



# Wild and Scenic Wasteland: Conservation Politics in the Nuclear Wilderness

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**ABSTRACT** Nuclear weapons production has created a unique geography of irradiated open space in the United States. In recent years, many of these landscapes have been re-classified as national wildlife refuges in an attempt to transform the nation's atomic sacrifice zones into spaces of environmental salvation. However, these areas are also home to contaminated biota that migrate beyond refuge boundaries, inspiring biological vector control campaigns that frame nuclear nature as a threat that must be contained. How can these environments simultaneously embody ruin and redemption, and what work does this constitutive contradiction do? In this article, I explore the slippery subjectivities of nuclear waste and nature at Washington State's Hanford Nuclear Reservation. Beginning with the Hanford Reach National Monument, I examine how this space is framed as both pristine habitat and waste frontier. Next, I consider how Hanford's biological vector control program addresses the spread of radioactive flora and fauna. Looking specifically at one of the site's most notorious offenders (the fruit fly), I discuss how vector control uses instances of nuclear trespass to articulate the boundary between contaminated and uncontaminated. Finally, by examining the dual production of nature as both untouched wilderness and biological vector, I consider how this slippage between pure and polluted has been employed in the service of nuclear industry. I argue that in its doubling, nature is being recruited to do what the U.S. Department of Energy cannot: to solve Hanford's nuclear waste problem.

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Tracy stands on a mound of steaming garbage at the city landfill and tries to get used to the smell. Geiger counter in hand, she moves carefully between rolling hills of trash, feeling the unstable squish of each step on decaying ground. Searching. She steps over a plastic bag that has burst in the middle, spewing chicken bones, oily napkins, and a partially melted spatula. She checks the radiation count—normal—and wishes she could plug her nose. She moves on. Finally, beneath a rusting three legged chair she finds it: a garbage bag containing rotten food and elevated levels of Strontium 90—the signature of radioactive fruit flies. With a whoop, she reaches for the bag and calls it in. "Got one," she says over the radio.

I imagine this scene as I sit at Tracy's kitchen table, sipping tea and listening to her tell stories about biological vector control. Tracy is a Health Physics Technician (HPT) at the Hanford Nuclear Reservation, a 586 square mile nuclear weapons complex in southeastern Washington State. Once the heart of American plutonium production, Hanford is now the nation's most contaminated nuclear site, laced with more than 450 billion gallons of liquid

nuclear waste.<sup>1</sup> Under the direction of the U.S. Department of Energy (DOE), Hanford is currently engaged in the largest and most expensive environmental remediation project in human history—struggling to contain the material byproducts of weapons manufacture.

Also known as Radiological Control Technicians, HPTs like Tracy are the border guards of nuclear industry. They survey land, equipment, and people for elevated levels of radioactivity, patrolling the official boundary between safe and unsafe exposure. At Hanford, Health Physics Technicians are charged with containing nuclear materials, ensuring that contamination does not move beyond “controlled”<sup>2</sup> areas of the site. Workers, for example, must be “released” by an HPT before they can leave radioactive space, shedding protective gear like toxic skin in preparation for their return to the “uncontaminated” world. However, the scale and ubiquity of Hanford’s toxicity disrupt the rigid boundaries that HPTs so faithfully enforce. Hanford’s living environment, dynamic and mobile, regularly carries contamination beyond controlled territory, necessitating a multi-million dollar biological vector control program in the service of radioactive pest management.

During her 23 years at Hanford, Tracy has often been assigned vector control duty. With a wink and a reference to Spiderman, she recalls the black widow she found living in a high-level nuclear waste tank, and the day she realized that contaminated coyote urine was to blame for Hanford’s radioactive telephone poles. She tells me about the atomic tumbleweeds that drink contaminated groundwater and then roll away with their toxic burden, and the radioactive mice and rabbits who spread Cesium-laced<sup>3</sup> droppings across vast areas of the site. She describes the mud dauber wasps that build radioactive nests in the eaves of aging reactor buildings and the ants that construct contaminated colonies in delicate networks underground; the herds of elk that browse irradiated grasses, spindly-legged calves in tow—their muscular bodies so infused with the bomb, they have become living breathing archives of atomic history.<sup>4</sup>

In 2000, more than half of this unique landscape renounced its official designation as nuclear production zone, assuming the new title and status of national wildlife refuge (undoubtedly a promotion). Created by presidential decree,<sup>5</sup> these 195,000 acres now comprise the Hanford Reach National Monument: a breathtaking expanse of shrub-steppe, towering white bluffs, and 51 miles of free-flowing river, the last undammed stretch of the once mighty Columbia.

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<sup>1</sup> Roy Gephart, *Hanford: A Conversation about Nuclear Waste and Cleanup* (Columbus: Battelle Press, 2003).

<sup>2</sup> A “controlled” area at Hanford is one in which contamination is known to exist, and is officially monitored.

<sup>3</sup> Like, Strontium 90, Cesium-137 is a common environmental toxicant found in nuclear production areas. Cesium-137 is water soluble and mimics Potassium in the body, most often lodging in muscle tissues and to a lesser extent, in bone.

<sup>4</sup> Interview with Author, Benton County, WA, 17 April, 2012.

<sup>5</sup> In Proclamation 7319, President Clinton created the Hanford Reach National Monument with the express purpose of protecting this “unique and biologically diverse landscape, encompassing an array of scientific and historic objects” (2000), 1322.



**Figure 1.** *The Hanford Reach of the Columbia River. Photo by Author.*

Wrapped like a thick blanket around Hanford's shoulders, the Monument rests on what was once the site's buffer zone: the requisite environmental barrier between nuclear weapons production and surrounding residential communities. Because its status as buffer offered protection from the last seven decades of agricultural and suburban expansion, the Monument now represents a unique parcel of open space in an increasingly developed region. This island of wilderness houses a diverse collection of plants and animals, including over 800 species considered rare, threatened, endangered, and/or new to science.<sup>6</sup> The majority of the Columbia River's fall Chinook salmon spawn here.<sup>7</sup> It is a genuinely beautiful place. It also surrounds one of the most contaminated places on Earth.

