

Birds as lines: The production of alternative regimes of environmental management in the aftermath of a toxic disaster



Israel Rodríguez-Giralte

Universitat Oberta de Catalunya (UOC), Rambla de Poblenou, 156, 08018 Barcelona, Spain

ARTICLE INFO

Article history:

Received 13 February 2014
Received in revised form 4 May 2015
Accepted 7 May 2015
Available online 27 May 2015

Keywords:

Toxic disaster
Environmental activism
Non-human agency
Lines
Environmental management

ABSTRACT

This paper analyses how in the aftermath of one of the worst environmental disasters ever to occur in Spain – the Aznalcóllar Disaster – various environmentalist and conservationist groups mobilised migratory birds to bring new insights and the need for new precautions to the controversy elicited by the spill. The case study, thus, revolves around how environmentalists established a “hybrid collective action” to draw attention to unconsidered risks and impacts of the disaster and thereby make the case for open debate. Building upon this, I engage with two different, though interrelated, theoretical debates that contribute to a rethinking of environmental management (EM) as a social and materially situated practice. Drawing on the idea of “tactic” (De Certeau, 1984), I draw attention to the devices, actions and procedures that environmentalists carried out to resist attempts to minimise the spill and to undermine administrations’ assumptions of control, coherence and singularity associated the idea of management. Drawing on Tim Ingold’s latest work (2007, 2008, 2011), I analyse environmentalists’ most successful tactic: the enactment of migratory birds as “lines”. Together with other authors in this special issue, I will use this notion to make an argument against some of the assumptions of the “hybrid ontology”. In contrast to more essentialists and static notions of non-human agency and politics, the idea of line is particularly useful as a way of understanding how nature(s) can be effectuated differently and how this leads to the imagining of new regimes of cohabitation, human and non-human management and intervention.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

It is said that the Romans would not make important decisions without consulting the *augur*, a priest who could divine the will of the gods by interpreting the flight of birds; by ‘taking the auspices’. The case I present in this paper in a way re-enacts this indicative capacity of birds, particularly as signs or *sentinel devices* warning of potential risks, damages or catastrophes (Keck and Lakoff, 2013). Specifically, I analyse how, in the aftermath of one of the worst environmental disasters ever to occur in Spain – the Aznalcóllar Disaster – various environmentalist and conservationist groups mobilised migratory birds to bring new insights and the need for new precautions to the controversy elicited by the spill. These birds were mobilised to such an extent they refashioned the geography of the pollution and the account of the disaster’s environmental impact.

I will begin by retelling the circumstances of the disaster, the uncertainties and controversies it triggered and how, in this context, migratory birds nesting in the National Park of Doñana, a well-known protected area close to the mine that caused the spill, increasingly became protagonists in the drama. Drawing on

primary and secondary sources,¹ I will illustrate how this spill transformed an entire region into a huge ecotoxicological “experiment” (Rojas, 2015). This paper narrates the frantic, frequently improvised and hugely controversial work carried out in attempts to control and monitor the toxic spill, and how, in this context, scientists, environmentalists and technicians enlisted technologies, plants and animals to understand the elusive and hidden destructive power of pollution. Mostly, however, with this paper I relate the story of how, in a context of vigilance and monitoring, environmentalist groups active in the area *managed* to transform the spill into a public issue, a matter of concern (Latour, 2004).

My focus in this paper, therefore, is what these improvised managers “did” to reconfigure the socionatural space of Doñana after the spill. Building upon this, I engage with two different, though interrelated, theoretical debates that contribute to a rethinking of environmental management (EM) as a social and materially situated

¹ This paper draws upon fieldwork and documentary analysis conducted (2008). I was not the only researcher carrying out this work, and I wish to thank Aleix Causa, Francisco Tirado and Miquel Domènech for collecting relevant data in different periods of the long controversy triggered by the spill. Later on, some of the activists involved granted me follow-up interviews, for which I am also thankful.

E-mail address: irodriguezgir@uoc.edu

practice. Firstly, as Tironi and Farías also explore in this issue, this case features EM in a situation of material disruption and radical uncertainty: a toxic spill as a “cosmopolitical event” (Schillmeier, 2011) where it is difficult to differentiate between the natural and the social, the interior and the exterior of the disaster, and between experts and non-experts. I discuss the performativity of EM in such a context. This shows us the net-work (Latour, 2011) involved in articulating logics of (un)containment, (dis)protection and conservation: how different actors constantly configured and reconfigured (Krause, 2015) arrangements between human activities, animals, ecosystems and threatening pollutants, as well as how precarious and controversial these configurations were. Rephrasing Callon and Rabeharisoa (2003), we can say that this episode illustrates a situation of “management in the wild” (wilderness is here related to the “excessiveness” of disasters rather than to a pristine and untouched nature). In this context, I consider it important to reflect upon how environmentalists managed to open new ways of imagining the Park, of socialising humans and non-humans and, ultimately, of introducing new affective ethical and political attachments to the management of the disaster and of Doñana. Now rephrasing De Certeau (1984), I will argue that environmentalist action must be read in “tactical” terms rather than as a counter-production. By coining the idea of tactic, De Certeau wants to draw our attention to those devices, actions, and procedures people use on the micro level to subvert, temporarily, the disciplining powers. In the aftermath of the spill, I use this notion of tactic to refer to those actions and procedures that environmentalists carried out to “poach”, “divert” and/or “borrow” (not take over or destroy) the space of the other (mainly the authorities and “official” scientists). From this point of view, this case study illustrates the significance of small, improvised and situated practices in resisting attempts to minimise the spill and in increasing understanding of the disaster and management of the Park. It also speaks of how these “cracks” and “surprises” helped to undermine assumptions of control, coherence and singularity traditionally associated to the idea of management (replacing them with images of partiality, interdependency and coexistence).

