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Awakening the Slumbering Giant: How Horizontal Drilling Technology Brought the Endangered Species Act to Bear on Hydraulic Fracturing

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AWAKENING THE SLUMBERING GIANT: HOW HORIZONTAL DRILLING TECHNOLOGY BROUGHT THE ENDANGERED SPECIES ACT TO BEAR ON HYDRAULIC FRACTURING

Kalyani Robbins[†]

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INTRODUCTION

Hydraulic fracturing (also known as “fracking”) is nothing new. It dates back to the 1940s and drew little environmental attention or concern for most of its existence. It is a form of natural gas extraction that involves pumping water, chemicals, and sand slurry into a well at extremely high pressure in order to fracture the surrounding rock formation and prop open passages. This frees up the trapped natural gas to flow from the resulting rock fractures to the production well for capture. Fracking operations have evolved from using a range of 20,000 to 80,000 gallons of water per well to using up to 8 million gallons of water and 75,000 to 320,000 pounds of sand (proppant) per well.¹ Much of this advancement happened in the last two decades, thanks largely to the development of dramatically more advanced drilling technology that allows for horizontal drilling deep under the ground. After drilling

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1. *A Brief History of Hydraulic Fracturing*, ENVTL. ENG'G & CONTRACTING, <http://www.eecworld.com/contact-us/los-angeles-office/258> (last visited Mar. 24, 2013).

downward from the point of entry, the drill turns roughly ninety degrees once deep underground, thereafter traveling parallel to the surface. To visualize this process, imagine a very tall “L” with the long side horizontal underground and the short side’s tip at the surface. While the downward drilling goes a substantial distance, the drill goes much further after it turns horizontally, and is thus able to get at exponentially more of the shale rock. This new technology has not only rendered the method far more productive and profitable but has also increased the environmental impact.

The recent development of utility-scale hydraulic fracturing, which has taken place at a gold-rush pace and with a corresponding level of excitement, has raised many new environmental concerns. The issues are quite serious, ranging from drinking water contamination to earthquakes, so it is not surprising that wildlife has not been at the forefront of the alarms. But as it turns out the wildlife problem, and not the contamination of the human water supply, may well be the most ominous for the industry. This seemingly anomalous circumstance stems from the array of regulatory exemptions granted to the industry in the statutes designed to protect human health and the complete absence of such exceptions in the Endangered Species Act (ESA). Indeed, the ESA tends to be the least flexible of environmental statutes. It may not get its due in implementation, but when it is applied, it is fierce and unbending. We are just now gradually learning that the new scale of hydraulic fracturing technology is fraught with potential ESA violations, and early signs suggest that the wildlife agencies and NGOs are poised to halt the activity.

I. WHAT IS HYDRAULIC FRACTURING AND HOW HAS IT CHANGED?

Traditional oil and gas extraction involves drilling through impervious rock that traps concentrated underground reservoirs of oil and gas.² Extraction occurs simply due to the change in pressure caused by the drilling, and this method has always been very

2. See CARL E. BEHRENS ET AL., CONG. RESEARCH SERV., R 40872, U.S. FOSSIL FUEL RESOURCES: TERMINOLOGY, REPORTING, AND SUMMARY 6 (2011) (discussing these technologies), available at <http://www.fas.org/sgp/crs/misc/R40872.pdf>; Simon Mathias, Professor, Dep’t of Earth Sciences, Durham Univ., Presentation: Hydraulic Fracturing of Shale Gas Reservoirs—Implications for the Surrounding Environment (Sept. 2010) (same); Robert A. McDonald, *California’s Silent Oil Rush*, NEW TIMES (San Louis Obispo), Aug. 31, 2011, <http://www.newtimeslo.com/cover/6555/californias-silent-oil-rush/> (discussing the impact of these changes on California); Paleontological Research Inst., *Understanding Drilling Technology*, MARCELLUS SHALE, Jan. 2012, at 1, 1, available at http://www.museumoftheearth.org/files/marcellus/Marcellus_issue6.pdf (discussing these technologies with regard to Marcellus Shale resources).

economically appealing, resulting in as much exploitation as is permitted. But not all of the earth's coveted fossil fuels sit conveniently in these conventional deposits. Quite a bit is trapped in tiny pores and cracks within otherwise impermeable sedimentary rock formations, such that a similar quantity of the resource is spread out over a much larger area. Shale (which is most often the target of the current fracking boom) is an example of such rock. For this reason, the fossil fuel deposits in shale are far more difficult to reach than those in conventional pooled deposits. This oil (called "tight oil") and gas were thus at one time effectively out of our reach.

Hydraulic fracturing solves this problem. In order to reach the many tiny deposits throughout the rock, it is fractured by injecting a specially formulated fluid into it with tremendous pressure. This fluid contains sand, coarsely ground walnut shells, and other similarly sized materials to serve as proppant, so that the many cracks created by the immense pressure do not simply close back up the moment the force is reduced or stopped. Although the fracking fluid, or "slickwater," is largely water, it contains many dangerous chemicals in addition to the proppant. The wide variety of chemicals

are included to perform specific actions, such as the addition of friction reducers which allows a fracturing fluid and proppant to be pumped to the target zone at a higher rate and reduced pressure than by using water alone. In addition to friction reducers, other additives include biocides to prevent micro-organism growth and reduce bio-fouling of fractures. Oxygen scavengers and other stabilizers which prevent corrosion of metal pipes, and acids which are used to remove drilling mud damage within the area near wellbore are also common either in fracturing fluids or as part of the fracture treatment.³

Although the basic idea of fracturing the shale rock to release the gas stored throughout it dates back at least to the 1940s, two major changes in the 1990s made the practice far more efficient. Improvement in fracking fluid is one of them; the other is horizontal technology, allowing the operation to reach far more of the shale as well as to reach shale in locations that were previously inaccessible. These two developments have rendered the practice dramatically more lucrative and have also exponentially increased the quantity of shale gas available for capture. Oil and gas companies saw that there was great profit available, and government regulators saw the amazing potential for domestic energy production, and the boom

3. J. DANIEL ARTHUR ET AL., N.Y. DEP'T OF ENVTL. CONSERVATION, HYDRAULIC FRACTURING CONSIDERATIONS FOR NATURAL GAS WELLS OF THE MARCELLUS SHALE 10-11 (2008), *available at* http://www.dec.ny.gov/docs/materials_minerals_pdf/GWPCMarcellus.pdf.

commenced, with regulatory loopholes designed to pave the way. This paving also sped things along at a break-neck pace, such that the development had already begun to spread across the countryside before substantial environmental analyses could be done.

