ‘The Mammoth Cometh’, *The New York Times* 24 Feb. 2014. Available on the internet at http://www.nytimes.com/2014/03/02/magazine/the-mammoth-cometh.html?_r=0 (last visited 24 Feb. 2015). On candidates for de-extinction see <http://longnow.org/revive/> (last visited 24 Feb 2015).

²⁹ Article 22 of Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (see n. 8 above) answers that question as follows:

In implementing the provisions of this Directive, Member States shall:

‘(a) study the desirability of re-introducing species in Annex IV that are native to their territory where this might contribute to their conservation, provided that an investigation, also taking into account experience in other Member States or elsewhere, has established that such re-introduction contributes effectively to re-establishing these species at a favourable conservation status and that it takes place only after proper consultation of the public concerned;

(b) ensure that the deliberate introduction into the wild of any species which is not native to their territory is regulated so as not to prejudice natural habitats within their natural range or the wild native fauna and flora and, if they consider it necessary, prohibit such introduction. The results of the assessment undertaken shall be forwarded to the committee for information

(...).’

| | | |
|--|--|-------------------------------|
| | | temperature reduction targets |
|--|--|-------------------------------|

Unlike duties to improve the environment (e.g. climate adaptation), the temporal and substantive scope of which can be determined with reference to whatever it is that states have committed themselves to preserve and protect, the question at what point and to what end climate engineering must or may be deployed is harder to answer. Tentatively and inspired by the return of the Pyrenean ibex, however, we might suggest that climate engineering deployed to realize agreed temperature reduction targets in support of (ineffective) mitigation and adaption measures is consistent with duties to improve.

Hard and troubling as these questions are, however, some may still concur with judge Easterbrook that they are still not so fundamentally different from similar questions that have begun to trouble the minds of nature conservation scholars as to call for a Law of the Mammoth.³⁰ However, as the ubiquitous practice of agricultural biotechnology shows, our efforts to engineer the environment are not constrained by the traits that evolution has bestowed on present or even past animal and plant life. In terms of technological prowess, almost literally, the sky is the limit. And it is not just the living environment that has become the target of human ambitions fundamentally to redesign the environment, climate engineering proving that point. Astounding examples of such enhancement ambitions can be derived from the past. In fact, we must go back more than 2.5 billion years to find a natural event that has changed the global nitrogen cycle as fundamentally as the Haber-Bosch process, through which atmospheric nitrogen is converted into ammonia on a massive scale for the production of agricultural fertilizer. Patented by Fritz Haber in 1908 and earning him the Nobel Prize in Chemistry, nitrogen fixation has changed the planet for ever.³¹

The preceding analysis suggests that current EU environmental law is positively inclined towards these ambitions to alter the living and non-living environment. The example of the Habitat Directive shows that this is so even if those ambitions go beyond preserving, protecting and improving environments relative to pre-agreed base-lines derived from the environmental status quo or status quo ante. A crucial follow-up question is whether Member States may have *duties* not just to preserve, protect and improve the environment but at some point may be mandated to ‘enhance’ the environment in those cases when mere

³⁰ On the problem of hybrids on nature conservation law, for example, see A. Trouwborst, ‘Exploring the Legal Status of Wolf-Dog Hybrids and Other Dubious Animals: International and EU Law and the Wildlife Conservation Problem of Hybridization with Domestic and Alien Species’, in: (2014) 23 *Review of European, Comparative & International Environmental Law*, 111-24.

³¹ See J.W. Erisman *et al.*, ‘How a Century of Ammonia Synthesis Changed The World’, (2008) 1 *Nature Geoscience* 636-39.

‘improvement’ will no longer do. Although that question cannot be fully discussed here, if such a duty were to exist or to arise, it is submitted, a Law of Mammoth would be called for along the lines depicted by Table 3.

Table 3: Genesis of the living and non-living environment and the Law of the Mammoth

| Duty to Preserve → | Duty to Protect → | Duty to Improve → | Duty to Enhance |
|---------------------------|--------------------------|--|---|
| Climate mitigation | Climate adaptation | Climate engineering in support of pre- agreed temperature reduction targets | Climate engineering outside the realm of pre-agreed targets |