Secondly, as has been discussed elsewhere, these “tactics” of protest hardly fit within the cognitive and consumerist assumptions of a deliberative and market-based democracy (Bingham and Hinchliffe, 2008). On the contrary, most of these kind of struggles take place in an ontological terrain (Callon and Rabeharisoa, 2008). From this point of view, this is an example of how the production of certain natures is specific to the matters of concern with which each actor is engaged (Lippert, 2015). Specifically, the case enables me to analyse how environmentalists mobilised birds as non-human indicators (a quite unusual type of indicator, as I will discuss) to make visible some of the hidden damages and dimensions of the contamination, and how this conferred on them a particular political force (Marres, 2012). Drawing on Tim Ingold’s latest work (2007, 2011), I will argue that this political significance of birds was caused by the enactment of these animals (most notably) as lines. That is, as ever-extending trajectories enmeshing with, and potentially threatening, distant species and ecosystems. Engaging critically with Ingold’s proposal, I will use the idea of line more empirically; as a way of understanding how environmentalists transformed migratory birds into a powerful and *boundless* mediator (Latour, 1997), a liminal, elusive and ambivalent figure through which to uncover hidden and untold dimensions of the disaster, and enrol distant actors initially reluctant to enter into the dispute.

2. Aznalcóllar’s toxic spill

On April 25, 1998, the downstream dam of a tailings lagoon owned by the Boliden-Apirsa mining company collapsed. The rupture led to 5.5 Mm³ of acid and metal-rich water cascading into the

Guadimar river, together with a thick sludge of toxic tailings (estimated to be between 1.3 and 1.9 Mton). The spill – the equivalent of 500 Exxon-Valdez tankers – flooded the riverbanks along the Agrio and Guadimar rivers down to the Entremuros marshes, 40 km south of the mine, at the border of the Doñana National Park (see Fig. 1).

According to the Regional Government of Andalusia, approximately 4600 hectares of agricultural and wild land were immediately affected by the toxic flood. The spill also affected inhabited zones (10 municipalities, 46,000 inhabitants), killed river flora and fauna and destroyed crops, fields and pastures (Junta de Andalucía, 1999b).

By any criteria, the spill was a major disaster (Simón et al., 1999), but this was especially the case due to the proximity of Doñana National Park.² Being home to some of the region’s most protected species, such as the lynx and the imperial eagle, the Park was considered a “pearl” of European nature conservation.³ On top of this, the Park played an important role in the region’s economy,⁴ with both agriculture and tourism strongly dependent on the proximity of the Park.

From the very onset of the disaster, thus, the protection of the Park was a major concern for most of the actors involved: this was so for the Spanish Authorities; for the media, which extensively covered the episode (see Fernández Reyes, 2001); for several environmentalist and conservation groups, most historically active in the area; and for the scientific community, particularly those working and researching within the Park.

In the following sections I tell the story of how this consensus around protection of the Park was created, and how this gave birth to an unprecedented dispositive of contention, cleaning-up and monitoring of the contamination, particularly by the Spanish authorities and the scientists of CSIC (the Spanish National Research Council). I will also present an account of how, alongside these activities, environmentalist movements operating in the area managed to politicise the event.

2.1. Containing/uncontaining the spill

In the first hours after the damn burst, attempts were made to contain the spread of sludge, the main concern being that toxic water would enter the Guadimar River, a fundamental part of Doñana’s hydrological system: if polluted water entered the Park it would be a catastrophe of untold magnitude. To coordinate a response, the Central and Regional administrations, together with the Park managers, agreed to send heavy machinery (mainly excavators) to Entremuros, a hydraulic barrier running along the Park border, and build improvised containment walls to prevent the toxic wave entering the Park (Junta de Andalucía, 1998).

The water was dammed a few hours later, prompting the then Minister for the Environment, Isabel Tocino, to publicly announce “the heart of Doñana was safe” (Elías, 2002).

² The Doñana National Park is the largest wetland reserve in Southern Europe. The Park is subject to two types of protection: the National Park (54,250 ha), which embraces the heart of the wetlands is owned and managed by the Spanish Central Government, while the Natural Park of Doñana (50,720 ha), a more peripheral land, is managed by the Andalusian Regional Government. Together they are commonly referred to as the Doñana Park, or simply Doñana, the terminology I use in this paper.

³ The ecological value of this environment has been widely recognised by a number of international organisations. Doñana is a UNESCO Biosphere Reserve, a Ramsar site for waterfowl protection (1980), and a UN World Heritage Site (1994). It is also part of the Natura 2000 network and was given Protected Area status by the Council of Europe (see De Lucio, 1997).

⁴ The region where Doñana is located is one of the poorest regions in both Spain and Europe, with a strong dependence on the primary sector and tourism. The unemployment rate is one of the highest across Europe. This may explain the traditionally conflicting relationship between development and environmental conservation (see Sauri et al., 2003).