The New York State Department of Environmental Conservation provides the following overview of technological milestones for hydraulic fracturing:

*Hydraulic Fracturing Technological Milestones*⁴

Early 1900s	Natural gas extracted from shale wells Vertical wells fractured with foam
1983	First gas well drilled in Barnett Shale in Texas
1980–1990s	Cross-linked gel fracturing fluids developed and used in vertical wells
1991	First horizontal well drilled in Barnett Shale
1991	Orientation of induced fractures identified
1996	Slickwater fracturing fluids introduced
1996	Microseismic post-fracturing mapping developed
1998	Slickwater refracturing of originally gel-fractured wells
2002	Multi-stage slickwater fracturing of horizontal wells
2003	First hydraulic fracturing of Marcellus Shale
2005	Increased emphasis on improving the recovery factor
2007	Use of multi-well pads and cluster drilling

The importance of the horizontal drilling technology cannot be overstated. Even with the slickwater and the ability to fracture the rock and collect gas from numerous fissures along the wellbore, when this is done only in a vertical line from the well pad at the surface, it lacks economic value. The shale deposits are relatively thin (albeit deep under the ground) layers, but cover massive (multi-state) horizontal areas and a vertical drill only engages with a tiny area of

4. N.Y. STATE DEP'T OF ENVTL. CONSERVATION, REVISED DRAFT SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM: WELL PERMIT ISSUANCE FOR HORIZONTAL DRILLING AND HIGH-VOLUME HYDRAULIC FRACTURING TO DEVELOP THE MARCELLUS SHALE AND OTHER LOW-PERMEABILITY GAS RESERVOIRS 5-5 (2011) [hereinafter NYDEC REPORT], available at <http://www.dec.ny.gov/energy/75370.html> (click on "V. Natural Gas Development Activities and High-Volume Hydraulic Fracturing (PDF) (5.2 MB)").

the rock. As such, the expense of a vertical drilling operation is not justified by the potential gas development. But when the wellbore can turn to the side and follow along this huge area of horizontally laid sedimentary shale rock, it reaches a much larger area. It is not unusual to extend the fracture a full horizontal mile, reaching all of the shale that would have gone untapped in a vertical drilling operation. It is not difficult to see how dramatically more profitable horizontal drilling renders the practice of hydraulic fracturing. It also explains why hydraulic fracturing technology existed but was barely used for half a century, then suddenly exploded onto the scene as if it were something new.

Given that these developments happened two decades ago, why are we just beginning to talk about the resulting phenomenon now? Like with most technological advancement, there is a delay from initial discovery or design to the point of peak efficiency. Hydraulic fracturing technology has improved over time, and has only recently become a force to be reckoned with:

From 2007 to 2009, the average lateral length of horizontal drilling for shale rock resources increased by a factor of five, allowing for a tripling of the initial production rate in some shale formations. This technological advance substantially lowered costs and allowed for greater technical access to the shale gas resource in-place. [As of 2011] in North America, break-even prices for some of the more prolific shales [were] estimated to be as low as \$3 per thousand cubic feet (mcf), with a large majority of the resource accessible at below \$6/mcf. Ten years ago, costs were three to four times higher. As firms continue to make cost reducing innovations, it is likely that the recoverable resource base is larger than presently estimated.⁵

Indeed, when scientists estimated the total amount of shale gas in the world in 1997 (one fourth of which was to be found in North America), less than ten percent was deemed technically recoverable, and even less of it economically so.⁶ A decade later, estimates were around forty percent.⁷ That recent decade more than quadrupled our technological access to shale gas and corresponding development

5. AMY MYERS JAFFE ET AL., JAMES A. BAKER III INST. FOR PUB. POLICY, *THE STATUS OF WORLD OIL RESERVES: CONVENTIONAL AND UNCONVENTIONAL RESOURCES IN THE FUTURE SUPPLY MIX 12* (2011).

6. *Id.* at 11.

7. *Id.* at 11–12.

potential. And from 2008 to 2009, Pennsylvania's number of fracking wells more than quadrupled as well.⁸

In addition to making the practice of fracking far more lucrative, these two new technologies also exacerbated its environmental impact—and not just due to increased fracking activity (though of course that has been substantial). The well pad and other surface disturbances now cover a much larger area than before.⁹ Also, given the significantly increased length of the wells, it is more difficult to get adequate pressure from a single fluid injection, so drillers have developed multi-stage fracking, in which only one small segment of the wellbore is treated at a time—as little as 300 feet of a wellbore that is a mile or more long.¹⁰ Fracking a dozen or more segments one at a time results in a substantially longer period of invasive activity and requires millions more gallons of contaminated water.

The meteoric rise of hydraulic fracturing in the early twenty-first century was further fueled by a generous set of regulatory exemptions, freeing the activity from many of the laws that might have constrained it. “In 2005, Congress expressly excluded hydraulic fracturing from the definition of ‘underground injection,’ meaning that the federal Safe Drinking Water Act requirements for the prevention of contamination of groundwater do not apply to the practice.”¹¹ This exemption is especially embarrassing considering that tap water contamination has become the most highly publicized fracking hazard. The 2010 film *Gasland*,¹² famous for its depiction of tap water that catches on fire when lit, was nominated for numerous awards, including the Academy Award for Best Documentary, and it won a Primetime Emmy as well as a half-dozen mainstream film festival awards.¹³ A sequel is underway.¹⁴

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8. See Hannah Wiseman, *Regulatory Adaptation in Fractured Appalachia*, 21 VILL. ENVTL. L.J. 229, 240 (2010) (“Between 2008 and 2009, the number of Marcellus wells drilled in Pennsylvania more than quadrupled.”).
 9. See NYDEC REPORT, *supra* note 4, at 524 (describing changes linked to horizontal drilling).
 10. See *id.* at 5-93 to 5-94 (describing the procedures and impacts of multi-stage fracking).
 11. Wiseman, *supra* note 8, at 243 (citing 42 U.S.C. § 300h(d)(1) (2006)).
 12. GASLAND (Int'l WOW Co. 2010).
 13. *Awards for Gasland*, INTERNET MOVIE DATABASE, http://www.imdb.com/title/tt1558250/awards?ref_=tt_awd (last visited Mar. 24, 2013) (cataloguing awards for *Gasland*).
 14. See Jeff Goodell, *New Anti-Fracking Film by Gasland's Josh Fox Targets Cuomo: 'Governor, What Color Will the Sky Be Over New York?'*, ROLLING STONE POLITICS BLOG (June 20, 2012, 11:30 AM), <http://www.rollingstone.com/politics/blogs/national-affairs/new-anti-fracking-film-by-gaslands-josh-fox-targets-cuomo-governor-what-color-will-t>

Arguably more disturbing is the industry's exemption from regulation under the Resource Conservation and Recovery Act (RCRA),¹⁵ the statute regulating ground disposal of hazardous wastes. That impressive perk was the result of intense oil and gas industry lobbying efforts in the 1980s,¹⁶ and it was initially intended to last only while Congress asked the EPA to investigate whether the industry should be subject to RCRA regulation.¹⁷ The EPA's study found that the water produced from this type of drilling contained concentrations exceeding 100 times the health-based standards for toxic chemicals such as "benzene, arsenic, barium, and boron."¹⁸ Nonetheless, the EPA recommended continued exemptions for the industry upon which much of our energy hopes were resting. Such regulatory choices have indeed reduced the cost of natural gas, but the savings may be blinding us to the real cost.