What are we to make of this wild and scenic wasteland? How can Hanford's environment simultaneously embody ruin and redemption, and what work does this constitutive contradiction do? In this article, I explore the slippery subjectivities of nuclear waste and nature. Beginning with the Hanford Reach National Monument, I examine how this space is positioned as both pristine habitat and waste frontier. Next, I consider how Hanford's biological vector control program addresses the spread of radioactive flora and fauna. Looking

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<sup>6</sup> Michele Gerber, *On the Home Front: The Cold War Legacy of the Hanford Nuclear Site* (Lincoln: University of Nebraska Press, 2007).

<sup>7</sup> U.S. Fish and Wildlife Service, "Wildlife and Habitat: Salmon," accessed 16 April 2015, [http://www.fws.gov/refuge/Hanford\\_Reach/Wildlife\\_Habitat/Fish.html](http://www.fws.gov/refuge/Hanford_Reach/Wildlife_Habitat/Fish.html).

specifically at one of the site's most notorious offenders (the fruit fly), I discuss how vector control uses instances of nuclear trespass to articulate the boundary between contaminated and uncontaminated. Finally, by examining the dual production of nature as both untouched wilderness and biological vector, I consider how this slippage between pure and polluted, wild and controlled, has been employed in the service of nuclear industry. I argue that in its doubling, nature is being recruited to do what the Department of Energy cannot: to solve Hanford's nuclear waste problem.

### **"Thank God it's a Nuclear Reactor!"**

By the end of the Cold War, nuclear weapons production had become a trillion-dollar industry.<sup>8</sup> As Manhattan Project physicist Niels Bohr predicted in 1939, making the bomb had successfully "turned the United States into one huge factory."<sup>9</sup> Indeed, by the time the Soviet Union formally dissolved in 1991, the U.S. nuclear complex occupied 3,300 square miles of land and had created massive weapons-based economies surrounding production facilities in Oak Ridge, Tennessee; Richland, Washington; Los Alamos, New Mexico; Aiken, South Carolina; Amarillo, Texas; Idaho Falls, Idaho; Rocky Flats, Colorado; and hundreds of other smaller sites.<sup>10</sup>

However, this vast industrial infrastructure was never designed to *stop* making nuclear weapons. There was no end point in the nuclear deterrence model. Peace, former DOE advisor Bob Alvarez explains, was a "profoundly disruptive thing to a system that had never envisioned stopping. The United States and Russia, and especially the people running their nuclear weapons industries, never thought about stopping and what that means. There were no contingencies. They just thought this would go on forever."<sup>11</sup>

Thus, as the Cold War came to a close, the U.S. Government began the previously unthinkable task of post-production accounting. In 1989, Secretary of Energy James Watkins created the Office of Environmental Restoration and Waste Management<sup>12</sup> with the express purpose of "mitigating the risks and hazards posed by the legacy of nuclear weapons production."<sup>13</sup> In 1993, Watkins' successor Hazel O'Leary launched a department-wide Openness Initiative, revealing thousands of wartime human radiation experiments and intentional contaminant releases.<sup>14,15</sup> In 1995, the National Defense Authorization Act required

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<sup>8</sup> Stephen Schwartz, *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940* (Washington D.C.: Brookings Institution Press, 1998).

<sup>9</sup> Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1986), 294.

<sup>10</sup> Schwartz, *Atomic Audit*.

<sup>11</sup> Robert Alvarez, "Energy and Weapons in 2009: How Do We Assure a Sustainable, Nuclear-Free Future?" Town Hall, Seattle, WA, 10 June, 2009.

<sup>12</sup> Now called the Office of Environmental Management.

<sup>13</sup> U.S. Department of Energy, *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences* (Washington D.C.: Office of Environmental Management, 1997), 1.

<sup>14</sup> O'Leary was outspoken in her campaign to change the culture of nuclear secrecy in the United States. As a sign of her intentions as Secretary of Energy, she changed the name of the Office of Classification to the Office of Declassification. "The Cold War is over," she told a press conference on 7 December, 1993, "we're coming clean." O'Leary's Openness Initiative declassified and reviewed more than three

that the Department of Energy provide a detailed analysis of weapons-based waste and contamination. In response, the DOE produced a series of reports with titles like, *Closing the Circle on the Splitting of the Atom: The Environmental Legacy of Nuclear Weapons Production and What the Department of Energy is Doing About It*,<sup>16</sup> *Estimating the Cold War Mortgage: The 1995 Baseline Environmental Management Report*,<sup>17</sup> and *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences*,<sup>18</sup> to name a few.

Collectively, these reports assess the material remains of a national security strategy that emphasized the immediate threat of Soviet attack rather than the slow violence of environmental contamination.<sup>19</sup> The result of these Cold War policies, they find, is a distinct “geography of sacrifice,”<sup>20</sup> requiring a nation-wide cleanup effort likely to cost more than the nuclear arsenal itself.<sup>21</sup> However, even as they emphasize the magnitude of environmental impact associated with weapons development, these reports also position cleanup efforts as the manageable second half of the nuclear production cycle.

For example, in the introduction to *Closing the Circle on the Splitting of the Atom*, Assistant Secretary of Environmental Management Thomas Grumbly likens the story of American nuclear production to the “full sweep of a clock face.”<sup>22</sup> At noon, he writes, the world’s first atomic bombs were born, followed by Cold War geopolitics and weapons manufacture from 2:00 until 5:00 pm. Early evening marked the close of the Cold War and the majority of its weapons programs—the Berlin Wall crumbling at around 5:30, in time for U.S. nuclear remediation to begin at 5:45. Looking forward, Grumbly envisions the final six hours and 15 minutes of the nuclear project in which contaminated landscapes are scrubbed clean and radioactive wastes stored securely. At midnight, he imagines, the hands of nuclear time will return to their original position, sealing the U.S. atomic endeavor with a neat click.<sup>23</sup>

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million documents about nuclear science, manufacture, and testing and prompted a series of public hearings and the formation of the Advisory Committee on Human Radiation Experiments (ACHRE).

<sup>15</sup> Eileen Welsome, *The Plutonium Files: America’s Secret Medical Experiments in the Cold War* (New York: Delta Books, 1999).

<sup>16</sup> U.S. Department of Energy, *Closing the Circle on the Splitting of the Atom: The Environmental Legacy of Nuclear Weapons Production and what the Department is Doing about it* (Washington D.C.: Office of Environmental Management, 1996).

