# Mediating Animal-Infrastructure Relations[1]

Lisa Parks

The triptych in figure 4.4.1 below materializes a set of relations, or intra-actions, between animals and infrastructures. I became interested in such relations after noticing animal traces at media infrastructure sites that I visited and studied over the years. Paw prints, scat, nests, and gnawed cables prompted me to consider how animals become part of infrastructural materialities. Animals and infrastructures (and artists!) are defined by their ability to mark territories. As Rosi Braidotti writes, "Like artists, animals mark their territory physically, by colour, sound or marking/framing. In order to mark, code, possess or frame their territory, animals produce signals and signs constantly. … It is non-verbal communication at its best."[2] But how do animals mark infrastructures? Put another way, what kinds of intra-actions materialize animals and infrastructures in relation to one another?[3]

Philosophical definitions of "animal" and "infrastructure" are expansive and complex. I will not rehearse them here; instead, I mobilize these terms tactically as a media scholar interested in extending the ontology of the infrastructural. For the purpose of this analysis, "animal" refers to *organic nonhumans existing in a technologized global environment*. "Infrastructure" is *a dynamic sociotechnical formation with multiple parts that are distributed and situated in particular material conditions*. The "socio" of *sociotechnical* includes the animal. Since infrastructures are designed, installed, and used within biospheres, they are always already animal. As such they incarnate the ideas of feminist theorists such as Donna Haraway, Rosi Braidotti, and others, who conceptualize technology as a site of human-animal-machine hybridizations.[4] Even if this is the case, infrastructure is not typically imagined or specified as such. More often, its conceptualization oscillates between the systemic and the architectural, the invisible and the spectacular, the mundane and the monumental.[5] Rarely are nonhuman species considered as part of infrastructural materialities in critical humanities discussions, which is surprising given that infrastructures are surrounded by biomatter, from roots beneath them to fungi on top of them to wildlife around them.

To draw further critical attention to animal-infrastructure relations, this essay draws upon visual media to describe and analyze a series of animal-infrastructure intra-actions. From the perspective of media studies, the challenge of investigating these relations is not to fixate upon or canonize particular species that have been integral to media and telecommunication histories—such as the horse, pigeon, or dolphin—but to recognize instead the myriad potential intra-actions that shape and affect infrastructures' more general conceptualization and materialization. In this way, my approach builds on the work of media scholar Jussi Parikka, who has called for "broader definitions of media and aesthetics" that allow us "to consider the connections of the organic human bodies in the organic and nonorganic surroundings."[6] Like Haraway and Braidotti, Parikka sets out to delineate a "continuum of medianatures where the natural ecology is entirely entangled with the technological one."[7]

To explore the encounters and entanglements of animals and infrastructures, I also embrace Karen Barad's notion of "intra-action." As Barad explains,

> intra-action queers the familiar sense of causality (where one or more causal agents precede and produce an effect), and more generally unsettles the metaphysics of individualism (the belief that there are individually constituted agents or entities, as well as times and places) … "individuals" do not pre-exist as such but rather materialize in intra-action. That is, intra-action goes to the questions of making differences, of "individuals," rather than assuming their independent or prior existence.

"Phenomena," in Barad's sense of agential realism, "are the entanglement—the ontological inseparability—of intra-acting entities." She continues, "It is through specific agential intra-actions that the boundaries and properties of 'individuals' within the phenomenon become determinate and particular material articulations of the world become meaningful."[8] Building on these ideas, I hope to reinforce the ontological inseparability of animals and infrastructures by exploring their intra-actions.

While intra-actions materialize animal-infrastructure relations all the time, they are often *elusive*. In what follows, I explore these relations through three examples: ospreys and cell phone towers; a chimpanzee on a power grid; and wildlife crossings at highways.[9] I selected these examples based on my own phenomenological and mediated engagements. While researching and analyzing these

Figure 4.4.1: Triptych of different kinds of animal-infrastructure relations created by the author.