II. THE GIANT

The ESA requires the listing of species that are either endangered or threatened. A species is endangered if it "is in danger of extinction throughout all or a significant portion of its range,"¹⁹ and a species is threatened if it "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."²⁰ These species-listing determinations, and the enforcement of resulting protections, are tasked to the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS), which I will collectively refer to as the Services or the wildlife agencies. The FWS is responsible for terrestrial species and freshwater fish, and the NMFS focuses on marine species and anadromous fish.²¹ The ESA is

he-sky-be-over-new-york-20120620 ("FYI, Josh [Fox] is working on a sequel for HBO, called *Gasland 2*, which will be out later this year.").

15. Resource Conservation and Recovery Act of 1976, 42 U.S.C. §§ 6901–6992k (2006).
16. James R. Cox, *Revisiting RCRA's Oilfield Waste Exemption as to Certain Hazardous Oilfield Exploration and Production Wastes*, 14 VILL. ENVTL. L.J. 1, 2–3 (2003).
17. Wiseman, *supra* note 8, at 244.
18. Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes, 53 Fed. Reg. 25,446, 25,455–56 (July 6, 1988) (to be codified at 40 C.F.R. pt. 257).
19. Endangered Species Act of 1973 § 3(6), 16 U.S.C. § 1532(6) (2006).
20. 16 U.S.C. § 1532(20).
21. *Endangered Species Act (ESA)*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., <http://www.nmfs.noaa.gov/pr/laws/esa> (last updated Mar. 7, 2013). "Anadromous" refers to a species practice of moving from the sea to a freshwater body (typically a river) to breed.

often called the “pit bull” of environmental legislation,²² in part because of the landmark case *Tennessee Valley Authority v. Hill*, in which the Supreme Court held that the ESA was intended “to halt and reverse the trend toward species extinction, whatever the cost.”²³ In that case, it meant that a nearly completed, federally funded multi-million-dollar dam had to go to waste (not be operated) to protect a minute population of tiny fish. When listing a species, the Services must also designate critical habitat essential to the conservation of the species.²⁴

Once listed, substantial protections are available to a species. Section 7 of the ESA requires all federal agencies to ensure that the actions they carry out, fund, or authorize (such as by granting permits to private parties, as is often necessary in the fracking context) are not likely to jeopardize the continued existence of any listed species or adversely modify any designated critical habitat.²⁵ The action agency accomplishes this via formal consultation with the wildlife agency responsible for the listed species at issue, which is any species that may be affected by the agency action.²⁶ The wildlife agency must then issue a formal biological opinion determining whether the action is or is not likely to jeopardize the species or adversely modify the critical habitat.²⁷ The action agency holds the ultimate responsibility for compliance with the section and is not bound by the biological opinion in determining how to proceed.²⁸ In other words, the action agency must not jeopardize the species, nor adversely modify its designated critical habitat, regardless of what the wildlife agency says in its biological opinion.

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22. George Cameron Coggins, *An Ivory Tower Perspective on Endangered Species Law*, 8 NAT. RESOURCES & ENV'T 3, 3 (1993); Oliver A. Houck, *The Endangered Species Act and Its Implementation by the U.S. Departments of Interior and Commerce*, 64 U. COLO. L. REV. 277, 279 (1993) (footnote omitted); Robert D. Thornton, *Searching for Consensus and Predictability: Habitat Conservation Planning Under the Endangered Species Act of 1973*, 21 ENVTL. L. 605, 605 (1991); Steven P. Quarles, *The Pit Bull Goes to School*, 15 ENVTL. F., Sept.–Oct. 1998, at 55; Timothy Egan, *Strongest U.S. Environment Law May Become Endangered Species*, N.Y. TIMES, May 26, 1992, at A1 (quoting Donald Barry, a vice president of the World Wildlife Fund).
 23. *Tenn. Valley Auth. v. Hill*, 437 U.S. 153, 184 (1978).
 24. 16 U.S.C. § 1533(a)(3)(A)(i).
 25. *Id.* § 1536(a)(2).
 26. 50 C.F.R. § 402.14(g)(4) (2012).
 27. 16 U.S.C. § 1536(b)(3)(A).
 28. *Sierra Club v. Froehлке*, 534 F.2d 1289, 1303–04 (8th Cir. 1976); 50 C.F.R. § 402.15.

Section 9 of the ESA prohibits any person, public or private, from “taking” a listed species of fish or wildlife.²⁹ “Take” is a term of art—and a relatively broad one—encompassing both direct harm to individual members of a protected species and indirect harm through habitat alterations that injure any such individual.³⁰ “Section 9 imposes extraordinarily broad liability, particularly in comparison to the laws that preceded it.”³¹ The ESA directly entitles endangered species to this protection, while threatened species can only obtain section 9 protection via regulations.³² All threatened species (with limited exceptions) governed by the FWS have this coverage,³³ and the NMFS provides it case by case to individual species.³⁴ To grasp the incredible power behind section 9, consider that it applies to private use of private property, prohibiting even mere habitat alterations—without requiring those alterations to be so great as to jeopardize the species. Any alterations injurious to an individual member of the protected species are proscribed, where “injury” includes impact on its ability to breed, feed, or obtain shelter.³⁵

Whether one uses the traditional pit bull or my giant as the metaphor, it is easy to see how devastating the ESA can be to human development, whether in the context of urban sprawl, logging, dams, or fracking. It is oblivious to economic demands. It does not care if you can domestically power the country for decades or if the efficiency of your technology might reduce the cost of energy at a desperate time. What matters under the ESA is far more black and white than all that: Will you jeopardize or “take” a listed species, or damage its habitat? You simply may not do so, no matter what. Avoiding extinction trumps everything else. It is irreparable damage.

Unlike the other statutes that might otherwise stand in the way of fracking if not for their loopholes and fracking-specific exemptions, the ESA will not so yield. After four decades of costly sacrifices, it has yet to offer exceptions. That said, after even more decades of fracking, at least until recently, we had yet to see any interest in restricting the practice under the ESA. This is because traditional fracking, using

29. 16 U.S.C. §§ 1538(a)(1)(B)–(C).

30. *Id.* § 1532(19).

31. Holly Doremus, *The Purposes, Effects, and Future of the Endangered Species Act’s Best Available Science Mandate*, 34 ENVTL. L. 397, 405 (2004).

32. 16 U.S.C. § 1533(d).

33. 50 C.F.R. § 17.31(a) (2012).

34. *See, e.g., id.* §§ 223.201–03, 205 (regulations governing Steller sea lions, anadromous fish, and sea turtles, respectively).

35. *See Babbitt v. Sweet Home Chapter of Cmty. for a Great Or.*, 515 U.S. 687, 695–704 (1995) (upholding this expansive reading of “harm”).

vertical-only technology, was capable of reaching very little of the target rock. This meant two things: first, fewer chemicals were needed and the environmental impact was thus minimized; and second, it was less productive or efficient, and thus less attractive and only minimally utilized. Traditional fracking was not a major threat to ecosystems. The ESA giant slumbered peacefully. Then the modern horizontal fracking technology entered the scene.