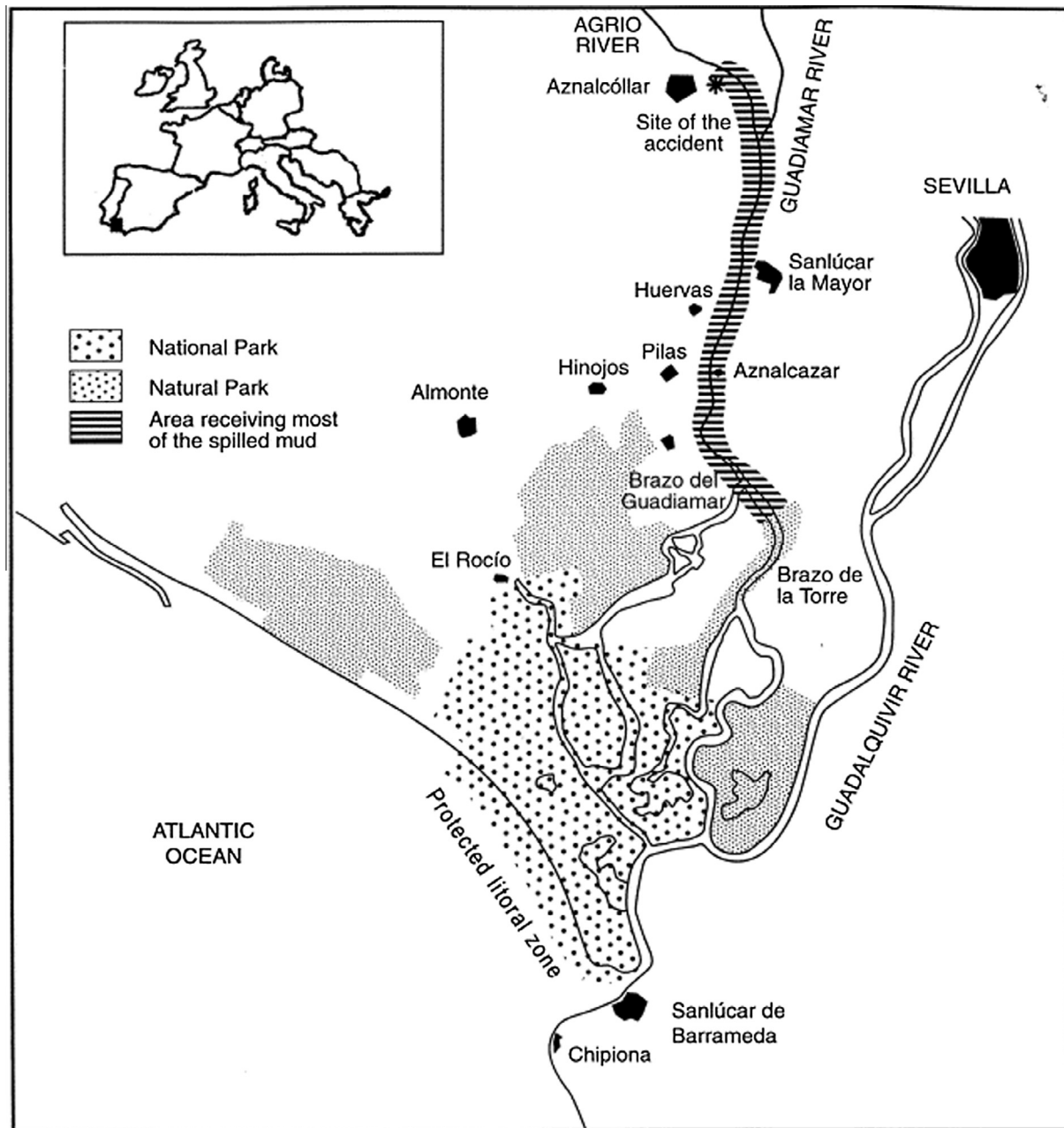


Fig. 1. Map of the Doñana Park and its surrounding area, including the location of the Aznalcóllar mine (see Grimalt et al., 1999)

While investigating the causes of the disaster, and to ensure Doñana had been saved, the administrations created a working group to define an Urgent Action Plan, recruiting several engineers and experts (Montes, 2002). This plan included rapid removal of the sludge and contaminated vegetation, treatment of the acidic water retained in Entremuros and the purchase of all land affected by the spill. It also included supervision by an expert group of 80 scientists from CSIC (the Spanish National Research Council), who would officially help monitor the accident and prevent further possible negative effects.

The media welcomed this decision as a way to “silence the politicians and let the scientists speak” (*Ecologistas en Acción*, 2008). Indeed, this turned the area into a huge experimental site, where several action-research projects were conducted, including evaluation of the soil contamination and heavy metal levels in aquatic and terrestrial living beings, a search for bio-indicators, and soil phytoremediation.

For some other actors, the situation appeared far from under control. This was certainly the case for scientists from the Doñana Biological Station ICTS, a public Research Institute from CSIC that had a field station within the Natural Park, and for many environmental and conservation organisations such as WWF/ADENA, SEO/Birdlife, Greenpeace or CEPA/Ecologistas en Acción (these were the most active organisations, particularly during the first months after the disaster). Although these organisations embodied quite different political, scientific and environmental views, they agreed to criticise the administrations’ lack of preventive measures – denounced long before by many of these organisations – their slow response and constant improvisation. While they offered their help and cooperation they also made it clear they would appeal for administrative, civil, criminal and political consequences for what they considered “the chronicle of a catastrophe foretold” (Menor de Gaspar and Pérez, 1998; *Ecologistas en Acción*, 2008).

Greenpeace, for instance, sent a delegation of activists to the area to document the impact of the spill and carry out their own evaluation (Greenpeace, 1999). In one of their raids, Greenpeace boats found dead fish at the mouth of el Brazo de la Torre, in the Guadalquivir River. Days later, tests carried out by Greenpeace activists revealed the contamination had penetrated the Park through the Cherry Canal, confirmation, for them at least, that the spill was far from under control.

Representatives from SEO/Birdlife (1998) were also collecting dead fish and eggs, and helping evacuate animals from Entremuros to safer areas, while those from WWF (2002) were roaming the Park, inspecting water wells and gates, and picking up dead birds.

All this action on the ground played an essential role in mobilising volunteers, attracting the media's attention and organising demonstrations to "raise environmental awareness" in places like Sanlúcar Barrameda, Seville and Madrid.

To prevent further damage, the various environmentalist organisations also agreed to demand the dam be sealed, the mine closed and all forms of land use be banned. This included the prohibition of hunting, fishing and using wells for irrigation over the entire area, therefore economic compensation for those farmers, fishermen and residents affected was also requested.

Neighbours, miners and farmers, however, were strongly opposed to such action, which, in their opinion, would have a highly negative impact upon the local economy by fostering consumer distrust towards local products, such as strawberries, citrus fruit, rice and crustaceans. For these interested parties, as well as for the administrations, the most urgent action needed was a rapid removal of the sludge, before the autumn rains arrived.

Cleaning-up operations began in early May, a few days after the spill. Although CSIC scientists and environmentalists recommended manual cleaning, the authorities decided to mobilise heavy machinery to speed up removal of the toxic sludge (up to 800 trucks at the height of the operation, see Sauri et al., 2003). This prompted complaints from environmental groups, who observed how the machines mixed sludge with uncontaminated soil, causing a dangerous rise in the solubility of toxic metals (Greenpeace, 1999).