<sup>17</sup> U.S. Department of Energy, *Estimating the Cold War Mortgage: The 1995 Baseline Environmental Management Report* (Washington D.C.: Office of Environmental Management, 1996).

<sup>18</sup> U.S. Department of Energy, *Linking Legacies*.

<sup>19</sup> Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge: Harvard University Press, 2011).

<sup>20</sup> Valerie Kuletz, *The Tainted Desert: Environmental Ruin in the American West* (New York: Routledge, 1998).

<sup>21</sup> Schwartz, *Atomic Audit*.

<sup>22</sup> U.S. DOE, *Closing the Circle*, ix.

<sup>23</sup> Grumbly’s vision of time stands in stark contrast to the Bulletin of the Atomic Scientists’ famous “Doomsday Clock.” Designed to convey imminent civilizational collapse as a result of things like nuclear weapons and climate change, the Doomsday Clock ticks closer to midnight as humankind nears total ruin. In a January 2015 Press Release, for example, the Bulletin announced that “unchecked climate change and global nuclear weapons modernization” have brought the hands of time forward to three minutes to midnight, warning that “the probability of global catastrophe is very high.”

Detailing plans for remediation, *Closing the Circle* extends Grumbly's metaphor, envisioning nuclear production from cradle to grave as a circular rather than linear process. Selecting a circle as the shape of nuclear progress points to several DOE mandates for remediation. First, and most evident, is that of containment. By "closing the circle," the state rhetorically re-seals Pandora's box, asserting control over runaway radionuclides and radically uncertain nuclear futures. Second, circular imagery portrays time as cyclical, suggesting that movement toward complete remediation is also progression towards an original state. As such, advances in nuclear technology facilitate a return to edenic nature, painting science as an agent of both progress and purification and allowing narratives of production and erasure to entwine. Ultimately, by naturalizing nuclear production as cyclical—expanding and retracting, moving forward while forever returning to itself—the Department of Energy not only renders remediation attainable, but inevitable; as certain as the passage of time.

In this vision, nature plays a critical role in the remediation process. Buffer zones for weapons production in the United States created a unique cartography of irradiated open space—large areas of land whose military fortifications produced a national map of toxic undevelopment. One of the uncomfortable ironies of the American nuclear project is that daily human traffic is more immediately harmful to the environment than radioactive materials. Indeed, nuclear production actually *preserved* (at least in the short term) vast ecosystems that would have otherwise been lost to agricultural and suburban expansion.

The Hanford Reach National Monument, for example, boasts the largest parcel of shrub-steppe vegetation in Washington State. As Geographer Morris Uebelacker describes in the 2007 documentary *Arid Lands*:

That landscape of irony really struck me one time when I had to survey a power line out by the Fast Flux power reactor [at Hanford] ... The first thing I noticed is that this might be the first time I was ever in shrub-steppe vegetation that looks like its supposed to out of a text book. And I realized that by being internal to Hanford, and keeping people out, they had actually created pockets of vegetation that were healthy. I mean this blew me away! I thought, my God! So I started to say things like, well *thank God it's a nuclear reactor* or we wouldn't even know what shrub-steppe vegetation ought to look like!<sup>24</sup>

Within this logic, preservation is a natural byproduct of the atomic age. Weapons production not only saved American citizens from Soviet attack, but it also rescued critical habitats from the ravages of development. Nuclear wildlife refuges, therefore, allow the Department of Energy to "expand retroactively its Cold War mission from nuclear deterrence to environmental protection ... replacing nuclear weapons systems with biodiversity as the security object of the nuclear state."<sup>25</sup> So too, this strategic emphasis on "returning to nature" envisions the nuclear project as having come full circle, equating the pre-nuclear past with the post-nuclear future.

This transposition of land from production to preservation permits the U.S. Government to complete the atomic cycle both discursively and bureaucratically. Over the last 15 years, the Department of Energy and Department of Defense have transferred hundreds of thousands of

<sup>24</sup> Grant Aaker and Josh Wallaert, *Arid Lands* (Sidelong Films, 2007).

<sup>25</sup> Joseph Masco, *The Nuclear Borderlands: The Manhattan Project in Post-Cold War New Mexico* (Princeton: Princeton University Press, 2006), 313.

acres of land into the hands of the U.S. Fish and Wildlife Service.<sup>26</sup> This administrative code-switch—alternately referred to as military-to-wildlife, warfare-to-wildlife, and bombs-to-birds—imagines a clean break between human and non-human worlds. It evokes preservationist notions of nature as healer, fundamentally adaptive once free from the destructive human, nature's other. Radioactive ecologies thus serve as evidence of survival rather than destruction. Plants and animals become proof of post-nuclear perseverance, "emblems of nature's resilience as opposed to its vulnerability, porosity, or damage."<sup>27</sup>

Visitors to the Hanford Reach National Monument website, for example, are greeted with the following description:

The Monument is a place of sweeping vistas and stark beauty, of towering bluffs and delicate flowers. Wildlife abounds in this harsh landscape—rare is a trip along the river that doesn't produce mule deer, coyotes, bald eagles, great blue herons, or white pelicans. A large elk herd hides in the canyons, and incredibly, porcupines are a common sight. Rare plants defy the drought, wind and heat ... The Monument is also a reminder of our history. Plutonium reactors stand along the river, remnants of WWII and the Cold War. Plutonium from B Reactor fueled "Fat Man," the atomic bomb dropped on Nagasaki, Japan on August 9, 1945. No longer in production, these reactors are now being dismantled, and the lands and waters cleaned. So, whether you're interested in history, sightseeing, wildlife, hunting, fishing, or just enjoying a bit of time away from the bustle of everyday life, the Hanford Reach National Monument has something to offer you. But don't come expecting a lot of visitor facilities—they don't exist. You'll be experiencing the Monument on its own terms.<sup>28</sup>

The Monument in this frame is an active space, housing a community of natural survivors. Its rare plants don't simply exist in Hanford's arid environment, they "defy the drought, wind, and heat." A picture of autonomy and self-determination, the Monument evokes the transformative potential of Turner's frontier, successfully negotiating the challenges of western aridity and nuclear contamination "on its own terms." The Monument's website therefore espouses a basic logic of the weapons-to-wildlife program: nature, if left to its own devices, can survive nuclear disaster. Amazingly, this narrative transforms Hanford—the most toxic nuclear site in North America—into an environmental success story. The solution to nuclear contamination, it seems, is to simply let nature be.

