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Jacob Darwin Hamblin

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Contents

Introduction by Jacob Darwin Hamblin, Oregon State University	2
Comments by Sara Dant, Weber State University	4
Comments by Michael Lewis, Salisbury University	7
Comments by Robert M. Wilson, Syracuse University	12
Author's Response by Etienne Benson, Max Planck Institute	15
About the Contributors	21

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Author's Response by Etienne Benson, Max Planck Institute for History of Science

On a humid summer evening in 2006, I joined a small team to search for turtles in the Great Meadows National Wildlife Refuge, which stretches along parts of the Concord and Sudbury Rivers outside of Boston. The team consisted of employees of a local environmental consulting company hired by the town of Concord a few years earlier to study and protect the refuge's population of Blanding's turtles, which had been declining since the 1970s. During the nesting season, employees of the company monitored the turtles' movements, recorded causes of mortality, and set up protective fences around egg-laden nests, which were sometimes plundered by raccoons and dogs. Their monitoring work had revealed that many female Blanding's turtles never even got to the point of laying eggs; instead, moving away from the wetlands in search of dry ground, they were crushed by cars on the roads surrounding the refuge. Like most such refuges, Great Meadows was intimately connected to the landscape surrounding it.

I didn't see any Blanding's turtles that evening, living or dead, but I did hear them on the radio. Several dozen of the refuge's turtles had been fitted with radio-tags, each broadcasting on a unique frequency. After walking some of the refuge's trails, we stopped near a municipal wastewater treatment facility to try to triangulate the turtles' signals. At first, holding the receiver in my hand and rotating slowly with the tip of the antenna pointed toward the horizon and the tines parallel to the ground, I picked up nothing but the whine of interference from Hanscom Air Force Base, located a few miles east of the refuge. Hanscom is the home of the Electronic Systems Center, whose mission is to provide the Air Force and its partners with the "latest command, control, communications and information systems." Standing a few miles from where Henry David Thoreau had lived in a one-room shack a century and a half earlier, the entangled history of nature protection and cold war science and technology was difficult to ignore.

After rotating the tines of the antenna by ninety degrees at the recommendation of one of the members of the team, I managed to pick up a faint beep through the static in the direction of the wetlands at the heart of the refuge. We noted down the location and moved on to the next frequency. During an evening spent amid the sounds of buzzing insects, the hum of distant traffic, and the crackling static of the radio-tracking receiver, that beep was the only evidence I had that Great Meadows still harbored the Blanding's turtle, although I was told that it was not unusual to encounter a turtle in the flesh. As we scrambled up dirt piles and squelched through meadows, one of the team members, with palpable frustration in his voice, told me about a local resident who had recently discovered a radio-tagged turtle resting along one of the refuge's trails. Believing the turtle to be in distress, she had removed the tag and turned it in to refuge authorities, thereby rendering that turtle once more anonymous, untrackable, unprotectable.

It was this messy world of field research on wildlife and endangered species, with its human and nonhuman actors, thorny ethical brambles, local practices, embodied knowledges, and misunderstandings among scientists, conservationists, and animal lovers, that I tried to depict in *Wired Wilderness*. I am grateful to Sara Dant, Michael Lewis, and Robert Wilson for their generous commentaries on the book and to Jacob Darwin Hamblin for organizing the roundtable. It has given me a welcome opportunity to think again about some of the book's themes and to assess some of its strengths and weaknesses.

As several of the commentators suggest, *Wired Wilderness* can be counted among the numerous responses to the debate set off by William Cronon's essay on "The Trouble with Wilderness" and other critiques of the American wilderness ideal that emerged in the 1990s. In the wake of these critiques, radiotracking seemed to offer a way of examining the tension between visions of a pristine, untrammelled nature that needed to be protected from civilization and the gritty work of actually protecting it. In the late-twentieth-century United States, the latter seemed to me to have become an extraordinarily technocentric and often technocratic practice. By tracing the technique's history, I hoped to show how a community of people who cared deeply about the preservation of wild animals and places came to place much of their hope in technologies of surveillance and control. As someone trained in science and technology studies, I felt this was an important factor that had been neglected in the voluminous literature of the "great new wilderness debate."

In retrospect, the decision to structure each of the book's chapters around a few key species and places had the disadvantage of sometimes obscuring the larger narrative, as several of the commentators note. I chose it because it allowed me to show just how very messy, contingent, and place- and species-specific research in wildlife biology has been. To select the particular cases, I conducted oral history interviews and searched in archives for evidence that would allow me to reconstruct these messy histories in detail. Although there is some overlap between the chapters, each moves the narrative progressively forward from the 1950s to the 2000s and each addresses a different set of themes. These include, roughly in order of appearance, the ideology of wildlife management, cold war science and technology, science in national parks, the wilderness movement, international wildlife conservation, postcolonial conservation biology, and the representation and regulation of field biology in legislatures, courtrooms, and the popular media.