III. THE AWAKENING

The development of drastically more efficient and productive fracking technology surely seemed like a good idea, given our severe energy deficiencies, and the advance has caused a great deal of excitement. At first blush, it is indeed exciting. Massive quantities of natural gas, enough to power the nation, previously inaccessible to us, can be reached in a manner that one could very nearly describe as easy and relatively inexpensive. The website for a pro-fracking advocacy group describes the process in several pages, one of which is titled “A Few Days of Fracking, Decades of Oil and Gas Production.”³⁶ Such a boon is so great that one can hardly begrudge the industry for jumping in with both feet. It is not at all surprising that those capable of carrying out this golden new technology would fail to take the time to think through every possible concern. Time is money after all. But while the industry celebrates its way across the land, its increased activity has shaken our giant awake. The giant has observed some disconcerting phenomena, and its team of enforcers (the agencies and NGOs) is just now being deployed.

The problem is that fracking can be quite harmful to wildlife and ecosystems, and when the industry gets big enough, it inevitably begins to reach some of the more vulnerable species and their habitats. In 2012, this reality began to come to light. It is rare in researching an issue that virtually all results—technical reports, lawsuit filings, relevant species listings, and scholarly articles (of which there are very few in any event)—come from the same year, but that is how sudden and dramatic this awakening is. This symposium Article is itself on the front end of the battle between fracking and endangered species protection. In this sense it is somewhat speculative as to how large a role the ESA will play, but the early data strongly support the potential for a ramping-up of the conflict.

Before getting into the conflicts with wildlife specifically, and thus the potential for an ESA roadblock, let us review some of the environmentally relevant differences between old fracking (the first half-century plus of the practice) and new fracking, as it is this jump

36. *A Few Days of Fracking, Decades of Oil and Gas Production*, ENERGYFROMSHALE, <http://www.energyfromshale.org/hydraulic-fracturing/shale-natural-gas> (last visited Mar. 29, 2013).

that has stirred our ESA giant. A document created for the Marcellus Accountability Project does a fabulous job of summarizing the major differences:

- **More Chemicals:** Per fracturing, old hydrofracturing used 700 to 2,800 lbs. of chemical additives, but HVHF [High Volume Hydraulic Fracturing—the new fracking] will use 130,000 to 580,000 lbs., many of which are toxic to humans and wildlife.
- **More Toxic Waste Requiring Disposal:** Assuming HVHF wells use 100 times more fluid than traditional wells (within the 40 to 200x range noted above), the drilling of 16 wells per square mile (1 well per 40 acres) in the Marcellus shale creates an amount of toxic waste fluid equivalent to that from 1,600 traditional wells per square mile.
- **More Truck Traffic:** To construct one traditional well requires fewer than 225 to 484 tanker truck trips, but one HVHF well requires 1,180 to 1,324 trips. Thus, a typical Marcellus well pad with 7 wells adds about 9,000 round-trip truck trips to local roads.
- **More Fresh Water Used:** With HVHF, more fresh water will be removed from local streams, lakes, and aquifers; because it will be contaminated, it probably will not be returned to the watershed, although how the volumes of waste will be disposed of has yet to be determined. HVHF of one well would remove 3.5 million gallons of fresh water, more than the City of Ithaca [in upstate New York] uses each day to supply over 35,000 customers.
- **More Drill Cuttings Requiring Disposal:** A traditional vertical well 3,000 [feet] deep creates about 54 [cubic yards] of drill cuttings, but a HVHF well to the same depth will create 94 cubic yards, about 74% more [drill cuttings]. Cuttings may contain radioactive materials (NORM) [Naturally Occurring Radioactive Materials], heavy metals, and various toxic chemicals, depending on the types of drilling muds (fluids) used.
- **Larger Disturbed Areas:** HVHF well pads will be larger (4 to 5 cleared acres) than those for traditional wells (2 to 3 acres) because (1) they must store more fluid, chemicals, drill cuttings, drilling fluids, and equipment, and (2) they are expected to contain multiple wells. Thus any given HVHF well pad will create more run-off, siltation, and visual scars, and disturb more forest or agricultural land.³⁷

37. MARCELLUS ACCOUNTABILITY PROJECT, HOW WILL HIGH-VOLUME (SLICKWATER) HYDRAULIC FRACTURING OF THE MARCELLUS (OR UTICA) SHALE DIFFER FROM TRADITIONAL HYDRAULIC FRACTURING? (2010) (footnotes omitted).

The increased potential for ESA conflict (awakening our giant) begins with a 2012 United States Geological Survey (USGS) report that quantified landscape changes due to natural gas extraction between 2004 and 2010 in Bradford and Washington Counties, Pennsylvania, and concluded that shale gas and coalbed methane natural gas extraction practices (specifically, hydraulic fracturing) “create potentially serious patterns of disturbance on the landscape.”³⁸ The report considered the impacts of landscape disturbance caused by well pads, roads, pipelines, impoundments, water use, processing plants, storage tanks, and staging areas.³⁹ It observed an increase in disturbances to habitat, especially forest habitat, due to increased forest fragmentation.⁴⁰ This led to the problem of edge-effects, in which there is an increase in edge forest and a substantial decrease in the interior forest upon which many species depend, as well as an overall loss of forest.⁴¹ These forest alterations can have serious detrimental impacts on both flora and fauna.⁴²

While the industry touts its ability to get at a lot of natural gas with a relatively small surface footprint, the problem is that these relatively small footprints are scattered throughout a region, effectively riddling it with bullet holes. Indeed, the USGS report goes so far as to characterize the problem as

38. E.T. SLONECKER ET AL., U.S. GEOLOGICAL SURVEY, LANDSCAPE CONSEQUENCES OF NATURAL GAS EXTRACTION IN BRADFORD AND WASHINGTON COUNTIES, PENNSYLVANIA, 2004–2010, at 1 (2012), available at <http://pubs.usgs.gov/of/2012/1154/of2012-1154.pdf>.

39. *Id.* at 8.

40. *Id.* at 9–10.

41. *Id.*

42. The report states:

Numerous secondary roads and pipeline networks crisscross and subdivide habitat structure. Landscape disturbance associated with shale-gas development infrastructure directly alters habitat through loss, fragmentation, and edge effects, which in turn alters the flora and fauna dependent on that habitat. The fragmentation of habitat is expected to amplify the problem of total habitat area reduction for wildlife species, as well as contribute towards habitat degradation. Fragmentation alters the landscape by creating a mosaic of spatially distinct habitats from originally contiguous habitat, resulting in smaller patch size, greater number of patches, and decreased interior to edge ratio. Fragmentation generally results in detrimental impacts to flora and fauna, resulting from increased mortality of individuals moving between patches, lower recolonization rates, and reduced local population sizes. The remaining patches may be too small, isolated, and possibly too influenced by edge effects to maintain viable populations of some species.