At the same time, activists and volunteers from WWF, SEO/Birdlife and Greenpeace continued picking up dead birds to avoid further contamination through the food chain, and collected samples of sludge for evaluation.

SEO/Birdlife, for instance, used their fieldwork to condemn the pollution of agricultural land and nine different areas of water inside the Park, including 590 hectares of the Special Protection Area for birds (SEO/Birdlife, 1998).

Meanwhile, Greenpeace sent the samples of "Doñana's cocktail" they had collected to an independent laboratory in Barcelona, the findings of which, published a few weeks later, caused quite a stir (Greenpeace, 1999). According to this report, the affected area was twice the size of the official estimate, both in terms of acres of land and kilometres travelled by the sludge, and a significant number of wells and aquifers had been affected.

The report also found evidence of heavy metals, some in high concentrations (iron, mercury, arsenic and cadmium) and some unusual for a pyrite industry like the one run by Boliden (zinc, lead and sulphur). Moreover, many of these heavy metals were dissolved in the water: an important point as this proved such material could travel by water rather than remaining in the sludge in solid form (Ferrer, 1998). These "mobile pollutants" could easily reach the deepest parts of the aquifers, seriously damaging these crucial hydrological unities, which in turn could damage the entire underground water cycle connecting the interior and exterior of the Park.

A few days later, CSIC corroborated the majority of these results (CSIC, 1999).

The authorities, however, accused environmentalists of being "alarmists" (El Mundo, 4-05-98) "catastrophists" and of "preferring ducks⁵ to people" (Menor de Gaspar and Pérez, 1998). While the situation was far from resolved, they argued, there was nothing to be worried about; the first emergency measures had been a success. Excavators and trucks, containment walls and hydraulic barriers had all contributed to saving the "heart" of Doñana. Additionally, an ambitious network of scientific monitoring and control had been established to assess and assure the safety of plant species, agricultural products, fisheries, livestock, wildlife and the human population, and in a few months Doñana would be completely restored (Junta de Andalucía, 1999a).

A similar point of view was shared by the owners of the mine ("it's serious but not a catastrophe"), local farmers and neighbours, who felt they had more immediate problems than worrying about wildlife. Indeed, in a demonstration in Aznalcóllar, those defending the miners' jobs shouted "Medio ambiente si, trabajo también" (Environment, yes; jobs too). This was interpreted as a criticism of environmentalists' claims (Fernández, 1999: 8).

For environmentalist groups, though, these were attempts to discredit them, and most importantly, to undermine the seriousness of what had happened. In contrast to the authorities, they considered it crucial to design a more ambitious plan for assessing and monitoring the future impact of the affected fauna and ecosystems. They also wanted more public information and greater coordination between the different administrations, as well as a long-term action plan to ban mining activities and restore and recover the natural value affected by "the ecological tragedy". They offered their knowledge and networks of experts⁶ to help clarify the causes and consequences in the short, medium and long term.

One of the hottest points of the controversy was the possible entry of heavy metals in the food chain. Although the administrations officially ended the cleaning-up operations on October 30, environmentalists continued alerting about the effects of remaining metals in the soil on water, plants and herbivores. CSIC had also confirmed some of these fears. This suggested, environmentalists warned, that fauna could have a role as a potential disperser of pollutants to unaffected areas, species and ecosystems. The most notorious example was birds.

2.2. Doñana as a "ticking-bomb"

The presence of "birders" in Doñana can be traced back to the 1950s, a time before the National Park had officially been created (Asiain et al., 2008). Since then, many environmental activists, scientists and birders had championed the relevance of Doñana as a strategic location for birds, particularly waterfowl species, which use the Park as a breeding and wintering site (up to 6000.000 individuals). This huge avian presence, the environmentalists cautioned, was a "ticking bomb" for an area considered to be of special interest and a Biosphere Reserve.

⁵ This is a recurrent argument in Doñana, mostly coined by local and regional authorities, as well as miners and their families, to delegitimise environmentalists' longstanding claims that the mine should close. It basically portrays environmentalists as "naturalists" and "conservative" actors, only concerned for the protection of a pristine and non-human nature (and not for the development and economic progress of the region). See Estevan, 1998; Menor de Gaspar and Pérez, 1998).

⁶ Although cooperative, there was growing unease among environmentalists with the "opportunism" shown by CSIC as an institution. Environmentalists, as well as a significant group of scientists, some from CSIC itself, claimed the research council had turned the disaster into an opportunity to brand and internationally promote Spanish Science. They demanded less political intervention and more collaboration with NGOs (for a discussion see Aparicio et al., 1998).

ADENA/WWF and SEO/Birdlife were probably the first organizations to raise concerns about possible bird contamination (WWF, 2002; SEO, 1998). Since the very beginning they had feared that these animals – mainly waterfowl, storks, kites, shorebirds and terns – searching for food and water, could easily move to Entremuros where the toxic spill had been contained. If so, these birds could then absorb the toxic metals, bringing them into the food chain (WWF, 2002).

The authorities did not share this concern. Although they were aware the spill has probably affected birds, in their opinion there was no reason to be alarmed. Firstly, the risk to the birds themselves was certainly not lethal (Junta de Andalucía, 1999a), and secondly, the birds' movements could be easily restricted by drying out certain areas outside the Park that served as drinking sites for some species.

The situation began to change during the summer months. As the autumn rains approached, environmentalists were more and more concerned about the possibility of dormant toxins washing over the land again (Birdlife, 1998).

Later analyses corroborated some of these fears. Data collected during the summer revealed a progressive contamination of birds collected in areas not directly polluted: up to 150 dead specimens were analysed, some found at a distance of 5 km from the spill area (El País, 3-10-98). CSIC concluded, however, that the contamination only affected individuals, not communities and that the pollution of birds in any way was a threat to the human population (Hernández et al., 1999).