Figure 4.4.2: This photograph of an osprey nest on an electrical tower near the Bitterroot River in Missoula, Montana reveals how the raptors claim these high perches near rivers and use them to raise their young and hunt fish. Photo by the author.

relations, I photographed and drew particular infrastructure sites and also gathered visual materials online. These media were then used to create three video vignettes entitled "Nesting, Escaping, Crossing" in collaboration with Slovenian artist Miha Vipotnik. The videos, which can be viewed online, are designed to bring forth, circle around, layer, and mediate animal-infrastructure relations so that their ontological inseparability becomes more intelligible and analyzable. Adopting Harold Innis's and Walter Benjamin's belief that "the collection of rich empirical detail could itself be a mode of philosophical and historical reflection,"[10] I hope that the description and analysis of these relations can help to extend materialist conceptualizations of the infrastructural. Ultimately, I use this ensemble of animal-infrastructure intra-actions to argue for a more expansive, perverse, unpredictable, and political economic ontology of the infrastructural, one that recognizes the potential to (re)organize various kinds of materials/objects/bodies/resources into distributed entities that are sustaining.

As cell phone towers have popped up throughout the world, they have linked billions of users to mobile phone networks. In areas throughout the United States, cell phone towers and electrical poles (see figure 4.4.2) have also become prime habitats for raptors such as ospreys and eagles. Over the past two decades, ospreys have transformed the horizontal mounting platforms of many cell towers into nesting sites. In the past these large, fish-eating birds, which often have a six-foot wingspan, established their nests in high-canopy or dead trees. Since they favor perches with a clear approach, the cell tower, which is usually fifty to two hundred feet high, has become an optimal nesting site.[11] In Florida 45% of the state's cell towers are home to osprey nests.[12] A Flint, Michigan newspaper headline attributes the species' revival in the area to cell tower installation, proclaiming: "Osprey return gets boost from cell towers."[13] Cell towers have been described as "encouraging" ospreys to extend their breeding range into new areas, including densely populated urban regions near water.[14]

Osprey nests on cell towers can be quite large. According to one biologist, the nests can weigh half a ton and be big enough for a person to sit inside. Once these nests are established, osprey behavior and flight patterns are reorganized in relation to the tower. The nests usually stay active for several months during which time an osprey may lay up to five eggs, which take about fifty days to hatch. Thus, the cell tower takes on a second life if you will, not only routing mobile phone signals but also serving migratory birds. Problems emerge, however, when osprey maneuvers interfere with or compromise the value of the network operators' equipment.[15]

A case in Virginia Beach is instructive. In 2011 a company called Ntelos decided to remove an osprey nest that had been on top of a cell tower for two years. Ntelos wanted to install its cellular equipment on the tower. After taking down the nest, workers put a massive tarp around the tower top to prevent the ospreys from returning. Yet Ntelos may have acted illegally as the nest was still active. Ospreys are covered by the federal Migratory Bird Treaty Act, which protects their nests, eggs, and feathers, even on private property.[16] The broader community only learned of these issues when a local TV news station produced a segment about it. As reporter Andy Fox stands beneath the cell tower explaining details of the controversy, the camera tilts up to reveal low-angle views of the tower top covered by a large blue tarp after the nest's removal. Fox then interviews Eric Moore, a resident of the area who had watched this osprey nest for two years and was disturbed by its sudden and potentially illegal removal. The segment concludes, however, with a statement from an Ntelos engineer who insists, "We had permission from Game and Inland Fisheries to do it." And, as the reporter sums it up, "The blue tarp is there to discourage the osprey from returning."[17]

The segment not only demonstrates

Figure 4.4.3: Screen capture of video showing workers removing an osprey nest from a tower in Florida. Reproduced under the fair use doctrine.

the awkward discourse of news producers trying to provide balanced coverage of animal-infrastructure relations, but also reveals what a bird-blocked cell tower looks like. Fox's report ultimately privileges the position of Ntelos by sanctioning the nest's removal and casting osprey-nesting as an act of commercial interference. A *Wall Street Journal* article reinforces this point by suggesting that osprey nesting on cell towers directly impacted market competition between US mobile providers.[18] In 2012, when Sprint was trying to expand its national LTE network to compete with Verizon, the company had to contend with osprey nests on seven hundred cell phone towers. This became known in the industry as "avian delays," as ospreys refused to move from cell phone towers.