Id. at 9–10 (citations omitted).

extensive and long-term habitat conversion [that] has a greater impact on natural ecosystems than activities such as logging or agriculture, given the great dissimilarity between gas-well pad infrastructure and adjacent natural areas and the low probability that the disturbed land will revert back to a natural state in the near future.⁴³

This is not just about forest quality for the region, but becomes a matter of ESA enforcement when you consider that listed species live in these forests. Indeed, there are already plans for new fracking development in areas occupied by several dwindling species that are highly sensitive to human activity, including the greater sage grouse and lesser prairie chicken.⁴⁴ This hazard is especially serious for species with limited geographic ranges.⁴⁵

Another very serious menace is that withdrawing water from streams and rivers for fracking can threaten fisheries, as can contamination by wastewater. “To drill a single well in the Marcellus Shale, a natural gas company requires, on average, around seven million gallons of fresh water. . . . Some of Pennsylvania’s streams have already gone dry on account of this activity.”⁴⁶ Many aquatic species cannot even survive a substantial reduction in water level, much less complete loss, which is obviously catastrophic to the ecosystem. The rivers in the fracking gold rush territory are in serious trouble. In a 2010 report, American Rivers named the Upper Delaware River America’s most endangered river and the Monongahela River America’s ninth most endangered river, based expressly on the increased natural-gas activity and the rivers’ position above the Marcellus Shale.⁴⁷

43. *Id.* at 10.

44. See WILDLIFE SOCIETY, TECHNICAL REV. 12-02, IMPACTS OF CRUDE OIL AND NATURAL GAS DEVELOPMENTS ON WILDLIFE AND WILDLIFE HABITAT IN THE ROCKY MOUNTAIN REGION 3 (Theodore A. Bookhout ed., 2012), available at http://wildlife.org/documents/technical-reviews/docs/Oil%20and%20Gas%20Technical%20Review_2012.pdf (describing the effects of energy development on these species).

45. See Jennifer L. Gillen & Erik Kiviat, *Hydraulic Fracturing Threats to Species with Restricted Geographic Ranges in the Eastern United States*, 14 ENVTL. PRAC. 320–31 (2012) (describing the threat posed to species with restricted geographic ranges that overlap with the Marcellus and Utica shales).

46. Michael Dillon, *Water Scarcity and Hydraulic Fracturing in Pennsylvania: Examining Pennsylvania Water Law and Water Shortage Issues Presented by Natural Gas Operations in the Marcellus Shale*, 84 TEMP. L. REV. 201, 202 (2011) (footnotes omitted).

47. Press Release, Am. Rivers, American Rivers Announces America’s Most Endangered Rivers (June 2, 2010), available at <http://www.americanrivers.org/newsroom/press-releases/2010/americas-most-endangered-rive>

Once again, as with the forest fragmentation, it is not just about river or fishery quality for the region but becomes a matter of ESA enforcement because listed aquatic species live in these rivers and streams. Many local, regional, and national news outlets have reported on fish kills as a result of fracking contamination,⁴⁸ and some have linked hydraulic fracturing to such events as a “rash of bird and

rs-2010-6-2-2010.html. The relevant portion of the press release on the report stated:

1) Upper Delaware River (NY, PA)

Threat: Gas drilling

The Upper Delaware River provides drinking water for 17 million people across Pennsylvania and New York. Unfortunately, this clean water source is threatened by natural gas extraction activities in the Marcellus Shale, where chemicals are injected into the ground creating untreatable toxic wastewater. The Delaware River Basin Commission must not issue permits for gas drilling in this watershed until a thorough study of impacts is completed. Congress must also pass the Fracturing Responsibility and Awareness of Chemicals Act of 2009.

. . . .

9) Monongahela River (WV, PA)

Threat: Gas drilling

The Monongahela River provides drinking water for hundreds of thousands of people, and is home to some of the East Coast's best fishing, whitewater boating, and wildlife. However, the river and its clean water are threatened by toxic pollution created by natural gas extraction activities in the Marcellus Shale. The Ohio River Valley Water Sanitation Commission, and the states of Pennsylvania and West Virginia, must act to prohibit pollution associated with Marcellus Shale drilling to protect the region's clean water for future generations.

Id.

48. See, e.g., Mike Soraghan & Greenwire, *EPA Scientist Points at Fracking in Fish-Kill Mystery*, SCI. AM. (Oct. 12, 2011), <http://www.scientificamerican.com/article.cfm?id=epa-scientist-points-at-fracking-in-fish-kill-mystery> (reporting that an EPA scientist linked a toxic algae bloom at Dunkard Creek in West Virginia and Pennsylvania to fracking in the Marcellus shale); David O. Williams, *Fracking Fluid Kills Fish in Pennsylvania Stream, State Enviro Officials Say*, COLO. INDEP. (Sept. 22, 2009, 7:20 AM), <http://coloradoindependent.com/38306/fracking-fluid-kills-fish-in-pennsylvania-stream-state-enviro-officials-say> (reporting that “8,000 gallons of a ‘potential carcinogen’ manufactured by Halliburton” used in hydraulic fracturing spilled into a creek near Dimock, Pennsylvania); Abraham Lustgarten, *Frack Fluid Spill in Dimock Contaminates Stream, Killing Fish*, PROPUBLICA (Sept. 21, 2009, 4:09 PM), <http://www.propublica.org/article/frack-fluid-spill-in-dimock-contaminates-stream-killing-fish-921> (same).

fish deaths in Arkansas.”⁴⁹ A major concern is that the industry has forged ahead with its impressive new drilling technology without any corresponding technological advance to cope with the massive quantity of toxic wastewater created by the practice. The Pennsylvania method is to use wastewater treatment plants inadequately designed to deal with the harsh chemicals used in fracking, and the Arkansas method is no better, using wastewater injection wells that sometimes cause earthquakes and water contamination.⁵⁰

Next on the list of harms is the increase of human transportation and construction activity. Any time you bring a lot of new traffic into an ecosystem there will be impacts, especially when the traffic is heavy and on the large scale of construction equipment. In its statement opposing fracking development in California, the Center for Biological Diversity noted:

Fracking comes with intense industrial development, including multi-well pads and massive truck traffic. That’s because, unlike a pool of oil that can be accessed by a single well, shale formations are typically fractured in many places to extract fossil fuels, requiring multiple routes for trucks, adding habitat disturbance for wildlife and more pollution.⁵¹

This sort of wildlife disturbance exacerbates the problems already discussed, especially that of fragmentation, resulting in potentially catastrophic impacts on wildlife and ecosystem functioning.

Bringing loud human activity into otherwise natural areas can directly disturb the wildlife there. Sensitive bird species and other wildlife can be directly affected by drilling noise and construction commotion. A Nature Conservancy study looked at 250 hydraulic fracturing drilling sites “to get a robust look at the spacial footprint” and found potential for the destruction of vast tracts of forestland.⁵² Reviewing a range of disturbances from well pads, roads, pipelines, and containment pits, the study found that each well pad could disturb up to thirty acres of habitat, and thus recommended increasing the

49. John Guerrero, *Ark. Earthquakes, Fish Kill, Bird Deaths Related to Fracking Wastewater Disposal*, EXAMINER.COM (Mar. 14, 2011), <http://www.examiner.com/article/ark-earthquakes-fish-kill-bird-deaths-related-to-fracking-wastewater-disposal>.

50. *See id.* (discussing Arkansas and Pennsylvania fracking procedures).