Of course, these redemption stories rely upon a selective view of nuclear transformation. They elide the cellular transgressions and mutant potentialities that also distinguish these parcels of uncommon Eden. Exposure produces disparate effects, each body a distinct expression of nuclear contact. So too, radiogenic illness, especially in the case of low-level exposures, may take decades or even generations to manifest. These extended timescales remove the element of immediate causality, introducing doubt as to the source of cancer, mutation, and birth defects. Thus, contamination's impact often exists at the level of partial

<sup>26</sup> David Havlick, "Logics of Change for Military-to-Wildlife Conversions in the United States," *GeoJournal* 69 (2007): 151-164.

<sup>27</sup> Shiloh Krupar, *Hot Spotter's Report: Military Fables of Toxic Waste* (Minneapolis: University of Minnesota Press, 2013), 32.

<sup>28</sup> U.S. Fish and Wildlife Service, "About Hanford Reach National Monument," accessed 16 April 2015, [http://www.fws.gov/refuge/Hanford\\_Reach/About.html](http://www.fws.gov/refuge/Hanford_Reach/About.html).

knowledge—a collection of symptoms and stories, aches and pains, that remain fractured beneath Medicine’s totalizing gaze.<sup>29</sup>

The creation of places like the Hanford Reach National Monument is a critical component of this uncertainty management. Placing the emphasis on salvation rather than contamination, the DOE positions itself as caretaker of fragile ecosystems, protector of a pre-industrial past. At the same time, it forwards claims about possibilities for the post-nuclear future—of landscapes returned, good as new, to the communities who participated in the U.S. nuclear endeavor. As Washington senator Patty Murray said of the Monument’s designation in 2000:

I’m thrilled this day has finally arrived, that the Hanford Reach will be protected for generations to come. This designation means more salmon restoration, more recreation and tourism, and national prominence for the Tri-Cities community and the state of Washington. My dad grew up in the Tri-Cities. When I started fighting to protect the Reach, he told me how proud he was that I was working to give something back to a community that has given so much to our family and our country.<sup>30</sup>

In her speech, senator Murray uses the spectacle of environmental preservation to rhetorically manage the multi-millennial challenge of nuclear waste. The “generations to come” she imagines enjoy eternal nature in the form of wildlife rather than radionuclides.

What senator Murray fails to acknowledge is that the Monument’s designation “gives something back” to the Department of Energy as well. Because remediation must adhere to human-based risk standards under the terms of federal law, re-inscribing nuclear space as natural space means that less material nuclear management is necessary. Humans are not allowed to live in national wildlife refuges, which dramatically reduces the risk that they will develop cancer from these places. Therefore, the DOE can leave *more* radioactive waste in the environment while still remaining legally compliant. The refuge designation thus operates as a form of “thrifty environmentalism”<sup>31</sup>—one that “preserves” federal expenditures as well.

This doubled nature is also evident in the Monument’s official role as natural laboratory. Hanford maintains one of the Department of Energy’s seven National Environmental Research Parks (NERPs): multi-use outdoor laboratories that examine the ecological dynamics of nuclear production. Initiated in 1972 with its first research park at the Savannah River site, the NERP program emerged in response to federal mandates that industry evaluate its environmental impact. Though weapons production often eluded such environmental requirements, NERPs provided opportunities for expanding the methodological boundaries of fields like

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<sup>29</sup> Adriana Petryna, *Life, Exposed: Biological Citizens After Chernobyl* (Princeton: Princeton University Press, 2003); Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers* (Durham: Duke University Press, 2006).

<sup>30</sup> U.S. Senator Patty Murray, “Senator Murray Applauds Hanford Reach Designation,” accessed 16 April 2015, <http://www.murray.senate.gov/public/index.cfm/newsreleases?ID=52b8733e-8c1b-49fe-9777-762c9a65b0da>.

<sup>31</sup> Kristin Iversen, *Full Body Burden: Growing up in the Nuclear Shadow of Rocky Flats* (New York: Crown Publishers, 2012), 321.



radioecology. The program has continued to expand both scientifically and geographically and now comprises more than two million acres of land.<sup>32</sup>

Weapons production and environmental science have long been productively entwined.<sup>33</sup> During the Cold War, for example, questions about nuclear fallout produced an unprecedented commitment to research in climatology and the earth sciences.<sup>34</sup> Likewise, the field of ecology expanded in step with the international arms race, as radioactive materials from weapons testing allowed scientists to track ecosystem flows and dynamics.<sup>35</sup> As Howard and Eugene Odum wrote in their foundational text *Fundamentals of Ecology*, "Some of the things which we fear most in the future, radioactivity, for example, if intelligently studied, help solve the very problems they create. Thus, isotopes used as tracers in the environment elucidate turnover processes which we must understand before radioactive waste materials can safely be released into the environment."<sup>36</sup>

The NERP program reflects this tautological reasoning that contamination can be both problem and solution. "Serving important national defense, science, engineering, and industrial purposes," Shearer and Frazer write, "NERPs also have a complementary role conducting research on environmental impacts ... protecting important habitats, and enhancing remediation and restoration technology."<sup>37</sup> In this sense, they argue, NERPs reflect the broader "complementarity principle" that atomic weapons "are at once the means of man's destruction and of his salvation."<sup>38</sup> Representational spaces like the Hanford Reach National Monument are thus used to naturalize the logic of nuclear deterrence. By symbolizing survival (even resilience) in its radioactive state, the Monument embodies the constitutive contradiction of Mutually Assured Destruction—that technologies of war engender peace.

### The Atom and the Fly

The atomic wildlife refuge only retains this strategic utility, however, if nuclear waste stays in the nuclear wilderness. Thus, the Department of Energy has instituted an extensive biological vector control program to maintain the integrity of nuclear space. Established in 1999, Hanford's Integrated Biological Control (IBC) system was designed to "reduce or eliminate spread of radioactive contamination by biotic vectors."<sup>39</sup> Since its inception, IBC has identified

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<sup>32</sup> Daniel Pava, "DOE's National Environmental Research Parks: A Positive Legacy of the Cold War," Rocky Mountain Land Use Institute Conference, Denver, CO, 4 March, 2011.

<sup>33</sup> Jacob Hamblin, *Arming Mother Nature: The Birth of Catastrophic Environmentalism* (Oxford: Oxford University Press, 2013).