Or at least these were the themes I hoped that readers would recognize underneath the stories about ruffed grouse, grizzly bears, Bengal tigers, and killer whales. I agree with the reviewers that more explicit framing of these themes would not have been amiss, and in several articles published since *Wired Wilderness* I have tried to provide some of that framing.

One chapter was perhaps especially in need of more framing than it ended up getting: the chapter on tiger research in India and Nepal, which both Dant and Lewis

single out, albeit for different reasons. (I should note that Lewis's *Inventing Global Ecology* was extremely helpful to my writing of this chapter.) Although it is the only chapter with a focus outside of the United States, it was not an afterthought or a throw-in. Early on in the project, I realized that the involvement of American biologists in conservation outside of the United States, particularly in the economically poor but biological rich parts of the world, was an essential part of the story. At its worst, American conservation biology fetishizes both technology and uninhabited wilderness, and as a raft of works in political ecology have demonstrated, American conservation biology has often been at its worst outside of the United States. Radiotracking is a small piece of this broader story. In many places, the technique symbolized not merely technological and modern solutions to wildlife conservation problems but also foreign, Western, and specifically American solutions. I wanted to show how what Ramachandra Guha famously described as "authoritarian biology" looked liked on the ground, where globe-trotting biologists from the United States and other rich countries were inevitably forced to work with, or around, local people and authorities.

Lewis is right to suggest that there are many other important "trans-border" stories that go untold in *Wired Wilderness*, and I hope that I or someone else will have the chance to tell them at some point. Nonetheless, although I can imagine writing, and sometimes wish I had written, a less U.S.-centric book, I still believe that the history of radiotracking cannot be disentangled from the very American idea that so-called pristine wilderness and wildlife can best be preserved through the deployment of complex technologies and armies of experts. Americans were not the only ones to believe in this idea, of course, but they believed in it with unusual fervency and had the wealth, power, and expertise to put it into practice on a grand scale.

On the subject of the Americanness of this story, I was happy to see Lewis's mention of Leo Marx's *The Machine in the Garden*, a landmark work in American studies that was written at about the same time that wildlife radiotracking was being invented. Marx co-taught the first seminar on the history of technology that I took as a graduate student at MIT, and, while my approach in *Wired Wilderness* is a long way from his, I was interested in some of the same questions. Lewis is right to suspect that some of the biologists who appear in the book were interested in them too. One biologist involved in developing some of the first radiotracking collars in the early 1960s told me that he had intended to pursue a graduate degree in American studies at the University of Minnesota, where Marx taught in the 1950s, before the need for a steady income to support his family pulled him back to wildlife biology. In the papers of another, I found a careful evaluation of a manuscript that Marx had submitted to *Science* in the early 1970s on the responsibilities of scientists in the face of the ecological crisis. (The reviewer was critical of the article's occasionally "biased and reproachful" tone but thought it was nonetheless worth publishing.) Other examples of shared concerns among biologists and cultural critics would be easy to find.

Just as Marx and other proponents of a contextual approach to American literature were sometimes accused of ignoring formal concerns, I stand accused of ignoring the scientific motivations for and consequences of radiotracking. I plead mostly guilty, with caveats. *Wired Wilderness* focuses on the situated practice of radiotracking and on the technique's broader cultural and political significance. It says relatively little, although not nothing, about the nature of the knowledge produced using the technique or the broader scientific context that made that kind of knowledge particularly alluring. But as both Lewis and Wilson note, wildlife radiotelemetry was not just a vision, a symbol, a technology, or a source of diplomatic tensions, and it did not emerge from a scientific vacuum. It was also a method of producing knowledge that was enormously attractive to many scientists for reasons that were rooted in the history of biology and ecology in the twentieth century, and it built on and was used together with a number of other technologies of tracking. Wilson's book *Seeking Refuge*, which describes the history of waterfowl refuges and the science of waterfowl migration in North America, provides some of the context necessary for understanding this history.

Much work remains to be done to understand the scientific motivations for and consequences of a dramatically improved ability to continuously locate moving bodies in space in the twentieth century. One of the challenges in elucidating the scientific impact of wildlife radiotracking or other tracking techniques is that there is no one classic paper or small set of papers in which these techniques were used to make an important new biological discovery. Radiotelemetry was often used simply as an aid to compiling life histories of particular species or as a method for relocating animals in the field, where they could be studied using other methods. This was important and very useful work, essential to the practical decisions of wildlife managers and conservationists, but it was often as theoretically thin as it was empirically and methodologically rich. Even so, it seems clear to me now that *Wired Wilderness* underemphasizes the intellectual stakes of radiotracking. If I were writing it now, I would include more about the history of biological ideas of home range, territory, and migration, all of which helped motivate the development of new tracking techniques.

The commentaries raise a number of additional questions and themes that would be well worth pursuing if space allowed, but for the sake of keeping this response to a reasonable length I will focus on the two that seem to me most important: environmental governance and the ethics of wildlife research.