It is proper at this point to introduce the forceful ‘planetary boundaries’ discourse, which appears to contain seeds of answers to that critical question.³² Intimately related to the notion of the Anthropocene and embraced by the United Nations High-Level Panel on Global Sustainability, the Planetary Boundaries Hypothesis posits that there are nine critical, global biophysical thresholds to human development, and further claims that crossing these boundaries has catastrophic consequences for human welfare.³³ Some of these boundaries arguably already have been transgressed: the amount of CO₂ in the air is higher than in the past 2.5 million years and a new record of 400 ppm of CO₂ - triggering a glut of media attention - was recorded in 2014.³⁴ Morally and politically, it is not hard to argue the case that states are duty-bound pro-actively to steer clear of such critical thresholds that threaten human survival, if necessary by deploying environmental enhancement technologies. There is little room for arguing the logic that, when broadly conceived risks of unintentional climate change significantly exceed those of intentional climate change, the right thing to do is to turn to engineering the climate intentionally. A priori preferences for the status quo (i.e. unintentional and ill-considered anthropogenic environmental change) over risks from intentional and considered change indeed are irrational, but consistent with what psychologists and economists have taught us about biases favouring the status quo over change.³⁵ It appears that whilst we have resigned ourselves to the inevitability of unintentional unplanned human

³² J. Rockström *et al.*, ‘A Safe Operating Space for Humanity,’ *Nature* 461, no. 24 (Sept. 24, 2009).

³³ These are land-use change, biodiversity loss, nitrogen and phosphorous levels, freshwater use, ocean acidification, climate change, ozone depletion, aerosol loading, and chemical pollution.

³⁴ Up to date information is available on the Internet at <http://www.esrl.noaa.gov/gmd/ccgg/trends/>. In February 2014 the level stood at 400.26.

³⁵ See, for example, D. Kahnemann and A. Tversky, ‘Prospect Theory: An Analysis of Decision under Risk’, (1979) 47 *Econometria* 263-92.

interventions in complex earth systems notwithstanding risks, the prospect of wilfully assuming the immense responsibilities that come with intentional and considered interventions in such earth systems simply is too daunting to bear.³⁶ However, we may not be in a position to avoid cutting the Gordian knot much longer. Either we address potentially catastrophic risks of anthropogenic climate change engineered intentionally, or finally seriously engage similar risks of continued reliance on international mitigation and adaptation regimes that have allowed the consequences of unintentionally engineered anthropogenic climate change to become uncomfortably close to catastrophic.³⁷ Unless we find some categorical imperative instructing that risks of oblivion due to intentional climate engineering *ipso facto* outweigh those resulting from unintentional climate change, regulators hence might be duty-bound to decide in favour of pursuing intentional change by means of a well-considered climate engineering policy.

At present, the multitude of risks (environmental, moral, health, geo-political etc.) of different forms of climate engineering remains highly uncertain, of course, and the scientific basis to make that dramatic call therefore for the time being is grossly insufficient. Nor, for that matter, are risks of climate change resulting from business as usual scenarios (i.e. continued efforts to curb unintentional climate change through ‘radical’ cuts in greenhouse gas emissions coupled to adaptation measures) all that much better understood. Addressing those uncertainties, then, is a necessary if insufficient step on the road to informed policies aimed at steering humankind clear of climate disaster. This calls for multi-disciplinary research answering the highest standards of scientific and academic excellence, which may then pave the way for well-conceived public debates and, finally, a political decision-making process enjoying both input and output legitimacy.³⁸ As recent experience with (ultra-) hazardous technologies shows, that road is a treacherous and long one, demanding a combination of

³⁶ The term ‘ecological anxiety disorder’ has been coined to denote the state of paralysis that has ensued among conservation biologists, restoration ecologists and the like, because of the rapid loss of ‘environmental baselines, grounded and normal conditions from which to make objective assessments for advocating interventions in the world.’ See P. Robbins and S.A. Moore, ‘Ecological Anxiety Disorder: Diagnosing the Politics of the Anthropocene’, (2013) 20 *Cultural Geographies*, 3-19.

³⁷ For qualitative challenges of ‘climate law’ and more generally ‘adaptation law’ see J.B. Ruhl and J. Salzman ‘Climate Change Meets the Law of the Horse’ (2013) 62 *Duke Law Review* p. 975 et seq. See also J.D. Graham and J.B. Wiener, *Risk vs. Risk Tradeoffs in Protecting Health and the Environment* (Cambridge: Harvard University Press, 1997).

³⁸ Input legitimacy is derived from participation by citizens and measured by the degree of responsiveness to their concerns. Output legitimacy is judged on the basis of the effectiveness of policies in furthering the interests of citizens. Throughput legitimacy refers to the efficacy, transparency and openness of the EU’s governance process as such. See V.A. Schmidt, ‘Democracy and Legitimacy in the European Union Revisited: Input, Output and ‘Throughput’’, (2013) 61 *Political Studies* 2-22. See also S. Borrás, C. Koutalakis and F. Wendler, ‘European Agencies and Input Legitimacy EFSA, EMeA and EPO in the Post-Delegation Phase’ (2007) 29 *Journal of European Integration* 583-600.

massive investment of resources, political leadership and perseverance in the face of inevitable setbacks.