Environmentalist concerns grew when the Ministry of Environment decided to flood several areas of the Biological Reserve of Doñana. This was not an exceptional measure, often being carried out in particularly dry years, as that year was. The flood was intended to prevent the displacement of birds living in the Park to other contaminated areas outside the Park when searching for food and water. However, that year the pumping system used to take water from the wells broke down. Although this could easily be repaired, the problem caused a temporary but massive concentration of geese at Entremuros, a contaminated area outside the Park. This potential contamination of geese was particularly worrying, as geese were pivotal in Doñana's ecosystems, both for their direct effect on the environment and for their role within the food chain, being food for predators such as lynx and scavenger species (Hiraldo et al., 2003).

But geese were also migratory birds. Actually, their migratory condition rapidly generated a scientific and media frenzy. The mere possibility that these birds could be polluting distant areas transformed birds, until then passive victims of the disaster, into vectors of contamination, into the disaster itself.

The national and international media (ABC, 8-10-98; The Guardian, 6-01-99), along with the authorities of several countries, mainly Holland, Britain, Germany and the Scandinavian countries – all within the “Atlantic Migratory Route” of the geese – were now alerted to the situation.

Indeed, the European Union, hitherto reluctant to become involved in a “national” issue, was forced to enter the dispute. As environmentalists reiterated in several public appearances in Brussels, the contamination of birds obligated the Community – under the UN Convention on Biological Diversity – to take action to protect biodiversity and ensure sustainable management, ecologically but also economically, of Europe's most valuable and threatened habitats. This was the case for Doñana, as part of the NATURA 2000 ecological network,⁷ but

also for other valuable and protected sites now threatened by the flight of birds.

It is important here to note the contribution of ringing networks operating in the area. Invented in 1899 by Hans Christian Cornelius Mortensen (Preuss, 2001; Brown and Oschadleus, 2008), ringing is a well-known scientific method for understanding and following the complex migratory lives of populations and entire species of (mostly) birds. In Doñana the first ringing expeditions date back to 1952 (Asiain et al., 2008), and it is actually thanks to these expeditions the Park was created some years later (mainly) as an ornithological reserve.

Beyond this familiarity with ringing practices, however, it is important to note that the Aznalcóllar Disaster transformed this technique into an opportunistic technology. Until then used mainly as a biopolitical tool (Reinert, 2013), as a dispositive for managing wilderness (Benson, 2010), the disaster transformed ringing into an accidental dispositive to follow and evaluate the impact of pollution (Petryna, 2013). Although environmentalists could not participate in ringing practices that year, due to the toxicity remaining in the area, SEO managed to mobilise hundreds of volunteers throughout Europe to join reading campaigns, especially in the zones most at risk of contamination.

Through binoculars or telescopes, these activists read the PVC rings attached to birds' legs. These codes were then sent to a database (in Spain this was managed by the Doñana Biological Station and at European level by the EURING organization⁸) to generate statistics and maps to control and monitor the lines of flight, and the movements and evolution of avifauna nesting and wintering in the spill area.

This accidental relevance of migratory birds as ecotoxicological indicators was therefore pivotal in internationalising the dispute, avoiding its rapid closure and enriching it with new actors and new (and not so new) environmental concerns. For instance, conservationist groups such as WWF also took advantage of this escalation of the controversy to reopen⁹ the debate about the conservation of Doñana (Olano, 1998; Schimdt, 2000). Contrary to the existing policy of fencing and segregating species, landscapes and ecosystems, conservationists groups recommended opening the Park: to encompass the immanent and non-coherent processes, movements, contacts and interactions among materials, species and ecosystems, as well as human activities and cultural heritage (Cabello, 2003). But this also meant it was important to open the Park to a more multidisciplinary and collaborative management, one that not only included national and international administrations but also scientists, NGOs and local people (Asiain et al., 2008).

Actually, as a result of this debate, the Spanish authorities launched two important restoration programs: the Guadamar Green Corridor (Junta de Andalucía, 2003) and the Doñana 2005 Plan (Garrido, 2008; Carmona, 2008). Both projects, as the authorities acknowledged, were strongly influenced by environmentalist claims and intended to break Doñana's traditional isolation (Cabello, 2003).

3. Management in the wild

Rephrasing Callon and Rabeharisoa (2003), we can say that the episode illustrates a situation of “management in the wild”: that is, a situation in which practitioners and experts became entangled in

⁷ Natura 2000 is the centrepiece of EU nature & biodiversity policy. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and also incorporates Special Protection Areas (SPAs) which they designate under the 1979 Birds Directive.

⁸ EURING is a supranational organisation that coordinates all the national ringing centres in Europe (about 30 offices with more than 10,000 ringers). EURING ensures the use of standardised methods and protocols for collecting data and maintains the European data bank.

⁹ For a history of the conflicts between economic development and nature conservation in Doñana see Valverde (2003), Fernández and Pradas (1996).

relations of co-production, co-management (and co-research) with concerned groups (environmentalist and conservationist groups) in order to deal with the spill. In this context, I consider it important to reflect upon *how* environmentalists managed their entry into this “management in the wild” situation, contributing to the emergence of a hybrid collective that mixed humans and non-humans (Callon and Law, 1995; Rodríguez-Giralt, 2011), and how by *doing* this they could open new ways of imagining the Park, of socialising humans and non-humans and, ultimately, of introducing new affective ethical and political attachments to the management of the disaster and of Doñana. Building upon this, in this section I will further explore Doñana's disaster and reflect upon the performativity of EM in such a context.

The first thing that stands out from the environmentalist's collective action is the importance given to their “presence” at the scene of the disaster. From the early hours, and over the following months, these organisations did an outstanding job “*in situ*”. Environmentalists from several organisations walked up and down the park looking for leaks. Of course, they accompanied this with demonstrations, political lobbying, legal action and media communication, but their task was mainly grounded on a significant presence in the disaster area. This presence, according to them, was necessary to “independently” document the disaster, “witnessing for themselves” what had happened.