<sup>34</sup> Joseph Masco, *The Theater of Operations: National Security Affect from the Cold War to the War on Terror* (Durham: Duke University Press, 2014).

<sup>35</sup> Jake Kosek, *Understories: The Political Life of Forests in Northern New Mexico* (Durham: Duke University Press, 2006); Kuletz, *The Tainted Desert*.

<sup>36</sup> Eugene Odum and Howard Odum, *Fundamentals of Ecology* (Philadelphia: Saunders, 1971), v-vi.

<sup>37</sup> Russel Shearer and Nat Frazer, "The National Environmental Research Park: A New Model for Federal Land Use," *Natural Resources and Environment*, 12 (1997): 46-51.

<sup>38</sup> Shearer and Frazer, "The National Environmental Research Park," 46-51.

<sup>39</sup> A.R. Johnson, J.G. Cardiff, R.F. Giddings, et al., "An Integrated Biological Control System at Hanford," Waste Management Symposia, Phoenix, AZ, 8 March, 2010.

81 biological vectors on site (30 species of vegetation and 51 species of wildlife) and documented approximately 5,400 instances of “biological intrusion.”<sup>40</sup>

Although the current IBC program has been operating for less than two decades, the DOE has been monitoring its radioactive flora and fauna for much longer. Hanford scientists began writing classified ecological monitoring reports in the mid-1940s, detailing the presence of nuclear materials in area vegetation, birds, sheep, and cattle.<sup>41</sup> Throughout the following decades, Hanford produced many subsequent reviews, formalizing the “environmental surveillance” process through annual reports beginning in 1965.<sup>42</sup> Translating irradiated livers, bones, thyroids, and testes into sanitized ledgers, these reports make for an unsettling read. In each, animal bodies are deconstructed and rendered quantitative, creating tidy spreadsheets of ecological impact.

In the post-Cold War era, environmental monitoring at Hanford has expanded from producing classified technical reports to serving the DOE’s “communication needs” as well.<sup>43</sup> As Mission Support Alliance (the private contractor that runs Hanford’s IBC program) notes, “Interest in radioactive contamination spread has increased over the years from being localized to technical specialists on site, to making national and international news. Today, communication is to a variety of customers,” including members of the public and the media.<sup>44</sup> Thus, the IBC system is explicitly designed to manage the spread of both biological vectors and information, providing its “customers” with messages of containment and control.

Hanford’s current IBC program was instituted following the infamous “fruit fly incident” of 1998. The incident, which began with a set of mysterious circumstances, brought a flurry of media attention to the site. On 28 September of that year, Health Physics Technicians surveying a mobile office trailer that was being used as a lunchroom noticed an unusual pattern of contamination. Radioactive material on the light switch, knife, and cutting board initially led HPTs to believe that the source was someone’s contaminated hand. However, the distribution of radioactivity was strange, registering on the tip of the knife but not the handle. A few minutes later, HPTs found radioactive chewing tobacco in the trailer’s garbage bin and it seemed likely that this person had been internally contaminated.

When a Hanford worker identified a pair of contaminated socks in their home later that evening, the individual in question seemed to have been found. Subsequent bioassays of the worker’s urine, however, did not show elevated levels of radioactivity.<sup>45</sup> Instead, the source of the contamination was identified the following day when an HPT surveying the same trailer

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<sup>40</sup> Johnson et al., “An Integrated Biological Control System at Hanford.”

<sup>41</sup> For example, see K.E. Herde, “<sup>131</sup>I Accumulation in the Thyroid of Sheep Grazing near HEW” (document HW-3-3455, Richland, WA, 1946) and J.W. Healy, “Vegetation Contamination for First Quarter of 1946” (document HW-3-3495, Richland, WA, 1946).

<sup>42</sup> R.F. Foster, “Evaluation of Radiological Conditions in the Vicinity of Hanford for 1964” (document BNWL-90, Richland, WA, 1965).

<sup>43</sup> Johnson et al., “An Integrated Biological Control System at Hanford,” 2.

<sup>44</sup> *Ibid.*

<sup>45</sup> U.S. Department of Energy, “Fall 1998 200 East Area Biological Vector Contamination Report,” HNF-3628, March 1999.

noticed a speck of contamination “fly away.”<sup>46</sup> Perplexed, she called her partner over and together they repeated the exercise with the same result. Further investigation revealed that fruit flies—a previously unidentified vector at Hanford—were to blame.

In the weeks that followed, multiple hypotheses were put forward as to the source of the fruit flies’ radioactivity. Ultimately, the DOE concluded that the flies had been drawn to a monosaccharide-based fixative that had recently been sprayed in one of Hanford’s diversion pits. Laying their eggs in the sugary sweet waste, the flies’ babies were born radioactive. When the young left home, they spread contamination to a variety of areas including the trailer lunchroom and bathroom, the Ironworker shop, the Canister Storage Building, the clothing of at least three workers, several dumpsters, and eventually the city dump via routine garbage collection.

Evoking the plot of the popular 1954 horror film *Them!* in which giant irradiated ants terrorize American citizens, Hanford’s fruit flies made for easy headlines. The local *Tri-City Herald* published its first article after an anonymous tip, and the story was quickly picked up by news outlets across the country. Subsequent headlines mark the progression of the event: “Radioactive socks found in Hanford worker’s home;”<sup>47</sup> “Hanford puzzled by radioactive garbage bin;”<sup>48</sup> “Fruit flies suspects in Hanford’s contamination;”<sup>49</sup> “Hanford works to trap contaminated bugs,”<sup>50</sup> and so on.<sup>51</sup>

Hanford’s management team leapt into action, struggling to contain both the fruit flies and the message that their nuclear escape was sending. The DOE established a situation room near downtown Richland, Washington dedicated to the response effort, complete with “integrated sub-teams” for addressing issues like radiological control, solid waste, and policy.<sup>52</sup> Fly traps were installed across the site, affected areas sprayed with the insecticide Malathion, and a ten-acre radiological buffer created around the mobile office trailer and diversion pit area. More than 100 workers provided urine for bioassay testing. HPTs (including Tracy) were sent to the city landfill where they spent weeks surveying mountains of trash. In the end, more

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<sup>46</sup> R.L. Dirkes, R.W. Hanf, and T.M. Poston, “Hanford Site Environmental Report for Calendar Year 1998,” Prepared for the U.S. Department of Energy, PNNL-12088, September, 1999.