III. Concluding remarks: the case for a Law of the Mammoth

Climate engineering is a radical technological response to anthropogenic climate change and will most probably be resorted to only when it is near certain that current mitigation and adaptation policies cannot avert climate catastrophe. Should that point arrive, it is not altogether implausible to expect that states will be duty-bound to deploy climate engineering techniques, for example in order to fulfil the socio-economic right to health and environment. Climate engineering is radical especially in terms of the nature and scale of the risks involved, its institutional and global governance implications, and a host of other legal, ethical and policy concerns arising from the absence of agreed benchmarks as to what constitutes a desirable re-engineered climate.

The central question this article asked is whether conventional EU environmental law is fit to take on the challenges that arise from the large-scale deployment of a host of enhancement technologies. To equate that question with ‘risk’ is to dodge the issue of principle, and moreover fails to acknowledge the message implied in the Planetary Boundaries Hypothesis that conventional less effective policy responses carry equal or greater risk. We have therefore attempted to uncover the central tenet of conventional EU environmental law, which we argued is to preserve, protect and improve the environment. De-extinction projects, which may be viewed as an equivalent of what climate engineering endeavours to achieve for the non-living environment, give rise to difficult and new questions of a temporal and substantive nature (should we bring back the woolly mammoth or confine our efforts to species that are victims of unsuccessful conservation policies, and should we engineer a habitat that supports mammoths?). They also serve to illustrate the fluidity of the divide between ‘improvement’ and ‘enhancement’. We have tentatively suggested that technological interventions in the environment that aim to attain pre-agreed targets can be argued to be ramifications of the duty to improve the environment. This indeed is a big claim that perhaps needs further corroboration, as it means that the Pyrenean ibex must be cloned because it featured on Annex IV(a) of the Habitat Directive, and climate engineering must be deployed (again taking risk out of the equation) to realize agreed temperature reductions.

Environmental enhancement, then, is an intentional technological intervention in the environment in pursuit of human interests, needs or rights which takes place outside the confines of such pre-agreed environmental base-lines. The return of the mammoth is an example of environmental enhancement, as is climate engineering deployed to recreate climates that are colder than what has been internationally agreed as a target, the genetic manipulation of the *Aedes Aegypti* mosquito also enhances the environment, etc.

Can EU environmental law cope with environmental enhancement? It is suggested that the answer is in the negative. Crucially, EU environmental law does not include a general ecological standstill principle, but base-lines must be purposefully established by legal or administrative acts that assign environments a particular status. For example, SACs must be designated, binding ambient or aquatic quality objectives articulated, limit values for point-source emissions fixed, etc. With only very few exceptions, the protection of environments or the control of substances and industrial processes hinges on such prior constitutive acts.³⁹

Cloud formations have become famous by the Dutch masters of the Golden Age and are much loved today, but there is nothing that protects them until an act has been adopted establishing that cloud formations are worthy of protection. Similarly, *Aedes Aegypti* mosquito is outlawed until the day that it is explicitly protected. If dyeing the oceans white to combat climate change sounds like a good idea, then the good news is that colouring the ocean is permitted until it is prohibited.

In those instances where base-lines have been established, moreover, they dictate that environments must not deteriorate relative to that base-line (duties to preserve and protect) but do not rule out that states decide to enhance the environment provided that isolated legal ‘no go-areas’ are respected (in the context of the Habitat Directive Article 22 would not appear to rule out the return of the woolly mammoth). In short, and remembering that we have intentionally left risk out of the equation, environmental enhancement essentially is permitted unless it is prohibited.

Even though EU environmental law is of relatively recent origin (the first environmental action program dates from 1973), the drafters of course could never have fathomed that, within their lifetimes, we would be seriously discussing enhancing the climate and every single aspect of the living environment. For that reason alone there is ample reason urgently

³⁹ The REACH regulation implements an important innovation in this respect. Reversing preceding chemicals legislation, it stipulates that unless producers of chemicals can show a substance to be safe the substance cannot be marketed. See F.M. Fleurke and H. Somsen, ‘Precautionary Regulation of Chemical Risk: How REACH Confronts the Regulatory Challenges of Scale, Uncertainty, Complexity and Innovation, (2011) 48 *Common Market Law Review*, 357-93.

to consider the outlines of a Law of the Mammoth that reflects this new reality. A blank prohibition on environmental enhancement is most probably unrealistic, as the example of the *Aedes Aegypti* mosquito illustrates. Nor is it necessarily desirable, given the dire situation humankind has engineered itself into. At present however, due to the absence of a generic ecological standstill principle, EU environmental law effectively operates on a 'yes unless' basis. With hindsight that paradigm perhaps has never had much going for it, with foresight it seems crucial to instigate a fundamental overhaul of environmental law in ways that afford protection to the many different values intrinsic in the environment, regardless whether they have been explicated in legal acts acknowledging those values.