Not by Human Hands:
Five Technological Tenets for Environmental History in the Anthropocene

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Since Paul Crutzen and Eugene Stoermer proposed the concept of the Anthropocene in 2000, five years after the founding of the journal *Environment and History*, there has been increasing general public acceptance that humans have radically altered the Earth even down to the geological level.[1] These modifications may be at the hands of humans, but they are not because of human hands—they are the result of human technologies. If humans used only their hands, they would have no more effect upon the surface of the planet than any other animal with its paws or hooves. Instead, humans deploy technologies, from dirt paths to superhighways, from fire pits to coal-fired power generation stations, from abacuses to computers. To be human is to employ technologies, including physical objects as well as the processes of design, production, maintenance, and knowledge that go into their making.[2] It is technology that has made humans into a force of nature.

Environmental historians increasingly recognize the value of history of technology to explain many of the environmental changes humans cause.[3] Scholars working on urban environments have realized that it is impossible to separate water use, industrial pollution, and garbage disposal from the technologies that make them possible.[4] Those exploring the environmental histories of National Parks and outdoor recreation have recognized that the automobiles used to get there and the roads leading to and through these places are integral to their histories.[5] Others have considered that extensive technological modification to waterways and floodplains is intertwined with political and social histories.[6]

The potential and range of the integration of environmental and technological history is on display in the co-edited volume *Illusory Boundary: Technology and the Environment*.[7] The volume was the first cooperative outcome of the scholarly encounters of a group of likeminded historians working at the junction of environment and technology who came together in 2000 to form a

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[1] Crutzen and Stoermer 2000.
[2] Williams 2010. I recognize that some non-human animals also employ tools and shape environments through practices such as building beaver dams, but the scope and scale of human technology deployment far exceeds them.
[3] Although much of this attention has come in the last 20 years, it is worth noting that there is a long history of exploring the intersection of environment and technology. See Stine and Tarr 1998 for an overview of these early gestures toward historical envirotech scholarship.
[4] Melosi 1999, Tarr 1996, Porter 1998, Schott et al 2005.
[5] Sutter 2002, Zeller 2007.
[6] Colton 2006, Pritchard 2011, Biggs 2012.
[7] Reuss and Cutcliffe 2010.

special interest group within the Society for the History of Technology (SHOT) called Envirotech. The group soon began gathering at the American Society for Environmental History (ASEH) annual meeting in addition to SHOT, widening participation from those scholars who self-identified as historians of technology to those who considered themselves environmental historians.

One strain of scholarship at the environment-technology junction has turned to Science and Technology Studies (STS) for insight and inspiration. STS is a multidisciplinary, sprawling field including sociologists, philosophers, historians, and others. The goal of most STS work is to open up the black box of science and technology and show the processes which go into its making. Historians working in STS have aligned with the strong sociological tradition of developing methods, models, and approaches that can be applied to any case study. While some historians find such approaches constraining, the exploration of science and technology as constructed phenomena has resonated with some environmental historians keen to expose the environment as a human construction as well. Scholarship applying ideas developed with the framework of STS, including Actor Network Theory, mediation, scripting, enactment, boundary objects, and infrastructural work, among others, to environmental histories has begun to reveal the usefulness of seeing the whole constellation of science, technology, and environment as simultaneously human-made.[8]

STS methods encourage seeing nonhuman actors—both technological artifacts and other living beings—as vital in the histories we tell. Animal and plant life does not always behave as humans want—they have their own drivers for action—so including them in networks of power can reveal the limitations of human plans.[9] At the same time, animals and plants are affected by the technologies deployed in the network, and so telling histories of nonhuman living organisms requires bringing human technology into the story.[10] At the junction of environment and technology history, I propose five tenets about human interaction with nonhuman living beings, particularly animals, that should be adopted as central elements of environmental history.

I. Animals and plants are themselves technologies.

Humans have deliberately modified living beings to serve particular purposes for thousands of years. We are a direct evolutionary force.[11] As Charles Darwin recognized when discussing natural selection in *On the Origin of Species*, domestication involves artificial selection by selective breeding, encouraging particular traits and discouraging others in order to meet human needs.[12] Work animals such as horses and oxen are probably the easiest to recognize as

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[8] See for example the essays in Jørgensen, Jørgensen & Pritchard 2013; Nega 2008; and Carse 2012.

[9] Callon 1986

[10] Schrepfer and Scranton 2004, Russell 2011.

[11] As Russell 2011 argues, humans are more than just evolutionary agents; instead, humans and nonhumans coevolve. Humans adapt social, cultural and economic practices in response to nonhuman evolution.