Because of this, mobile operators and tower owners have explored various "deterrent strategies" designed to prevent osprey–cell tower entanglements. The Federal Communication Commission has issued guidelines encouraging tower owners to self-regulate by altering their equipment to protect migratory birds and prevent nesting.[19] For instance, some try to evict the osprey using a new device called OFF-sprey, a "raptor deterrent" device made of a stake and metal crossings installed on tower tops to block bird landings. Another preferred method has been to install an artificial platform nearby, encouraging ospreys to occupy it rather than the cell tower.[20] Other techniques are more extreme. One wildlife specialist tells his corporate clients to remove and bag up all the nest materials, drive them away in a truck, and dump them in the woods.[21]

Several online videos document professional nest interventions on cell phone towers. One five-minute video called "Osprey Nest Removal" features two linemen who climb a cell tower in Lexington, North Carolina and remove a large nest. The removal was recorded with a head-mounted camera and turned into a music video edited to the Busta Rymes song "Touch It." After the linemen climb the tower, the video speed accelerates as they dismantle the nest piece by piece, placing branches, sticks, strings, and other nest materials into a large cloth bag that is shuttled up and down to the ground several times using a pulley (see figure 4.4.3).[22] The video not only reveals how massive and complex osprey nests are—reverberating with what Ashley Carse calls "nature as infrastructure"[23]—it also enables the viewer to imagine how much effort is involved in creating and destroying them.

Another video from Canadian company Wildlife Shield features a team deployed to a cell tower near Toronto amidst a snowy landscape. Their task is to protect workers who have been assigned to repair a cell tower where there is an active nest. This video is set to a rock guitar number; as the Wildlife Shield workers climb up the tower they use a head-mounted camera to reveal a nest as well as a squealing osprey flying above the linemen as they work. After the repair is completed, the workers climb down and report a successful mission. Their "wildlife shield" protected them from the distressed osprey, and they managed to keep the nest intact.[24] Both videos celebrate the bravado of the linemen, turning cell tower nest interventions into a kind of extreme sport. At the same time, however, these videos materialize the osprey–cell tower relation as a site of interspecies relations, suggesting the need for a broader infrastructural ontology.

Drone service operators such as SkyShots, AirShark, iSky, The BuzzAbove, and DartDrones now sell cell tower maintenance and monitoring services that include bird-nesting checks.[25] Promotional videos show drones flying to the top of cell phone towers and circling around them, recording videos that can be used to determine whether nests exist, are active, and have eggs, whether equipment has been damaged, and whether signal strength has been compromised.[26] A short video loop on drone retailer Advexture's website features two maintenance men on the ground; their hydraulic crane or cherry picker is dissolved away and replaced with a drone that they use to effortlessly inspect a nearby tower top.[27] Such inspection technologies are integral to network providers' compliance with federal regulations, as tower owners are not allowed to disturb the nests of migratory birds between April 1 and August 31.

In such scenarios, drones fly and see from above, much like the ospreys they are monitoring. What differs is that the drone has been programmed to capture and render its flight paths and views as data that are intelligible to computers and humans. In this way, drones become the equivalent of domesticated or "good" birds, especially when contrasted with raptors that occupy, damage, or disrupt corporatized infrastructure and its economies.

Reinforcing this point, Sprint and other networks now use drones not only for tower inspections but also to mitigate network interruptions. By temporarily placing a drone in the sky near a tower that is shut down or not functioning properly, networks provide additional coverage when equipment has been damaged.[28] In this way, the drone materializes a more modular, flexible, and programmable network infrastructure, one that can alter its form and location in response to any number of conditions, ranging from software glitches to bird nesting to hurricanes.[29]