<sup>47</sup> “Radioactive Socks Found in Hanford Worker’s Home,” *Tri-City Herald*, 1 October, 1998.

<sup>48</sup> John Stang, “Hanford Puzzled by Radioactive Garbage Bin,” *Tri-City Herald*, 2 October, 1998.

<sup>49</sup> Annette Cary, “Fruit Flies Suspects in Hanford Contamination,” *Tri-City Herald*, 7 October, 1998.

<sup>50</sup> John Stang, “Hanford Works to Trap Contaminated Bugs,” *Tri-City Herald*, 13 October, 1998.

<sup>51</sup> It is significant that a fruit fly inspired Hanford’s new system of Integrated Biological Control because in 1927, a fruit fly also provided the first scientific evidence of radiation-induced mutation. According to Dr. Hermann Muller who won a Nobel Prize for his fruit fly studies in 1946, any dose of ionizing radiation can produce a genetic effect. However, this effect—while still harmful in a multi-generational sense—will not usually be immediately obvious. Muller was frustrated by cinematic representations of radiogenic monsters like the giant mutant ants in *Them!* “The popular idea that a mutation ordinarily results in a monster or a freak is a gross distortion of the facts,” he wrote in 1958 (232). Rather, he argued, assessing the extent of the bomb’s impact means attending to smaller genetic changes that grow increasingly harmful with time. These subtle, everyday, lived transformations that Joseph Masco has theorized through the notion of “mutant ecologies,” insist that we rethink the meaning and consequence of radioactive life in multigenerational terms (2004).

<sup>52</sup> U.S. Department of Energy, “Fall 1998 200 East Area Biological Vector Contamination Report,” F-6, F-7.

than 200 tons of garbage were returned to the Hanford site and placed in low-level nuclear waste burial grounds. The entire incident cost the DOE about two million dollars.<sup>53</sup>

However, despite its rigorous, expensive, and very public response, the DOE maintained that the fruit flies had never presented a risk to human health or the environment. As vice president of environmental health, safety, and quality Bob Shoup explained, most of the flies registered radioactivity rates of about 20,000 disintegrations per minute (dpm)—a little less than a dental X-ray.<sup>54</sup> Nevertheless, Shoup reiterated in multiple public announcements, “we have zero tolerance for any contamination spreads.”<sup>55</sup> In a site-wide message to Hanford employees, he wrote, “Any contamination outside of a control zone is of concern *because it isn’t supposed to happen* ... Even though the level of contamination is very small, any contamination outside of controlled radiation areas is unacceptable.”<sup>56</sup>

Shoup made it clear, therefore, that the DOE’s multi-million dollar response had more to do with the sanctity of the boundary than the fruit flies themselves. While their escape pointed to the inherent “slipperiness” of nuclear waste, the flies also allowed the DOE to emphasize tactical divisions between contaminated and uncontaminated space. The spectacle of the search for atomic fruit flies pointed to the porosity of Hanford’s border while at the same time reproducing that border as the official boundary that nuclear materials are not “supposed to” cross within normal operating procedure.

Thus, the fruit flies functioned as a proxy for radiation itself. Invisible and elusive, radioactivity evades physical and explanatory capture, making it extremely difficult to manage. As John Wirth, medical director for the Oak Ridge nuclear site wrote in 1951, “[Radioactivity] seems to get about as though it were a living creature, trying to spread itself anywhere.”<sup>57</sup> Indeed, the tiny size of each individual fruit fly, and the fact that it could land on something quickly and leave its mark without being seen, made it easy to equate the two.

Published in one of many official site-wide messages, workers’ questions about the event speak to the physical and psychological challenge of negotiating this invisible hazard. Among many other things, workers asked:

- How can I be sure that I’m not transporting contamination home?
- There was enough contamination to shut down the Canister Storage Building on Wednesday. Why are we not concerned about working there today (Thursday)?
- If contamination is not a big concern, then why are there so many news stories (i.e. newspaper articles and TV news)?
- The contaminated fruit flies have been detected in the 200 Area. How far can a fruit fly fly?<sup>58</sup>

<sup>53</sup> U.S. Department of Energy, “Fall 1998 200 East Area Biological Vector Contamination Report,” I-3.

<sup>54</sup> Several flies registered higher dpm counts, reaching close to 1,000,000 dpm.

<sup>55</sup> Michele Gerber, “All-Out Effort Stems Spreads of Contamination,” *Hanford Reach*, 19 October, 1998.

<sup>56</sup> U.S. Department of Energy, “Fall 1998 200 East Area Biological Vector Contamination Report,” F-18.

<sup>57</sup> Kate Brown, *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters* (Oxford: Oxford University Press, 2013), 57.

<sup>58</sup> U.S. Department of Energy, “Fall 1998 200 East Area Biological Vector Contamination Report,” F-21.

In apprehending every single tiny fly, drawing detailed maps of their movement, and sending workers to pick through tons of city garbage, the DOE sought to communicate a broader message that nuclear containment is possible. It positioned the flies' escape as an accident, an aberration that could have been prevented through procedural modifications and increased surveillance. Thus, vector control was not just managing fruit flies, but the ambiguous nature of radioactivity as well. It maintained the notion that there *is* an outside to nuclear contamination, that Cold War sacrifice zones have bounds.

Several months after the fruit fly incident officially ended, the DOE published the "Fall 1998 200 East Area Biological Vector Contamination Report." Comprising 229 pages of diagrams, summaries, and analyses, the report determined that while the "direct cause" of the incident was fruit flies, the "root cause" was a larger problem of "inadequate process."<sup>59</sup> In response, the DOE initiated the Integrated Biological Control program to improve the security of Hanford's radiological areas. Based on "new policies and procedures to unify the control of biota,"<sup>60</sup> IBC is a distinctly biopolitical project.<sup>61</sup> It extends disciplinary logics to non-human subjects, positioning nature as integral to the management of nuclear life. Under this new program, contaminated plants and animals are critical to the administration of Cold War materials. Through public displays of illicit crossing and then capture, biological vectors transform invisible and insensible radioactivity into a visible, tangible enemy that can be contained.