[12] Darwin 1859. See Ruse 1975 for a discussion of Darwin's intellectual debt to writings by domestic animal breeders.

technologies since they often power technological systems.[13] Yet as the essays in *Industrializing Organisms* reveal, animals are engineered to fit into industrial systems, from turbo-cows to the chicken of tomorrow.[14] Plants that are raw ingredients of industrial products are tested, manipulated, and refined as technological creations; commercial, political, and even military interests depend on the success of technological improvement.[15] The discovery and subsequent harnessing of biotechnology can have profound landscape-scale effects, such as widespread agricultural clearance. Just as harnessing nature in the guise of dams or energy sources has been commonplace in environmental history, harnessing living technologies should be as well.

As we commemorate the centenary of the beginning of World War I, looking at the technological animals engaged in combat provides one opportunity for environmental historians to analyze typically political or military histories from a new angle. Pigeons, for example, became a central cog in the communication and surveillance networks of the trenches.[16] Thousands upon thousands of birds became messengers during the war for both sides. In the line of duty, they faced dangers both inanimate (gunfire) and animate (trained hawks). Environmental historians could use these birds embedded in technological systems to explore not only human conflict but the direct enrollment of other living creatures in our conflicts.

II. Technologies provide means of controlling other living beings.

People wielding technologies have long been acknowledged to wield power over people,[17] but technologies can also change power relations with nonhumans. Humans deploy technologies to monitor, track, capture, and kill animals. Radio collars have been integrated into modern wildlife management; meanwhile, birds are captured, tagged, and recaptured repeatedly to track their migrations.[18] Often these technologies are deployed in the name of conservation, but not all control is benign. Pests loom large as subjects of controlling technologies in the name of human needs or desires.[19]

Invasive species, and how to deal with them, has become a ubiquitous topic in the ecological sciences. Attempts to eradicate species deemed harmful by scientists, politicians and/or local communities employ technologies of all sorts to aid in the hunt. Raccoon dogs in Sweden are a case in point. The animal had been brought to Russia for fur farming in the early 20th century and subsequently was released into the wild. It has reproduced and spread into

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[13] McShane and Tarr 2007; Greene 2004.
[14] Schrepfer and Scranton 2004.
[15] Finlay 2009.
[16] http://www.telegraph.co.uk/history/world-war-one/10566025/Honoured-the-WW1-pigeons-who-earned-their-wings.html. The Royal Pigeon Racing Association had an exhibit about war birds at its 2014 annual conference: http://www.rpra.org/pigeon-history/pigeons-in-war/. The Midlands National Flying Club (UK) also launched an educational program to teach school children about homing pigeons in war: http://www.secretmessages.org.uk/.
[17] Winner 1986, Johnson [Latour] 1988.
[18] Benson 2010; Whitney 2014.
[19] Russell 2001.

Finland and now some individuals have been found in Sweden where it is considered invasive. A network of camera traps alerts wildlife managers to incoming raccoon dogs, GPS transmitters are used to tag individuals then track them back to family groups to cull the group, caught animals are sexually sterilized, and databases manage all of the tracking and population data.[20] Technology has now become central to raccoon dog eradication.

III. Technologies mediate our knowledge of animals.

Animals are everywhere in media: children's books are filled with them, advertisers rely on them, and whole television stations are dedicated to films about them. Putting animals on film is a mediating process that shows some aspects of the subject and hides others; the wild is domesticated on film.[21] Real animals in motion are not only filmed and edited, but also watched live through a proliferation of web cameras available for online viewing. The Amazing FishCam, installed in 1994 and the longest-running camera website still in existence, has allowed us to watch fish gliding around a tank 24 hours a day for 20 years.[22] Digital mediation of nature has only recently come to the attention of environmental historians, yet it is a subject ripe for analysis.[23]

Maps, for example, are technological artifacts that record selected data about a place while intentionally excluding others—if everything about a place was recorded, the map would end up as big as the place itself.[24] While maps have become a standard data source for environmental historians to use in reconstructing past environments, maps can also be used to explore historical understanding of nature.[25] Atlases often use symbols to represent the "essence" of each place: little pictures of animals, crops, and major structures like the Eiffel tower or Statue of Liberty. Marking maps with these types of symbols goes back to at least the medieval Mappa Mundi which recorded cities, religious sites, mythical and real animals, and peoples of the world. On Olaus Magnus' *Carta Marina* from 1539, beavers appear in Karelia, an area currently divided between Russia and Finland. They are shown moving a log by having one animal lie on its back holding the log while the others drag their comrade, which was then-current natural science knowledge. [26] In his book about Scandinavia from 1555, Olaus Magnus wrote about "a great abundance of beavers in the North" where they live in quiet rural streams.[27] His placement of the beavers on the map reflects this idea that beavers lived only in wilderness far removed from urban settlements. The animals chosen for these maps can tell us much about the perception of animals and their mediation through artistic and textual representations.