Environmentalists positioned this early presence alongside a long-term presence. The latter allowed them to denounce the episode as “the chronicle of a catastrophe foretold”. To support this statement, environmentalists recalled past stories of contamination from the mine, how they had raised concerns over the state of the dam, even taking legal action against the company and the administrations responsible for periodical assessments of the dam, and how these cases had been “inexplicably” filed. Technicians, judges, employers, the workers in the mine, the various administrations, including the EU, all knew the plight of the dam. Yet, nobody did anything.

Environmentalists' participation, thus, was justified simultaneously as an *affective* state (a bond with the species and ecosystems of Doñana), a vital socio-material operation (documenting and witnessing), and as an ethico-political obligation (safeguarding the movement of wildlife as much as the economic future of Doñana). Interestingly, this turned them into a mixture of activists, “civic” scientists and amateurs (Law and Lynch, 1988; Lafuente, 2013). Actually, the very idea of *amateur* – meaning simultaneously non-professional, lay and lover – neatly encapsulates the liminal position environmentalists performed in order to legitimise their presence and intervention in the aftermath of the spill. Although cooperative, they made it clear they were part of a political and affective community (Lorimer, 2008), with their own interests and strong commitments to the place, individually and collectively. This allowed them to be at one and the same time normative – collaborating as complementary experts (by practice and by experience) with CSIC; volunteering with the administrations; and helping the managers of the Park – but also prescriptive, as they could subvert the protocols, cultivate, and perform, a different sensibility/watchfulness to the disaster (Ellis and Waterton, 2004).

In this regard, it is important to note that environmentalists were not interested in counter-producing their “own laboratory” (Brown et al., 2006). Although the involvement of scientists, and laboratory facilities (Greenpeace equipped boats, a laboratory in the University of Barcelona and the facilities of the Royal Society for the Protection of Birds) were crucial for producing their own account of the disaster, as well as gaining credibility (Brown, 2013), their main actions were not on the whole related to counter-producing evidence (Rabeharisoa et al., 2014). Rather than assembling their own “centre of calculation” (Latour, 1987), and

contesting the network of surveillance constructed by CSIC and the authorities, they worked to assemble a more grassroots infrastructure and produce a different kind of signs/knowledge (Wylie et al., 2014). Thus, while scientists sectioned the area, building up a network of points of observation and measurement, recruiting molluscs, birds and plant species to evaluate the impact of the spill, particularly to public health and the economy of the area, environmentalists roamed the affected area, taking pictures, collecting data, samples or eggs from areas that escaped CSIC's observation (see for instance [Picture 1](#) where Juan Criado, from SEO/Birdlife is collecting samples in the aftermath of the disaster). While scientists unfolded a sophisticated infrastructure to scientifically demonstrate the impact of the spill, environmentalists attempted to describe and document changes, anomalies, physiological or morphological alterations that somehow complemented, or rather diverted, official accounts. For instance, thanks to this kind of field-work environmentalists announced that 22 of the 389 white stork chicks born at la Dehesa de Abajo in the months after the spill had beak aberrations. These kind of aberrations, they added, had not been described before in white storks.¹⁰

This careful watchfulness, which worked as a sort of *gardening* (Manceron, 2013) was crucial for developing alternative indicators (Keck and Lakoff, 2013); unconventional signs that somehow denoted new risks, or more specific problems, and that had the capacity to produce new alerts, alarms and connections which attracted scientific and media attention (Gramaglia, 2013). With [Picture 2](#), for example, SEO/Birdlife indicates to publics white stork's beak deformation as a consequence of the spill.

This particular mode of seeing/displaying the disaster was crucial for renegotiating the environmentalists' role and identity within a context dominated by CSIC's authority and central position. To combat claims they were “anti-scientists”, they helped strengthen CSIC's surveillance network: providing new resources, analysis, and collaborating to improve techniques, expanding points of observation and increasing the species under surveillance. To those who had stigmatised them as “alarmists”, they showed how a more careful *gardening* of the Park – a closer engagement with the species and ecosystems – could provide invaluable insights and warnings for scientists and administrations. To those who called them “catastrophists”, they vindicated the importance of providing a more comprehensive understanding of the disaster, searching for the complex and interrelated ways in which animals, humans and pollutants became entangled.

This alternative cartography of the disaster had a paradoxical effect on the Park. On the one hand, it domesticated it, assuring and reassuring naturalistic identities of Doñana and the idea of the Park as a bounded-place to protect. On the other, it re-wilded it, opening up Doñana to uncertain and hidden processes, flows and interactions that redefined the Park as a lively, hybrid and boundless landscape.

“Doñana is a network of humanised and interconnected landscapes, whose close (or not) relations we just glimpse. Do we need a proof? The marshes as commonplace to refuge migratory birds that, when they travel to Africa or Northern Europe, shall carry the poison” (Álvarez Cobelas, 1998).

The coexistence and administration of these two images of the Park was actually crucial for environmentalists, both to give shape to their own voice and to resist the multiple, sometimes contradictory, attempts to minimise the spill: it simultaneously combated attempts to *territorialise* the spill (clearly demarcating the interior

¹⁰ Although CSIC would not consider this scientific proof, requiring that more prolonged research be carried out, they did include white storks as primary sentinels for further analysis of genotoxic damage in Doñana (Pastor et al., 2004; Meharg et al., 2002).



Picture 1. Juan Criado, from SEO/Birdlife, collecting samples in the aftermath of the disaster.

and the exterior of the disaster and of the Park); to *socialise* it (reducing it to a matter of jobs); to *naturalise* it (reducing it to an environmental episode); and to *atomise* it (dividing the spill into very discrete and unrelated components).