These social, political, and institutional boundaries of nuclear control are materialized in the daily practices of the IBC program. In monitoring and defending the border between the pure and the polluted, vector management simultaneously *produces* the particular territories it seeks to protect. The flight of a fruit fly and the practiced sweep of a Geiger counter, therefore, represent a material politics of containment. When Hanford workers scrape radioactive wasp nests from the eaves of aging reactors and when they collect and catalog radioactive tumbleweeds—they are not only managing the living remains of the bomb, they are shaping the very meaning of nuclear cleanup.

## Conclusion

When Tracy finishes her story about the fruit fly incident, she remembers that she has something she wants to show me. "I'll be right back," she says and goes down the hallway to her bedroom while I reach for another homemade muffin. Her dog, who has been sitting next to me for several hours, lays his head in my lap and looks at the muffin hopefully.

When she returns a few minutes later, Tracy is holding three old T-shirts. "I found them!" she says triumphantly, holding them up one-by-one for me to see. The first features a manic-looking cartoon fly that is glowing with radioactivity. The shirt reads, "Frutonium-98" as if the fly is evidence of a new element on the periodic table. "The workers on the fruit fly crew made these," she said, chuckling. "98 is for the year that it happened."

The second T-shirt has a drawing of several HPTs laughing in disbelief beneath the words, "You want me to release *that?!?*" Large cartoon tears spring from their eyes at the

<sup>59</sup> U.S. Department of Energy, "Fall 1998 200 East Area Biological Vector Contamination Report," 4-1.

<sup>60</sup> Johnson et al., "An Integrated Biological Control System at Hanford," 2.

<sup>61</sup> Michel Foucault, *Security, Territory, Population: Lectures at the College de France 1977-1978* (New York: Picador, 2004).

hilarity of this absurd directive from management. In its irreverence, the shirt points to the political nature of nuclear cleanup at Hanford. The HPTs are laughing because the idea of releasing an obviously contaminated item is irrational, ridiculous in the extreme. However, the shirt is only funny because it also recalls something familiar: they have each been in this situation before.

The final T-shirt is simple—no images, just words: “HPTs don’t get old, they’re just re-characterized.” We laugh for a while when Tracy shows me this one, appreciating its mix of sarcasm and nuclear jargon. Characterization is the process of testing and categorizing nuclear waste based on its relative radioactivity and bureaucratic definition. It is a complex process that lends itself to political manipulation (there is an incentive to characterize material economically). Joking that HPTs could be re-characterized not only references the plasticity of the category, it also equates working bodies with nuclear materials, linking waste and worker in their shared radioactivity and disposability. Like the T-shirt before, it’s the kind of funny that makes you roll your eyes knowingly because you recognize the dysfunction. It’s funny-sad, funny-exasperated, funny-ironic.

Tracy’s stories and the others I have outlined in this article speak to a broader politics of nature in the atomic age. They narrate a world that has been fundamentally altered by the bomb, producing new categories of meaning and matter (Frutonium!). Nuclear production, in other words, has changed the very “nature” of nature, disrupting taken-for-granted divisions between subject and object. It has transformed intimate relationships between society, environment, and self and even challenged the meaning of these terms.<sup>62</sup>

Remediation at Hanford represents a struggle over these new material-discursive categories. At stake are the conditions of nuclear impact—the meaning of clean on a planet saturated with fallout, the meaning of injury when mutation is the norm. As Gabrielle Hecht has argued, even the definition of “nuclear” is up for debate. “The boundary between nuclear and non-nuclear has been frequently contested,” she writes. “The qualities that make a nation, a program, a technology, a material, or a workplace count as ‘nuclear’ remain unstable, even today.”<sup>63</sup> This points to the broader social and administrative challenge of waste management in the atomic age: how to structure and implement nuclear cleanup when definitions of the materials and spaces in question are fluid and changing, even contradictory?

In this article, I have explored the multiple and often paradoxical natures that have emerged out of this search for definition. Creating the conditions of remediation has meant positioning nature as both healer and vector, wilderness and waste, ruined and redeemed. Indeed, this ability to tack back and forth allows the category of nature to play to structures of power. Its meaning depends upon particular histories and geographies, bodies and politics, nations and nationalisms. Thus, Hanford’s nuclear natures matter in an ontological sense, but also in the conditions of their making. They reflect the intricate social relations and uneven suffering constitutive of the plutonium economy.

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<sup>62</sup> Joseph Masco, *The Nuclear Borderlands*.

<sup>63</sup> Gabrielle Hecht, *Being Nuclear: Africans and the Global Uranium Trade* (Cambridge: MIT Press, 2012), 14.

In *Understories*, Jake Kosek writes, “the weakness at the heart of environmental politics is that it does not take seriously the politics of nature.”<sup>64</sup> With this in mind, I have sought to “expand the terrain”<sup>65</sup> on which we understand the nature of nuclear politics. By exploring the ways that wilderness and vector have become paradoxically and productively entwined, I am speaking to the larger social project of remediation at Hanford. I argue that by calling upon nature to mark the territories of both injury and recovery, remediation seeks to reimagine the scale and consequence of atomic development.

Reproducing the official dimensions of controlled space through the material and discursive production of its outside is vital to “closing the circle” of nuclear production. These structures and practices of containment have been naturalized through the Hanford Reach National Monument, the National Environmental Research Park system, and the Integrated Biological Control program. In each, nature is used to rethink and remake the post-nuclear future—transforming nuclear wastelands into manageable, aesthetically potent, scientifically productive, and economically efficient spaces.

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## Bibliography

- Aaker, Grant and Josh Wallaert. *Arid Lands*. Sidelong Films, 2007.
- Alvarez, Robert. “Energy and Weapons in 2009: How Do We Assure a Sustainable, Nuclear-Free Future?” Town Hall, Seattle, WA. 10 June, 2009.
- Brown, Kate. *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters*. Oxford: Oxford University Press, 2013.
- Bulletin of the Atomic Scientists. “2015: It Is 3 Minutes to Midnight.” Accessed 3 September 2015. <http://thebulletin.org/clock/2015>.
- Cary, Annette. “Fruit Flies Suspects in Hanford Contamination.” *Tri-City Herald*, 7 October, 1998.
- Dirkes, R.L., R.W. Hanf, and T.M. Poston. “Hanford Site Environmental Report for Calendar Year 1998.” Prepared for the U.S. Department of Energy. PNNL-12088. September, 1999.
- Foster, R.F. “Evaluation of Radiological Conditions in the Vicinity of Hanford for 1964.” Document BNWL-90, Richland, WA, 1965.
- Foucault, Michel. *Security, Territory, Population: Lectures at the College de France 1977-1978*. New York: Picador, 2004.
- Gephart, Roy. *Hanford: A Conversation about Nuclear Waste and Cleanup*. Columbus: Battelle Press, 2003.