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[20] Dahl et al. 2013.
[21] Mitman 1999.
[22] http://fishcam.com/
[23] Jørgensen 2014.
[24] As a short story by Jorge Luis Borges 2004 [1954] so nicely demonstrates.
[25] Scott 1998 argues that maps are tools of the state to be able to see (and control) the landscape.
[26] Carta Marina is available for online viewing at https://www.lib.umn.edu/apps/bell/map/OLAUS/TOUR/indext.html
[27] Magnus 1555: 604

IV. Technologies affect our valuation of other living creatures.
Because technological systems enable distancing from nature while it is still consumed, humans may become alienated from natural processes. Consumers and even workers are distanced from the animals killed for their dinners through industrialized slaughterhouse technologies.[28] Droves of animals with genetic mutations are custom-bred for laboratory medical research experimentation.[29] The valuation of these animals becomes displaced from the existence as natural beings to their technological function. This is not a question of de-valuation but rather one of shifting values.

Just because we can do something, should we?[30] Deextinction is the re-creating of currently extinct species using genetic cloning, back breeding, or a combination of the two. The idea of being able to re-constitute an extinct species is no longer only in the realm of science fiction: a cloned Pyrenean ibex, was born in 2003, three years after the last Pyrenean ibex had died.[31] The clone had been created from genetic material collected from the last living specimen and lived only a few minutes. Deextinction was, however briefly, a reality. There has been criticism that deextinction will lead people to value conservation of species less, since there will always be a back-up plan.[32] As an environmental historian, I have been keen to connect what might happen to deextincted species based on our history of interaction with reintroduced species.[33] For instance, if the Tasmanian thylacine is brought back, will it generate the same social controversies that have surrounded wolf reintroductions? Certainly the long-term success of deextinction hinges on a reorientation of values and whether or not people would value the species enough to make room for it again in the world.

V. Technology is part of the ecosystem.
Despite William Cronon's admonition nearly twenty years ago that the idea of wilderness as nature separated from humans is unproductive to environmental protection, there continues to be a tendency to place 'human technology' in opposition to 'nature'.[34] Yet from the point of view of living creatures, technological artifacts are no less part of their ecosystem than trees or grass or rocks. Some technological structures are dangerous: hundreds of thousands of birds die in collisions with window glass, deer and other wildlife are regular fatalities in roadways, squirrels are electrocuted when they interfere with electricity transformers. Other technological places become homes: birds make their homes in urban and rural birdhouses and visit birdfeeders, abandoned buildings serve as wild gardens, bats use attics as roosts. Animals often do not distinguish between technological artifacts and nature.[35]

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[28] Pachirat 2011.
[29] Anthes 2013.
[30] For a recent synthesis of the issues, see Ogden 2014. See also an ethicist's point of view in Sandler 2014.
[31] Zimmer 2013.
[32] Sherkow and Greely 2013.
[33] Jorgensen 2013b.
[34] Cronon 1995.
[35] Reiß 2012.

For example, the premise of artificial reefs made from either new or reused materials is that creatures will not care where the hard substrate originated from; they settle on and around artificial structures just like naturally-occurring rock outcrops. In the case of the conversion of disused offshore oil structures into artificial reefs, some opponents of the practice have stressed such reefs are non-natural because of their technological histories.[36] This is a human distinction between nature and technology—the barnacles, anemones, and corals that settle on these steel structures make no such distinction. Technological artifacts like artificial reefs need to be approached by environmental historians as part of ecosystems from the animal's point of view, rather than only as human interventions in nature.

In sum, I believe that consciously and conscientiously bringing technology into environmental history, particularly in cases involving other living beings, has great potential to shape the future of environmental history. My five tenets demand that historians break down conceptual barriers between artifacts and animals. Admitting that animals are technologies and technologies are part of ecosystems allows us to embrace hybridity as 'natural' rather relegating it to a 'polluted' or diminished state of nature. Recognizing that technologies afford control over others, mediate relationships, and affect value judgments makes us focus on the ways and means that humans interact with and understand the nonhuman rather than only the outcome of those power relations. Although narratives about the technological ravaging and scarring of the land certainly exist, all technological environmental histories need not be dystopian. Technological changes modify human relations with the nonhuman world rather than destroy them.

Just as human history is intertwined with technology, so is the whole history of the planet. The Anthropocene hypothesis implies that there is no longer environment without technology, no nature without humans. The environmental histories we tell need to reflect that reality. Sorting out the Anthropocene requires us to explore the complex historical relationships and networks of human bodies, technologies, and nonhumans—and few are as qualified and well-placed to do this as environmental historians.

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[36] Jørgensen 2013a.

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