Beyond complying with federal regulations and unpredictable conditions, network providers must contend with the force of the osprey itself. The species is known to have tenacious nest attachment, returning to the same nest year after year. Often the birds refuse to move even after their nests are destroyed. Biologists speculate that young ospreys are now being socialized to seek cell towers as nests.[30] A 2016 Door County, Wisconsin report indicated that ospreys and bald eagles were thriving in the area because of artificial nesting platforms placed near cell towers, and the return of the raptors significantly boosted the local economy by drawing tourists and making it a bird-watching destination.[31] Cell towers and artificial platforms may thus be related to the osprey's "rewilding" in some areas, as the species returns to or rebounds within an area after being threatened or displaced.[32] Cell towers may also have provided nesting sites in a various areas that ospreys had not inhabited before. As Kath Weston powerfully reminds us, "These days, organisms live in and through scientifically reconstituted ecosystems that include their own bodies, which are subject to constant technological amendment."[33]

TV news crews, wildlife activists, and network linemen have used media to document osprey–cell tower encounters for various reasons. Such media, I want to suggest, can be used to encourage a different kind of *bird watching*—one that recognizes the osprey as part of a technologized environment and acknowledges the species' integration within infrastructural materialities. The osprey's flights, nest construction, and refusal to relocate have affected the morphology of cell tower sites, the spatial position and temporal operation of networks, the kinds of labor performed by network employees, and local tourist economies in their vicinity. Such conditions suggest the need for an infrastructural ontology that recognizes osprey–cell tower infrastructure entanglement, as opposed to one that effaces it. Thought about in Barad's terms, ospreys and cell towers do not exist as discrete entities; rather, they materialize through their intra-action, and this process becomes intelligible to humans through acts of perception, language, and mediation. Imagining the infrastructural in such a way keeps the category open to the dynamisms of multiple, agential forces and accounts for the possibility of its changing materialities and morphologies.

Figure 4.4.4 (top): Screen capture of viral video showing Chacha on the electrical cables after his escape from the Sendai zoo in Japan. Reproduced under the fair use doctrine.

Figure 4.4.5 (bottom): Screen capture of viral video showing workers trying to tranquilize Chacha. Reproduced under the fair use doctrine.

I want to turn now to a more spectacular and sensational animal-infrastructure encounter. On April 14, 2016, twenty-four year-old chimpanzee Chacha escaped from the Yagiyama Zoological Park in Sendai, Japan. After freeing himself from the primate pen, the chimp climbed up a power pole in a densely populated residential area nearby. He maneuvered across the power cables for nearly two hours, giving satellite TV trucks time to stake out and capture the event live (see figures 4.4.4–5). Unable to coax Chacha down, the zoo's staff went up in a lift and shot a tranquilizer dart into the chimp's back. Cameras were rolling on the ground and through residents' apartment windows, capturing the encounter from multiple vantage points. In one video Chacha appears startled as the injection dart penetrates his back. The chimp lunges toward the zoo staff, turns around to pull the needle out of his back, and jumps further down the power lines. As Chacha approaches a thick crossroads of cables, the sedative begins to take effect. The chimp falls part way and clutches a lower cable until he is out completely and his limp body tumbles to the ground, where a cluster of uniformed zookeepers wrap him in a blanket and stick him in a van back to the zoo. Chacha survived and is still in the zoo.

Videos of Chacha's escape on the power lines went viral and were replayed online and in news outlets around the world.[34] What remained undiscussed were the conditions the chimp was escaping.[35] Photos from the Great Apes Information Network reveal his cramped, prison-like pen, and inspectors noted his "inactiveness" and "unconcern."[36] Also overlooked in press accounts was the fact that Chacha could have gone in any number of directions. A view of the zoo's location in Google Earth reveals a massive green space in one direction and endless buildings and infrastructure in the other. Why did Chacha seek refuge on the power lines instead of in the trees? News media declared that the chimp swung across the cables "as if they were rainforest vines"[37] and described him as "lounging and relaxing" on top of a power pole.[38] Some wondered how he was not electrocuted (recalling the fate of another infamous animal, Topsy the elephant, whose extermination was filmed by the Edison Film Company in 1903 to showcase the power of electricity). As the video of Chacha's escape ricocheted around global media circuits, it became apparent that the scene's attraction and currency were grounded in its familiarity.[39]