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<sup>64</sup> Jake Kosek, *Understories*, 273.

<sup>65</sup> *Ibid.*, 274.

- Gerber, Michele. *On the Home Front: The Cold War Legacy of the Hanford Nuclear Site*. Lincoln: University of Nebraska Press, 2007.
- \_\_\_\_\_. "All-Out Effort Stems Spreads of Contamination." *Hanford Reach*, 19 October, 1998.
- Hamblin, Jacob. *Arming Mother Nature: The Birth of Catastrophic Environmentalism*. Oxford: Oxford University Press, 2013.
- Havlick, David. "Logics of Change for Military-to-Wildlife Conversions in the United States." *GeoJournal* 69 (2007): 151-164.
- Healy, J.W. "Vegetation Contamination for First Quarter of 1946." Document HW-3-3495, Richland, WA, 1946.
- Hecht, Gabrielle. *Being Nuclear: Africans and the Global Uranium Trade*. Cambridge: MIT Press, 2012.
- Herde, K.E. "<sup>131</sup>I Accumulation in the Thyroid of Sheep Grazing near HEW." Document HW-3-3455, Richland, WA, 1946.
- Iversen, Kristin. *Full Body Burden: Growing up in the Nuclear Shadow of Rocky Flats*. New York: Crown Publishers, 2012.
- Kosek, Jake. *Understories: The Political Life of Forests in Northern New Mexico*. Durham: Duke University Press, 2006.
- Krupar, Shiloh. *Hot Spotter's Report: Military Fables of Toxic Waste*. Minneapolis: University of Minnesota Press, 2013.
- Kuletz, Valerie. *The Tainted Desert: Environmental Ruin in the American West*. New York: Routledge, 1998.
- Johnson, A.R., J.G. Cardiff, R.F. Giddings, et al. "An Integrated Biological Control System at Hanford." Waste Management Symposia/ Phoenix, AZ. 8 March, 2010.
- Masco, Joseph. *The Theater of Operations: National Security Affect from the Cold War to the War on Terror*. Durham: Duke University Press, 2014.
- \_\_\_\_\_. *The Nuclear Borderlands: The Manhattan Project in Post-Cold War New Mexico*. Princeton: Princeton University Press, 2006.
- \_\_\_\_\_. "Mutant Ecologies: Radioactive Life in Post-Cold War New Mexico." *Cultural Anthropology* 19 (2004): 517-550.
- Muller, Herman. "The Radiation Danger." *The Colorado Quarterly* 6 (1958): 229-254.
- Murphy, Michelle. *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers*. Durham: Duke University Press, 2006.
- Nixon, Rob. *Slow Violence and the Environmentalism of the Poor*. Cambridge: Harvard University Press, 2011.
- Odum, Eugene and Howard Odum. *Fundamentals of Ecology*. Philadelphia: Saunders, 1971.
- Pava, Daniel. "DOE's National Environmental Research Parks: A Positive Legacy of the Cold War." Rocky Mountain Land Use Institute Conference. Denver, CO. 4 March, 2011.
- Petryna, Adriana. *Life, Exposed: Biological Citizens After Chernobyl*. Princeton: Princeton University Press, 2003.
- "Radioactive Socks Found in Hanford Worker's Home." *Tri-City Herald*, 1 October, 1998.
- Rhodes, Richard. *The Making of the Atomic Bomb*. New York: Simon and Schuster, 1986.
- Schwartz, Stephen. *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940*. Washington D.C.: Brookings Institution Press, 1998.
- Shearer, Russell and Nat Frazer. "The National Environmental Research Park: A New Model for Federal Land Use." *Natural Resources and Environment* 12 (1997): 46-51.
- Stang, John. "Hanford Works to Trap Contaminated Bugs." *Tri-City Herald*, 13 October, 1998.
- \_\_\_\_\_. "Hanford Puzzled by Radioactive Garbage Bin." *Tri-City Herald*, 2 October, 1998.
- U.S. Department of Energy. "Fall 1998 200 East Area Biological Vector Contamination Report." HNF-3628. March 1999.



- \_\_\_\_\_. *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences*. Washington D.C.: Office of Environmental Management, 1997.
- \_\_\_\_\_. *Closing the Circle on the Splitting of the Atom: The Environmental Legacy of Nuclear Weapons Production and what the Department of Energy is Doing about it*. Washington D.C.: Office of Environmental Management, 1996.
- \_\_\_\_\_. *Estimating the Cold War Mortgage: The 1995 Baseline Environmental Management Report*. Washington D.C.: Office of Environmental Management, 1996.
- U.S. Fish and Wildlife Service. "About Hanford Reach National Monument." Accessed 16 April 2015. [http://www.fws.gov/refuge/Hanford\\_Reach/About.html](http://www.fws.gov/refuge/Hanford_Reach/About.html).
- \_\_\_\_\_. "Wildlife and Habitat: Salmon." Accessed 16 April 2015. [http://www.fws.gov/refuge/Hanford\\_Reach/Wildlife\\_Habitat/Fish.html](http://www.fws.gov/refuge/Hanford_Reach/Wildlife_Habitat/Fish.html).
- U.S. President. Proclamation, "Establishment of the Hanford Reach National Monument." *Federal Register* 36, no. 23 (9 June, 2000): 1322. <http://www.gpo.gov/fdsys/pkg/WCPD-2000-06-12/pdf/WCPD-2000-06-12-Pg1322.pdf>.
- U.S. Senator Patty Murray. "Senator Murray Applauds Hanford Reach Designation." Accessed 16 April 2015. <http://www.murray.senate.gov/public/index.cfm/newsreleases?ID=52b8733e-8c1b-49fe-9777-762c9a65b0da>.
- Welsome, Eileen. *The Plutonium Files: America's Secret Medical Experiments in the Cold War*. New York: Delta Books, 1999.