As Wilson notes, geographers and anthropologists have come to see tools such as radiotracking as part of a broader effort to render nature and human societies "legible." More specifically, radiotracking can be seen as one of many tools for "managing mobile populations," as Wilson nicely puts it. I find this phrasing particularly felicitous because "population" is broad enough to include many kinds of mobile beings, including humans. I intentionally left the history of the human surveillance and tracking out of *Wired Wilderness*, concerned that it would distract from my focus on wildness and wilderness. I now think that may have been a

mistake, even if including that history would have led to a very different book. While relatively few humans were involuntarily outfitted with radiotags and other tracking devices, many techniques and concepts of population surveillance and management traveled freely across the human-animal divide in the twentieth century, and many decisions were made with both humans and animals in mind. Maintaining an artificial divide between these closely related biopolitical histories is, I'm now convinced, not helpful to our understanding of either.

Nor do I think, incidentally, that the model of the panopticon is much help here, although like Lewis I have sometimes used the term when talking about radiotracking, usually to try to grab the attention of colleagues who are more interested in Foucault, Facebook, or the FBI than they are in wildlife. Unlike the prisoners in Bentham's design, wild animals are unlikely to be aware that the radiotags attached to them are mechanisms of surveillance, and they do not internalize their own oversight, at least not in the ways Bentham's inmates were supposed to. It might help conservationists (and ranchers) if radiocollared wolves would refrain from preying on sheep because they knew they were being tracked, but so far it has not turned out that way. Nonetheless, systems of pervasive, continuous, invisible surveillance transform the conditions and quality of their lives, just as they do those of numerous humans. *Wired Wilderness* was meant to show in detail how one such system was constructed and contested.

This leads me to the important question of the ethics of radiotagging. I would agree with Dant that one of the main themes of *Wired Wilderness* is the "ethics of using technology in the study of wildlife." My only qualification would be that all three of the key terms in this phrase—ethics, technology, and wildlife—deserve critical examination and historical contextualization. For example, as I have written elsewhere, "wildlife" is a term that only came into wide use in English in the 1920s and 1930s, that has no clear equivalent in most other languages, and that carries with it a number of assumptions about the proper relationship between humans and the fuzzy set of living beings that it picks out. One of these assumptions is that wildlife is a thing, or a set of things, that is amenable to management. In this sense, the category of "wildlife" was always technological, always modern. Wildlife radiotracking only made it obvious.

The concept of technology also needs to be handled with care. For example, although the idea that technology is inherently opposed to nature drove many of the wilderness-oriented critics of wildlife radiotracking, there is a long tradition of thinking of nature and technology as compatible or even inseparable. Figures like the Craighead brothers, who thrilled as much to the beep of a grizzly's radiocollar as they did to the honk of a migrating goose, should be seen as part of this tradition. For the Craigheads, it would have made little sense to speak of "balancing" the loss of wildness against the knowledge gained, since they understood grizzlies as creatures who had been living among humans and their technologies for thousands of years. Radiotracking was certainly a new and different technology, but it was no radical break. Although I am sympathetic to the wilderness purism of someone like

Adolph Murie, who fought to pull wildlife biology back from the technocratic brink, I find the Craigheads' vision ultimately more compelling. Since all of our interactions with wild animals are technological in some sense, there is no real difference between the "ethics of using technology in the study of wildlife" and the "ethics of studying wildlife" *tout court*.

Having spent an unreasonable amount of time thinking about the tiny radios that humans have strapped to, glued onto, implanted in, or otherwise attached to animals in order to keep track of their movements, I'm convinced that this technique is more diagnostic than distinctive. That is, it is important not because it is unique but rather because it makes visible an assumption that shaped American approaches to wildlife conservation and many other areas of nature protection or environmentalism in the early twentieth century. The assumption is that the only way to "save nature" is to bring it under ever-closer surveillance and ever-finer human control, using all of the scientific and technological methods available. This way of thinking is continually resurfacing in discussions of climate engineering and other areas of current environmental concern. My hope for *Wired Wilderness* is that it contributes something new to the ongoing discussion of the strengths and limits of such an approach.

I've occasionally been asked whether I'm for or against wildlife radiotracking, a question which I did my best to avoid answering in *Wired Wilderness*. For what it's worth, I think that radiotracking does not necessarily undermine the wildness of animals or places and can indeed help to preserve it, and that hands-on research techniques, when they are used with respect and care, can be just as ethical and humane as hands-off techniques. At the same time, the value of knowledge in wildlife conservation seems to me to have been highly overrated, not least by people who make their livings producing such knowledge, and radiotracking has clearly sometimes been used in ways that are inhumane and that hinder rather than help the conservation of wildlife and wilderness. The technique has a vital role to play, but I'd be happy to see it used less, and more carefully. The devil, as I tried to show in *Wired Wilderness*, is in the details.