For decades, science fiction films have concocted and reiterated a hyperbolic formula in which primates conquer urban infrastructures—from the art deco skylines of *King Kong*, to the crackling electrical plants of *King Kong vs. Godzilla*,[40] to the cables of the Golden Gate Bridge in Hollywood's *Rise of the Planet of the Apes*. The visual pleasure of these sequences is anchored in the ease of primates' movement through an urban environment built by and for humans (see figure 4.4.6). Science fiction is able to confront anxieties around animal-infrastructure relations by experimenting with them in various settings and modulating and reversing their relative power and dynamism through film narration. As Kristin Whissel reveals, science fiction cinema's most recent primates are computer-generated figures used to mediate life and death in the fictional worlds in which they appear. "These digital creatures," she writes, "are charged with an excess vitality that compensates for the fact that they are often pure code and never existed in space and time."[41] Indeed, Hollywood's primates are inseparable from digital infrastructure: they are brought to life via processes of data collection, processing, rendering, matting, and editing.

Although videos of Chacha's escape in Sendai had viral appeal because the scenes resonated with science fiction cinema, the videos documented an event that actually occurred. What does this hypermediated encounter between the chimp and the power grid tell us about the infrastructural? What does this intra-action materialize exactly?

Chacha was born in captivity at the Sapporo Maru-yama Zoo on March 3, 1992 and moved to the Sendai zoo in 1995. His father Tonny and mother Chaco were also born in captivity in Japanese zoos in 1979 and 1980 respectively. Chacha has had four offspring—three females and one male, with two different mates, Pocky and Medaka, all born in captivity in Japanese zoos—of whom one died.[42] Chacha comes


Figure 4.4.6: Screen capture of *Nesting, Escaping, Crossing* showing images of King Kong and Godzilla conquering human-built infrastructure. Video by Lisa Parks and Miha Vipotnik.



Figure 4.4.7: Photo of wildlife highway crossing near Banff, Canada. Photo by author.

from a family of chimps that has been reproduced within and used to populate primate pens in Japanese zoos since the 1960s. The artificial environment of the zoo *is* his natural habitat. Perhaps, because of this, the power grid was more enchanting than the forest.

Tohoku Electric Power, a private Japanese company that operates the grid in Sendai, owns the power cables on which Chacha climbed. The company formed in 1951 when the Allied Powers under US General McArthur approved a Japanese plan to reorganize and privatize the country's electrical power industry, and it became one of nine such companies.[43] Tohoku Electric Power now has almost 12,400 employees and is the fourth largest electric utility company in Japan, serving 7.6 million residential and business customers in seven prefectures.[44] When Chacha moved across the cables, his body connected to a grid sourced by nuclear, hydroelectric, and thermal power plants throughout the region; like the osprey on the cell tower, his actions had the potential to interrupt service or cause property damage. Tohoku Electric reported 1,848 homes briefly lost power during Chacha's escape.[45]

Both Chacha and Tohoku's power lines function as sustaining and distributed entities. For decades, Chacha and his kin have filled the walls, supported staff, and kept the lights on at zoos across Japan. These chimps have become infrastructural. What would the zoo be without its animals? As Tohuku Electric draws upon regional power plants to transmit electricity to customers throughout Sendai, it not only electrifies the zoo's lighting, computers, and security systems; it also energizes the media equipment, broadcast, and mobile phone networks that produced and distributed Chacha's escape as a media event. Thus, this transitory entanglement—this chimp–power grid intra-action—enables recognition of layered and intersecting dimensions of the infrastructural, from regulated primate reproduction to regional power distribution to media networking. These sustaining and distributed operations congeal in this mediated intra-action. Much more than built installations or technical operations, the infrastructural is a material crossroads of multiple organic and inorganic, human, animal, and machine forces that require specification. The infrastructural, then, is not a given; it is constituted through dynamic and hybrid materializations, which become most intelligible to us in instances of entanglement, relationality, and intra-action. In these instances, the power and force of the animal, or nonhuman, must be acknowledged and cannot be simply displaced, contained, or resolved.

The final animal-infrastructure relation I wish to explore is the wildlife crossing. A corridor built by humans to facilitate animals' passage above or beneath a highway, the wildlife crossing is part of a broader group of systems called "ecoducts" (see figure 4.4.7). For decades wildlife crossings have been installed at sites around the world to mitigate habitat fragmentation, reduce wildlife-vehicle collisions, and promote environmentalist ethics. In Europe and North America, public resources have been allocated to build "natural-looking" corridors above highways, inviting species to move through them unfettered. Just as the osprey changed the morphology of cell towers, so too have deer, coyotes, moose, and bears reshaped roads.