“All that is not legal “pollution” does not exist. That is, everything that is not defined in legislation is left out. For example, samples are taken to detect heavy metals in water but we know nothing about how they are distributed and accumulated in food chains; we know nothing of how they are infiltrating the soils or if they have begun to affect those removing the sludge” (Álvarez Cobelas, 1998)

In this regard, and rephrasing De Certeau (1984), I argue that this environmentalist action must be read in “tactical” terms rather than as a counter-production. By coining the idea of tactic, De Certeau wants to draw our attention to those devices, actions, and procedures people use on the micro level to temporarily “poach”, “subvert” or “divert” the disciplining powers – i.e. to the innumerable, dispersed and “microbe-like” operations and everyday practices by means of which people (users, readers, housewives...) creatively “reappropriate the space organized by techniques of sociocultural production” (1984: xiv). In the aftermath of the spill, the notion of tactic reverberates through these actions and procedures that environmentalists carried out to “poach”, “divert” and/or “borrow” (not take over or destroy) the space of the other (mainly administrators and “official” scientists): that is, it refers to how environmentalists resisted and subverted the anti-political assemblage(s) operating in the area, redefined CSIC’s role and expanded understandings of the disaster and management of the Park.



Picture 2. Beak alterations on white storks (SEO/Birdlife).

From this point of view, the case speaks of the relevance of these temporary, small, fragmented, non-coherent, usually improvised and mostly makeshift practices that mostly environmentalists carried out *in situ* to profit from the “cracks” and “leakages” of the administration’s network of disaster management. In this regard, rather than considering it a counter-production, or counter-engineering (Krause, 2015), these disparate and not always coherent practices bring out the more contingent, creative and heterogeneous dimensions of environmental protest and of environmental management itself. That is, it brings out the importance (affective as well as political) of this multitude of “tactics” articulated in the details of the everyday life of the controversy.

These “tactics”, as I have shown, were crucial to pluralise the aftermath of the spill, to fill the space with other imaginaries, affects and memories, and to make the area affected by the disaster somehow “habitable” again. Ultimately, then, the case brings out the more multiple, creative, fragmentary and “polemological” dimensions of EM. Not only because it shows a diversity of actors (from governments to scientists, from NGOs to farmers), skills and knowledge involved in the performance of EM. It also shows the importance, the inventiveness, of an incoherent, often contradictory, plurality of practices. A plurality that challenges traditional assumptions of control, coherence and singularity associated to EM, particularly regarding the management of Natural Parks (Zimmerer, 2000; Manning et al., 2009; Hanna et al., 2007); and that, on the contrary, brings out images of partiality, interdependency and coexistence of small, diverse and highly situated practices.

4. Birds as lines

As we’ve seen, birds had a highly significant role to play in this tactical deployment. They were central actors within environmentalists’ attempts to configure and reconfigure the arrangements between human activities, animals, ecosystems and threatening pollutants. In this section, I’d like to focus on their political significance. From this point of view, my paper also engages with recent developments from environmental anthropology in particular, as well as those areas in STS interested in analysing the significance of birds in human lives: as mythical figures, companions, or political devices (Marres, 2012). In particular, I’d like to engage with the literature that has recently explored the use of birds as non-human indicators, as environmental sentinels (see the excellent special issue edited by Keck and Lakoff, 2013). A well-known example is the use of canaries in mines to detect gas. More recently, birds have been mobilised as indicators of a potential global pandemic influenza (Keck, 2014; Fearnley, 2013) and as signs of significant environmental change (Manceron, 2013; Benson, 2010). Apart from their ability/capacity to perceive processes, risks and threats that human senses cannot detect, birds are distinctive for being liminal, fluctuating and puzzling entities. Among other “propensities”, their ability to fly and blur distinctions and boundaries between territories seems particularly intriguing for those interested in their contribution to the planning, maintenance and protection of ecosystems, territories and or landscapes (Nadai and Labussière, 2010; Krauss, 2009; Whitehouse, 2009).

This liminal condition is even more tangible in the event of a toxic disaster (Petryna, 2013; Brown, 2013). In this section I will analyse the processes through which birds were enrolled and redefined within environmentalist networks, transformed into a device to analyse the effects and complexities of the pollution: that is, how, thanks to the embodied knowledge of activists and amateur birders (Law and Lynch, 1988; Reinert, 2013),

environmentalist groups were able to reveal distant and invisible dimensions of the disaster, internationalising the dispute and enriching the debate with old and new matters of environmental (and not only environmental) concern. As such, this case study also relates to the literature concerned with how objects, materials and things decisively contribute to the production, reproduction and transformation of politics (Latour, 2004; Stengers, 2010). In particular, it engages with those approaches that attempt to go beyond an instrumental or subpolitical consideration of the political role of non-humans (Marres and Lezaun, 2011). Along this line of work, I consider non-human politics as an event, a complex *achievement* which requires certain conditions, particularly technological, but that also depends on combinations and contingencies that cannot be predicted. When it *happens* (no matter how local or situated the assemblage is), it is possible to say that a thing or an object, beyond generalist assumptions, significantly contributes to a political situation, whether this means the object elicits public participation, or contributes to the reframing of a situation.

The case, therefore, allows me to reflect upon the particular and intriguing material politics (Barry, 2013) unravelled by migratory birds: a politics that, as illustrated above, was complexly interwoven with a network of surveillance that involved different CSIC scientists, natural Park managers, and different forms of life, and that sought to anticipate and document the negative effects of the spill. Among these life-forms, as we've seen, we find the birds nesting and wintering in the Park. Their central role and position within the food chain made them important bioindicators to assess the ecological quality of the wetlands. But apart from their central role within trophic chains that interconnected the (polluted) vegetation surrounding the Park and the predators living within Doñana, their ability to fly gave them a central role within environmentalists' re-configuration of the disaster. This was even more significant in the case of migratory birds. By doing fieldwork within the Park and mobilising volunteers to follow and produce a bird census, environmentalists enacted an environment (Lippert, 2015): the particular environmental dimension of birds' "international" movements, and appealed to EU's role in the protection of Doñana as a Special Protection Area for Birds.