51. *Fracking Threatens California’s Wildlife*, CTR. FOR BIOLOGICAL DIVERSITY, http://www.biologicaldiversity.org/campaigns/california_fracking/wildlife.html (last visited Mar. 29, 2013).

52. David Thompson, *Conservancy: State Forests at Risk*, WILLIAMSPORT SUN-GAZETTE (Feb. 17, 2011), <http://www.sungazette.com/page/content.detail/id/560378/Conservancy--State-forests-at-risk.html?nav=5011> (quoting Nels Johnson of the Nature Conservancy’s Harrisburg, Pennsylvania, office).

number of wells drilled per pad.⁵³ Of course, while more wells per pad might help to reduce the geographic range of surface disturbance (or rather increase the amount of natural gas produced per disturbance area), it will increase the problems associated with drilling itself, such as the water, chemicals, and underground disturbance.

In spite of the long-understood harm fragmentation causes to ecosystems and their wildlife inhabitants, the industry continues to focus on the actual surface area utilized and not on the bigger picture. A study by The Nature Conservancy shows that there were approximately 1,000 drilled well pads in the Marcellus Shale as of 2010.⁵⁴ The study projects this number to grow exponentially by 2030.⁵⁵ For the forestland of Pennsylvania this means death by a thousand cuts. The Pennsylvania Department of Conservation and Natural Resources (DCNR) conducted a study in 2010 that overlaid existing gas leases with a map of ecologically sensitive areas, and the overlap is substantial.⁵⁶ Some of the leased areas also fall within areas deemed to be inaccessible without damaging sensitive areas.⁵⁷ Another map in the DCNR study shows the placement of well pads over an already developed forest.⁵⁸ They are perfectly spaced throughout, like the holes in a Chinese checkerboard, in order to maximize access to the Marcellus Shale. As a result, there is no substantial area of forest that remains untouched, wild, or roadless. Death by a thousand cuts.

As further evidence that fracking may be killing more wildlife than we even realize, a Cornell University study found that fracking was even killing off livestock and pets.⁵⁹ These deaths are more easily tracked than wildlife deaths. The Cornell study resulted in a 2012

53. *Id.*

54. NELS JOHNSON, PA. CHAPTER OF THE NATURE CONSERVANCY, PENNSYLVANIA ENERGY IMPACTS ASSESSMENT, REPORT 1: MARCELLUS SHALE NATURAL GAS AND WIND 12 (2010), *available at* http://www.nature.org/media/pa/tnc_energy_analysis.pdf.

55. *See id.* (“Depending on how many wells on average are placed on the same pad site . . . we project between 7,000 and 16,000 new well pad sites will be developed in Pennsylvania by 2030.”).

56. PA. DEP’T OF CONSERVATION & NATURAL RES., IMPACTS OF LEASING ADDITIONAL STATE FOREST FOR NATURAL GAS DEVELOPMENT 11 (2010) (“These ecologically sensitive areas protect water quality, provide wildlife travel corridors, are managed for aesthetics/scenery, and provide habitat connectivity. As such, they are not appropriate for gas development.”).

57. *See id.* at 12 (stating that certain areas “cannot be developed for gas without crossing and damaging ecologically sensitive areas”).

58. *See id.* at 21 (“An estimated 54 new well pads could be developed within the next 5–10 years in [an area of about] 65,000 acre[s] . . .”).

59. Michelle Bamberger & Robert E. Oswald, *Impacts of Gas Drilling on Human and Animal Health*, 22 NEW SOLUTIONS 51, 54–61 (2012).

report that “found dozens of cases of illness, death and reproductive issues in cows, horses, goats, llamas, chickens, dogs, cats, fish and other wildlife,” and linked them to fracking.⁶⁰ The study found these impacts in all six states covered—all heavy fracking states—using a variety of methods. As just one example,

[a] farmer separated his herd of cows into two groups: 60 were in a pasture with a creek where hydrofracking wastewater was allegedly dumped; 36 were in separate fields without creek access. Of the 60 cows exposed to the creek water, 21 died and 16 failed to produce calves the following spring. None of the 36 cows in separated fields had health problems, though one cow failed to breed in the spring.⁶¹

The study was somewhat impeded, however, by the secrecy the industry maintains surrounding its chemical cocktail.⁶² One of the study’s conclusions was that those engaged in hydraulic fracturing should be required to disclose the chemicals they intend to use in advance, so that groundwater can be pretested for those chemicals and later compared with post-fracking tests.⁶³

Fracking can also cause the introduction of invasive species, which are the second leading cause of species endangerment (after habitat destruction).⁶⁴ This is a concern for both terrestrial and aquatic ecosystems. On land, the heavy truck activity can bring in invasive species stowaways on the equipment and in the wheel beds.⁶⁵

60. Krishna Ramanujan, *Study Suggests Hydrofracking Is Killing Farm Animals, Pets*, CORNELL UNIV. CHRON. ONLINE (Mar. 7, 2012), <http://www.news.cornell.edu/stories/March12/FrackingAnimals.html>.

61. *Id.*

62. *See id.* (“[M]aking a direct link between death and illness is not possible due to . . . proprietary secrecy from gas drilling companies regarding the chemicals used in hydrofracking . . .”).

63. *Id.* (“Without knowledge of all the chemicals being used, you can’t test before drilling. . . . And if we don’t have predrilling tests then if you find a chemical postdrilling, how can you prove that it came from hydrofracking . . .”) (statement of veterinarian Michelle Bamberger) (internal quotation marks omitted).

64. NAT’L INVASIVE SPECIES COUNCIL, FISCAL YEAR 2005 INTERAGENCY INVASIVE SPECIES PERFORMANCE-BASED BUDGET 1 (2005), *available at* http://www.invasivespecies.gov/global/org_collab_budget/org_collab_budget_documents/NISC%20FY2005%20Crosscut%20Budget%20Summary.pdf.

65. *See* Sandra Steingraber, *Sandra’s 30 Days of Fracking Regs: January 8*, COAL. TO PROTECT N.Y. (Jan. 12, 2013), http://www.coalitiontoprotectnewyork.org/ailec_event/sandras-30-days-of-fracking-regs-january-8 (“Weeds or insect pests carried by trucks or construction equipment can flourish in disturbed areas around wellpads and, from there, spread to nearby agricultural fields.”).

Naturally, this is always a risk for any type of construction equipment, not just fracking equipment, but the difference is that fracking takes place in otherwise undeveloped areas that would not normally be subjected to a large influx of traffic and the corresponding invasive species danger. Aquatically, there have been implications that the equipment used to withdraw water for use in fracking has resulted in the introduction of invasive species into creeks and rivers, interfering with proper ecosystem functioning and causing some of the reported mass fish kills.⁶⁶

IV. THE GIANT'S FIRST STEPS

The impressive recent technological advancements in hydraulic fracturing, resulting in the sudden proliferation of fracking wells and corresponding environmental impact, has begun to attract the attention of the biodiversity conservation community, both governmental and nonprofit. The ESA response to fracking is just picking up. While some regulatory impacts based on endangered species were already playing a role in oil and gas development, including fracking, a few steps first taken in 2012 might be harbingers of doom for these new fracking glory days.