Wildlife management videos online show animals at crossings in Banff National Park in Canada; the Salish and Kootenai Indian reservation in Montana, the Sonora Desert in Arizona; the Prado Basin in California; and Highway I-70 in Colorado, known as the "Berlin Wall" for wildlife.[46] Depending on the area, species—from raccoons to bears to bobcats to skunks—can be seen crossing above or under roads (see figure 4.4.8). In Colorado deer canter across freeways and disappear into the western landscape. In Banff, a barbed wire fence is placed at the end of a crossing,

seeming to defeat its purpose. Wolves sniff the ground around it and appear tentative about crossing, possibly catching the scent of bears in the vicinity. In the Sonora Desert a snake, fox, warthog, and skunk enter a drainage tunnel. The warthog enters the tunnel until his nose smudges the camera, revealing how everyday tactile curiosities can generate animal-infrastructure relations. GPS and Google Maps track a bobcat's nighttime prowl back and forth across a highway near a suburban development in the Prado Basin of California, turning its moves into digital matter.

As these scenes imply, wildlife crossings are equipped with media systems designed to capture photos or video of animals as they approach or pass through the corridor. Closed-circuit surveillance technologies, which have saturated urban markets and are being phased out by biometrics and sensing devices, find new application in wildlife management. These systems are often solar- or battery-powered and, depending on their location, may be connected to the grid or a generator. The wildlife crossing videos rely on daylight for illumination, and motion-activated lights or infrared filter are used to track animals at night. The primary function of this footage is to confirm the use of wildlife crossings for the agencies and the publics that funded them and to identify and count the species that cross.

Wildlife crossing videos thus document human aspirations to build successful technologies as much as they advance environmentalist ethics. The ways wildlife managers use these videos—to count species and confirm their use of the crossings—reduces animal presence—wild life—to movement. If an animal can continue to move, so the logic goes, the crossing is working, and the species is supported. This logic is problematic because of its reductionism and implicit anthropocentrism: it reimagines the animal as an "auto-mobile" that needs its own "roads" in order to move and endure. It also treats all animal movements as if they are visible, "trackable" and manageable, and in doing so absorbs animal populations into systems of governmentality.[47] That highways have been redesigned to *serve* animals may at one level be environmentalist and progressive, yet the emergence of wildlife crossings also enables humans to suppress or neglect other material effects of transportation infrastructure, whether water, air, and noise pollution or fossil fuel dependency.

Perceived in another way, these videos confirm the success of wildlife crossings so that the global automobile and oil industries can continue with less interruption—less road kill, less property damage, less litigation, and more fuel use. Capturing the night and day movement of animals across their own roads becomes a perverse way of rationalizing and sustaining the global extractive order.[48] It is symptomatic of what might be called an *infrastructural compulsion*—that is, the construction of massive public works as a way of blocking changes to the fossil fuel economy or other logics of global capitalism. Ideologies are harder to change when they are built into massive public works.

Like the artificial nesting platforms created by mobile operators for osprey, the wildlife crossing was motivated first and foremost by cost-benefit calculus and risk assessment conducted by agencies and companies seeking to protect their resources and investments. In the United States, vehicle collisions with deer alone generate $1.1 billion in vehicle damage per year.[49] Though some animal rights activists and wildlife biologists have been involved in the development of wildlife crossings, a guiding principle for their emergence has been to protect *human* lives, property, and investments, and thus to sustain species hierarchy. Here, infrastructural transformation is as much a product of actuarial science as it is of environmentalism.

The potential for animal-vehicle collisions not only produced a material restructuring of highways; it also compelled the redesign of automobiles. Some cars and trucks are now equipped with motion-detecting headlights and infrared options that allow drivers to see deer at night. In 2014 Mercedes S-class vehicles were installed with infrared cameras designed to "recognize living, breathing obstacles like cows, moose, and deer."[50] In 2017 Volvo equipped some cars with the Large Animal Detection System, which uses radar to detect animals at night and slows the car down more or less according to the animal's size, proximity, and movement (see figure 4.4.9). The company's engineers used machine learning to teach cars' computers how to read animal presence.[51] Other vehicles are equipped with enormous wildlife-proof bumpers with brand names like BuckStop or Moose Guard, which are designed to prevent the killing of humans inside them.[52] Just as chimps become infrastructural for zoos, wildlife becomes infrastructural for secondary automobile markets: their

Figure 4.4.8: Screen captures from *Nesting, Escaping, Crossing* showing images of various animals using wildlife corridors. Video by Lisa Parks and Miha Vipotnik.



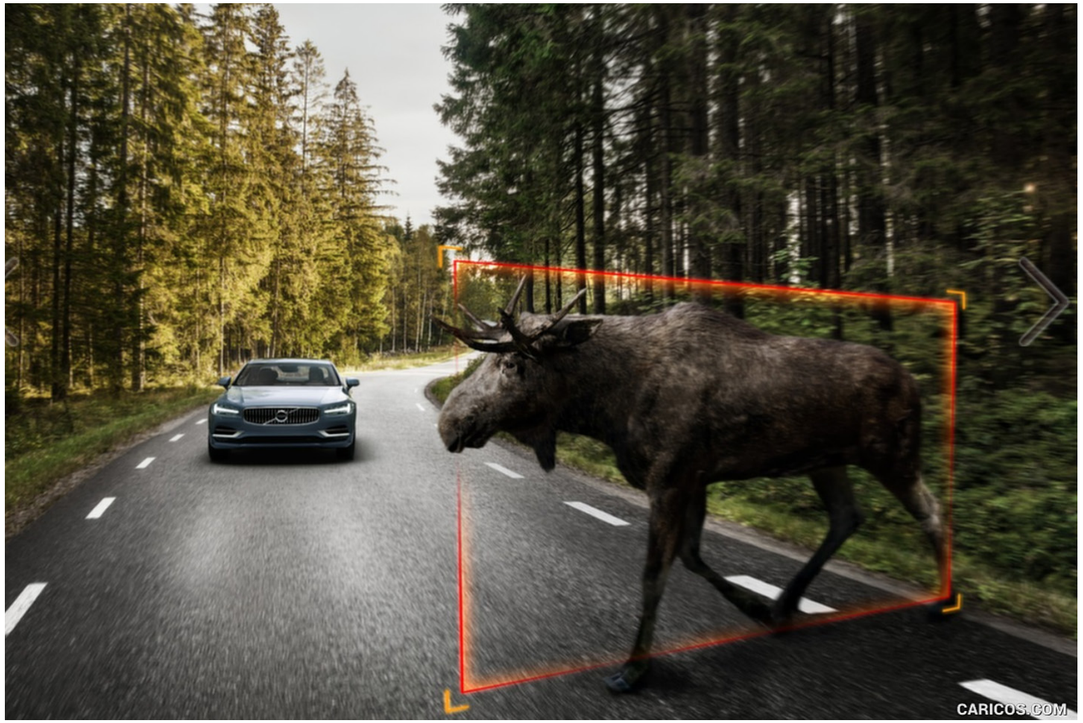


Figure 4.4.9: Volvo publicity shot used to promote its Large Animal Detection System. Reproduced under fair use doctrine. https://www.caricos.com/cars/v/volvo/2017_volvo_s90/images/52.html

unpredictable movements are used to catalyze and sustain subsidiary economies of the fossil fuel industries, whether manufacturers of massive bumpers or motion-detecting vision machines. Like the "wildlife shield" used to protect linemen from the osprey while they repair cell towers, the wildlife crossing enables the forces of governance and industry to protect drivers and save animals, while sustaining a fossil fuel world order that is killing us all.