The oil and gas industry has always had conflicts with wildlife, which have largely been one of the intermittent expenses of the trade. "There have been several multi-million dollar settlements for failure to prevent endangered birds from landing in (non-shale) oil and gas production waste pits, where exposure to chemicals has killed the birds."⁶⁷ On occasion, these conflicts can go beyond the economic expense category and into exposure to criminal charges. There have been successful criminal prosecutions under the Migratory Bird Treaty Act for bird deaths resulting from wastewater poisoning or entrapment in drilling equipment.⁶⁸

In addition, fracking operations have already required some attention to endangered species habitat location. "In Pennsylvania hydrofracking companies must have land surveyed for potential endangered species habitats, such as the Indiana Bat, before any well pad development can occur."⁶⁹ For instance, in the event that the

66. *Fracking Threatens California's Wildlife*, *supra* note 51.

67. David L. Callies, *Federal Laws, Regulations, and Programs Affecting Local Land Use Decisionmaking: Hydraulic Fracturing*, SU010 ALI-ABA 343, 357 (2012).

68. *See id.*

69. MAX SHAFER ET AL., BIOLOGY DEP'T, ST. LAWRENCE UNIV., HYDRAULIC FRACTURING IN NEW YORK STATE 33 (2012), available at http://web.stlawu.edu/academics/sites/stlawu.edu/academics/files/FINAL_Hydrofracking.pdf.

Indiana Bat is found in the area, there is an eight-month season in which the area must be clear of activity, so the fracking operation would have to be completed within a four-month window.⁷⁰ Similarly, the New York State permit application for drilling requires the applicant to determine whether there are any endangered or threatened species located at the intended drilling site.⁷¹

It is hardly surprising that listed species actually present at the drilling site would pose a problem, but of far greater (and newer) concern for the industry is the extent to which the new extraction methods are impacting species *outside* the drilling site. Many of the broader ecosystem-wide impacts described in Part III began to cause trouble for the industry in that aforementioned tipping-point year of 2012. On August 29, 2012, for example, the Center for Biological Diversity filed a notice of intent to sue the Bureau of Land Management (BLM), alleging:

[The] BLM continues to issue oil and gas leases and drilling permits that allow intensive, controversial, and environmentally destructive hydraulic fracturing (“fracking”) techniques, but the agency relies on outdated biological opinions that fail to evaluate the substantial impacts these techniques—and the consequent increase in drilling these techniques facilitate—may have on ESA-listed species.⁷²

The notice went on to describe the dangers modern high-volume fracking techniques would pose for listed species with habitat above the Monterey Shale, arguing that these dangers would be enhanced by the new fracking methodology that did not exist at the time of the “no jeopardy” biological opinion the FWS granted to the BLM for oil and gas leasing.⁷³ The notice alleged that the California condor, San Joaquin kit fox, blunt-nosed leopard lizard, steelhead, and giant kangaroo rat, among others, could be jeopardized by an influx of horizontal fracking wells.⁷⁴

The BLM’s response to the notice is, in some ways, arguably worse for the industry than the allegations themselves. This is because the primary argument—that there would not be an increase in

70. *Id.* at 33–34.

71. N.Y. State Dep’t of Env’tl. Conservation, Environmental Assessment Form: Attachment to Drilling Permit Application, *available at* http://www.dec.ny.gov/docs/materials_minerals_pdf/eaf_dril.pdf.

72. Letter from Sarah Uhlemann, Staff Att’y, Ctr. for Biological Diversity, to James G. Kenna, State Dir., Bureau of Land Mgmt., at 1 (Aug. 29, 2012), *available at* http://www.biologicaldiversity.org/campaigns/california_fracking/pdfs/BLM_Fracking_ESA_Notice_8_29_12.pdf.

73. *Id.* at 16–18.

74. *Id.* at 11–15.

adverse impacts to listed species—was accomplished by distinguishing California from the rest of the country.⁷⁵ The response stated, in pertinent part:

[H]ydraulic fracturing in California fundamentally differs from hydraulic fracturing in the rest of the nation because of the context of California's specific geology The impacts to endangered species and critical habitat from hydraulic fracturing are lower in California than in other areas of the country. Firstly, California has not seen a significant increase in drilling activity due to advances in hydraulic fracturing technology Hydraulic fracturing on public lands in California typically occurs in much shorter, vertically drilled wells. In comparison, multi-stage fracturing and horizontal drilling for natural gas in other parts of the country require much more water than in California. Impacts to air and water quality also are reduced by oil and gas operations' compliance with the State of California's stringent air and water quality regulations. Finally, the vast majority of oil development on public lands is concentrated within the BLM's Bakersfield Field Office boundaries, and occurs on already developed lands. Because development is concentrated on previously disturbed landscapes, this greatly limits disturbance of habitat on previously-undisturbed landscapes.⁷⁶

While these points may serve to defend the choice not to reinitiate ESA consultation for the specific California region at issue, the rest of the country falls squarely on the other side—thrown under the bus. What this response says to the NGO is that perhaps you should be directing your attention toward the massive fracking boom that is rapidly spreading across the eastern forests. It seems highly likely that there will be an increase in NGO attention there, and the ESA will serve as the toughest weapon.

The most frightening ESA actions of 2012 for the fracking industry were not litigation steps and not NGO based, but rather federal foundation laying that was more foreboding than direct or immediate. The FWS began listing endangered species based specifically on the threat of fracking.⁷⁷ The first final listing rule was

75. Letter from James G. Kenna, State Dir., Bureau of Land Mgmt, to Sarah Uhlemann, Staff Att'y, Ctr. for Biological Diversity (Oct. 26, 2012), *available at* http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/pa/energy/minerals.Par.65149.File.dat/10_26_12_BLM%20Response%20to%20CBD%20Notice.pdf.

76. *Id.* at 1–2.

77. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Rayed Bean and Snuffbox Mussels Throughout Their Ranges, 77 Fed. Reg. 8,656 (Feb. 14, 2012) (to be codified at 50 C.F.R. pt. 17).

published in February 2012 and gave endangered status to the rayed bean and snuffbox species of mussel.⁷⁸ In the listing's section on threats to the species, the FWS described the problem as follows:

Although oil and gas extraction generally occurs away from the river, extensive road networks are required to construct and maintain wells. These road networks frequently cross or occur near tributaries, contributing sediment to the receiving waterway. In addition, the construction and operation of wells may result in the discharge of brine (salt water), which can cause acute toxicity and mortality of mussels if mussel tolerance levels are exceeded. Point source discharges are typically regulated; however, nonpoint inputs such as silt and other contaminants may not be sufficiently regulated, particularly those originating some distance from a waterway. In 2006, the Pennsylvania Department of Environmental Protection issued more than 3,700 permits for oil and gas wells and 98 citations for permit violations at 54 wells.