## Conclusion

Visual mediations of animal-infrastructure relations serve as useful sites for excavating elusive materialisms and political economies of the infrastructural. I would like to close with two points. First, I want to emphasize that unpredictable relations among different kinds of objects are part of the historical development and operation of media systems and infrastructural materialities. Considering the intra-actions of the osprey, the chimp, and wildlife with cell towers, power lines, and highways not only works to extend materialist understandings of the infrastructural by accounting for animal actions, but also simultaneously demonstrates how animals *become infrastructural*. On the one hand, animal actions alter the morphology and operation of infrastructural installations and affect economic relations. And on the other, animal bodies and energies can be harnessed and reorganized as support systems for human-attention economies or motivate the design of products that reinforce past investments in the built environment and sustain species hierarchies. What I have not discussed are what might be called *natural infrastructures* designed by animals, such as a nest, mentioned briefly in the first section, which are as complex and important. Perhaps some infrastructures ought to *remain* elusive. As Braidotti poignantly states: "How to deterritorialize, or nomadize, the human-animal interaction … becomes the challenge." We have to be able to imagine "a life that does not require the supervision of the human mind in order to endure."[53]

Finally, all infrastructures are *media infrastructures*. No infrastructure goes unmediated and all infrastructures mediate. As these videos have suggested, drawings, photos, maps, graphics, and networks (and processes of storage) are used in the process of scouting locations for, designing, building, operating, maintaining, and analyzing the efficiency and use of contemporary infrastructures, whether mobile phone networks, electrical grids, or highways. Infrastructures also mediate, as I suggested at the outset, in that they mark territory and signal their existence through their location, form, scale, and operation. The question for media scholars is how to build the animal into historical and theoretical accounts of media technologies in ways that exceed the figurative or the metaphoric. Such a process would not only involve exploring how the flights of osprey, the captivity of a chimp, the highway crossings of wildlife (and the activities of untold other species) become infrastructural; it would also approach such kinds of intra-actions as integral to global ecologies and economies and to the establishment of ways of analyzing them. If the infrastructural involves the process of organizing and operating a sociotechnical system that is distributed across territory and sustained over time as well as ways of thinking about that system, then the animal is inherently part of this process. ◎

1. This essay was first developed as a keynote lecture for the Transmediale Festival in Berlin in February 2017 during the Becoming Environmental/ Becoming Infrastructural session. I am grateful to questions and feedback I received there as well as when I presented the paper at the Medium/ Environment Conference at UC Berkeley in April 2018. I also thank Miha Vipotnik for collaborating with me on three related videos.

2. Rosi Braidotti, *Metamorphoses: Towards a Materialist Theory of Becoming* (Cambridge, UK: Polity Press, 2003), 133. Citing Borges, Rosi Braidotti also writes, "Animals … come in three categories: those we humans eat; those we watch television with and those we are frightened of (wild, exotic or untamed ones)" (121).

3. Also see Richard Grusin, ed., *The Non-Human Turn* (Minneapolis: University of Minnesota Press, 2017).

4. Donna Haraway, *Simians, Cyborgs and Women* (London: Routledge, 1991), and *Staying with the Trouble* (Durham: Duke University Press, 2017); Braidotti, *Metamorphoses*.

5. Susan Leigh Star, "The Ethnography of Infrastructure," *American Behavioral Scientist* 43, no. 3 (1999): 377–391; Stephen Graham and Simon Marvin, *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition* (London: Routledge, 2001), 20.

6. Jussi Parikka, *A Geology of Media* (Minneapolis: University of Minnesota Press, 2015), 62.

7. Ibid., 63. Parikka calls for "alternative accounts of how to talk about materiality of media technology" (45).

8. I first encountered Barad's concept of intra-action in her book *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham: Duke University Press, 2017). I subsequently found an interview with her very helpful, and the quotes in this paragraph are taken from it: "Intra-actions: Interview of Karan Barad by Adam Kleinmann," 77, https://www.academia.edu/1857617/_Intra-actions_Interview_of_Karen_Barad_by_Adam_Kleinmann_.

9. As Donna Haraway suggests in *Staying with the Trouble*, "It matters what matters we use to think other matters with" (12).

10. John Durham Peters makes this observation about their work in *The Marvelous Clouds: Toward a Philosophy of Elemental Media* (Chicago: University of Chicago Press, 2015).

11. https://fresc.usgs.gov/products/papers/2345_Henny.pdf.

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