One issue of particular concern is the increase in natural gas extraction from the Marcellus Shale formation. The Marcellus formation is a black shale that is found from southern New York, across Pennsylvania, and into western Maryland, West Virginia, and eastern Ohio. This shale contains significant quantities of natural gas that is now being extracted using new drilling technologies and because of an increased demand for natural gas. In order to extract the natural gas from the shale, large volumes of water are needed to drill and hydraulically fracture the rock. After the drilling and fracturing is completed, the water must be removed from the well before the gas can flow. Extensive water withdrawals associated with the Marcellus Shale wells can dewater mussel beds and reduce habitat suitability. Concerns about the availability of water supplies needed for gas production and questions about wastewater disposal have been raised by water-resource agencies and citizens throughout the Marcellus Shale gas development region. . . .

Natural gas extraction in the Marcellus and Utica Shales has the potential to negatively impact rayed bean and snuffbox populations throughout New York, Pennsylvania, West Virginia, eastern Ohio, and Ontario, Canada.⁷⁹

Because the expansion of fracking operations is one of the reasons behind the need to list these species, it creates a host of potential problems for those who wish to place further well pads in the region (and, as one can see from the above portion of the listing, the fracking

78. *Id.*

79. *Id.* at 8,656 (citations omitted).

boom region is largely habitat for the newly listed mussels), or even to continue fracturing in some existing drill sites. For the very reasons described in the listing, it is highly probable that such operations may harm some of the listed mussels, in which case the driller would need to create a habitat conservation plan in order to obtain an incidental take permit. In the event that going forward might jeopardize the continued existence of either species, the permit would not be obtainable and the fracking could not proceed. Even to the extent that there tends to be minimal ESA enforcement and oil and gas companies might proceed without an incidental take permit on the theory that the FWS is too busy to look into whether takes are happening, fracking is such a hot political issue that a citizen suit would be quite likely. If the ESA stands in a position to block the practice, *somebody* will make it happen. In addition, the listing found that it would be prudent to designate critical habitat, but did not yet do so because the appropriate habitat was not yet determinable. But this only buys the agency a little time before it must designate the critical habitat. It seems likely that there will be some conflict between the area chosen and the fracking agenda.

The following month, the FWS listed another pair of mussels, this time the sheepnose and spectaclecase, and provided the same reasons relating to fracking.⁸⁰ In fact, it carried over much of the above-quoted language from the rayed bean and snuffbox listing, and added some new language regarding the perils of fracking for mussels as well:

The hydraulic fracturing process of Marcellus Shale natural gas extraction typically requires about one million gallons of water for a vertical well to approximately five million gallons of water for a vertical well with a horizontal lateral. The used water, often referred to as “frac returns[,]” must be reused in the next well or sent to an approved treatment facility before it is discharged into natural waterways. In Pennsylvania, there are currently few treatment facilities capable of treating Marcellus Shale frac returns fluids, which may have high total dissolved salts, particularly chlorides. In addition, infrastructure development associated with Marcellus Shale industry, such as dirt and gravel roads and pipeline construction, may increase sedimentation in rivers⁸¹

A few months after the four mussel listings were final, the FWS went on to publish a proposed listing for the diamond darter, a fish in

80. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Sheepnose and Spectaclecase Mussels Throughout Their Range, 77 Fed. Reg. 14,914 (Mar. 13, 2012) (to be codified at 50 C.F.R. pt. 17).

81. *Id.* at 14,939 (citations omitted).

the same region, once again pointing to fracking as a major source of concern.⁸² The discussion of the threat in the listing appears by then to be escalating in degree of concern about the harms of fracking.

Shale gas development is an emerging issue in the area. Although this is currently not the most productive area of the State, the entire current range of the diamond darter is underlain by the Marcellus and Utica Shale formation and potentially could be affected by well drilling and development. The pace of drilling for Marcellus Shale gas wells is expected to increase substantially in the future

Marcellus Shale gas wells require the use of different techniques than previously used for most gas well development in the area. When compared to more traditional methods, Marcellus Shale wells usually require more land disturbance, and more water and chemicals for operations. In addition to the size and length of any required access roads, between 0.8 and 2.0 ha (2 and 5 ac) are generally disturbed per well. Each well also requires about 500 to 800 truck trips to the site. Construction of these wells in close proximity to the Elk River and its tributaries could increase the amount of siltation in the area due to erosion from the disturbed area, road usage, and construction.

Shale gas wells typically employ a technique called hydrofracking which involves pumping a specially blended liquid mix of water and chemicals down a well, into a geologic formation. The pumping occurs under high pressure, causing the formation to crack open and form passages through which gas can flow into the well. During the drilling process, each well may utilize between 7 and 15 million liters (2 and 4 million ga) of water. This water is typically withdrawn from streams and waterbodies in close proximity to the location where the well is drilled. Excessive water withdrawals can reduce the quality and quantity of habitat available to fish within the streams, increase water temperatures, reduce dissolved oxygen concentrations, and increase the concentration of any pollutants in the remaining waters. Increasing water withdrawals has been shown to be associated with a loss of native fish species that are dependent on flowing-water habitats. Darters were one group of species that were noted to be particularly vulnerable to this threat.

In addition to water withdrawals, there is a potential for spills and discharges from oil and gas wells, particularly Marcellus Shale drilling operations. Pipelines and ponds being used to handle brine

82. Endangered and Threatened Wildlife and Plants; Endangered Status for the Diamond Darter and Designation of Critical Habitat, 77 Fed. Reg. 43,906 (July 26, 2012) (to be codified at 50 C.F.R. pt. 17).

and wastewaters from fracking operations can rupture, fail, or overflow and discharge into nearby streams and waterways. In Pennsylvania, accidental discharges of brine water from a well site have killed fish, invertebrates, and amphibians up to 0.4 mi (0.64 km) downstream of the discharge⁸³

Beyond the potential impact of the additional listing in the region, and unlike the various mussel listings, in the case of the diamond darter the FWS has proposed critical habitat designation concurrently with the listing proposal.⁸⁴ It maps out huge sections of river—122.5 river miles—flowing over a valuable chunk of prime Marcellus and Utica shale.⁸⁵ Federal agencies cannot authorize actions that will adversely modify critical habitat, which could stand in the way of providing take permits. This also means that federal agency actions, such as issuance of Clean Water Act permits or Federal Highway Administration approvals, would require consultation to avoid jeopardy or adverse modification if they may impact the species or its habitat. Further, the existence of critical habitat increases the likelihood that courts will find a take based on damage to habitat.

CONCLUSION

Hydraulic fracturing has been hailed as a solution to many of our problems. Not only is it lowering the cost of energy because it is such an efficient method of extraction, but the natural gas it extracts is slightly cleaner burning than other fossil fuels. The current boom is thus no surprise, and many people are thrilled to see it happening. But there are many downsides to fracking, with some very serious examples that are beyond the scope of this Article. Given the stubbornness of the ESA, the ecosystem downside may wind up being the single most formidable hurdle for the industry to leap over. The giant is heading in fast, and could prevent fracking from getting nearly as pervasive as the industry imagines.

83. *Id.* at 43,914 (citations omitted).

84. *Id.* at 43,906.

85. *Id.* at 43,937–38.



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