The migratory status of birds, thus, was particularly relevant for environmentalists' protest as a way of restoring the birds "wild" condition. Here "wild" does not refer to something untouched by humans, or a more or less stable feature of certain individuals or species. On the contrary, it means birds' disposition to fly unpredictably – e.g. in terms of distance, direction and breaks. It points to a complex quality that varies depending on individuals, species, weather conditions and human influence that fundamentally portrays birds as elusive and boundless being; as "exporters of contamination" (SEO/Birdlife). Birds, they alerted, came with the potential of producing unexpected environmental linkages, uncontrolled cross-scale relations and unpredictable new space–time commensurabilities:

"The spread of heavy metals may extend to far away places, such as nesting areas from Northern Europe, through animals that have ingested food from the polluted area (geese, several species of waterfowl, raptors, shorebirds etc.)" (Vega and Bartolomé, 1998: 9)

Importantly, this transformed birds into powerful mediators (Latour, 1997), capable of producing "unthinkable consequences" (Francisco Castro, SEO): Actually, and drawing on Tim Ingold's latest work I argue that birds' politicisation can be better understood through the notion of line.

For Ingold, a line is an ever-extending trajectory, a flux of activity that constantly *enmeshes with* and *spills out into* the world (2007, 2011). Building upon Heidegger's (1971) distinction

between objects and things,¹¹ Ingold speaks of lines as these "ever-extending trajectories" that "spill out into the world" (2010: 2). Interestingly, Ingold appeals to this notion as a way to contest the tendency in social sciences, and particularly in anthropology, to reduce and fragment our complex involvement with the world into static and self-bounded sequences of points. Nowhere is this more evident than when we consider human and non-human entanglements. We tend to treat the world outside us as a world of inert, well-defined and bounded objects. Yet we never interact with such an external, substantive and passive world-out-there. On the contrary, we constantly face materials with diverse and variable properties, mixing and melding with one another in the generation of more or less enduring "things". Forces, flows, paths, strings, or even better, *lines* that constantly flow, mingle and progress, fashioning form that the author calls "meshworks"¹² (2008: 211–212).

I consider Ingold's idea of line to be aligned with other conceptual explorations, particularly within geography (Whatmore, 2002; Philo, 2005; Braun, 2008; Murdoch, 2006; Massey, 2006), that similarly aim to find new, more organic metaphors to subvert and energise the cold (Philo, 2005), pointillist (Doel, 1996) and often anorexic (Latour, 2011) networks of early Actor-Network Theory (ANT), including those in which Latour himself participates (1999). In contrast to Ingold, however, I consider the idea of line in a more empirical and immanent way. Thus, rather than appealing to the idea of line as a way to speak, more or less abstractly, of the liveliness and inventiveness of birds – a crucial point but one that goes far beyond the scope of this paper (for a discussion on new materialist sensibilities see Tironi and Farías, 2015) – I use this concept to speak of an empirical transformation, an achievement in the controversy through which birds turned into boundless entities, trajectories that held significance ecologically as well as politically.

To this end, as we've seen, environmentalists had to mobilise complex scientific, legal and political arrangements in which all these signals were seen as a threat, not only to local, but also to international, biodiversity conservation. They had to turn birds' propensity for flight into a powerful indicator of unexpected environmental linkages, cross-scale relations and new space–time commensurabilities. So, rather than merely signifying an essential quality, the idea of line allows me to speak of a practical and tactical achievement: that is, situated, densely mediated, but also contingent (as it can *happen* or not) through which birds became a substance, a trajectory, with a significant political role (Marres, 2012). That is, with a capacity to pluralise the management of the spill, transforming administrations' operations into opportunities to debate about processes of flowing, transference and emergence of the contamination. In this regard, the idea of line enables me to speak of how, in the aftermath of the disaster, environmentalists enacted birds as trajectories, as boundless mediators, and so break with more static, self-bound and undifferentiated images traditionally associated with non-humans (Whatmore and Thorne, 2000; Stengers, 2010).

This observation is not new, particularly within the field of geography. Influenced by bio- and geo-philosophies of thinkers such as Deleuze, Bergson and Whitehead, several authors have tried to take into account, more explicitly, this liveliness – processes of adaptation, becoming and difference – of matter and

¹¹ For the German philosopher, objectivity, rather than a state previous and external to being human, is a dimension reached when any object of the many that are around us becomes useful. But that characterisation is not the culmination of Heideggerian ontology. There are also what he calls things. In contrast to objects, talking about things is to talk about things-in-the-world, things that enmesh and become entwined with the world, generating and opening complex totalities (Heidegger, 1971).

¹² This concept was originally coined by Henry Lefebvre (1991: 117–118) and is used for Ingold (2008) to criticise the modern notion of network, particularly the one coined by modern communication and transport.

things, even of those apparently inanimate (Lulka, 2004; Murdoch, 2006; Emel et al., 2002; Hinchliffe, 2008; Massey, 2006). However, in this context the idea of line stands out for its simplicity. That is, it accommodates under a single concept a series of vibrant, creative and dynamic qualities of animals and ecosystems that frequently become a practical problem for environmental managers (Hinchliffe, 2008). Even more importantly in this case study it provides the possibility of exploring how nature(s) can be “effectuated” differently and facilitates critical discussion on how this leads to the imagining of new regimes of cohabitation, human and non-human management and intervention (Bear and Eden, 2008; Massey, 2006; Lulka, 2004).

To phrase this differently, thinking along the idea of line enables us to open up new and interesting possibilities to speak of, to follow a series of flows, trajectories and intersections (contamination flowing through birds' flights, food chain and biological processes that cause genetic damages to new generations) that environmentalists practical and situatedly performed during the controversy. As such, it also allows us to open up new and interesting possibilities to speak, politically but also sociologically, of vibrant and creative qualities of animals and ecosystems that are usually disregarded or subsumed under more static, functionalist or schematic metaphors. This is actually part of Ingold's critique of Latourian networks (2008). In a meshwork there are no entities, only trajectories, improvisatory movements of opening continually surpassing themselves. There are no self-contained objects but moving-forward lines (things) that live along (and not between) other lines of growth and movement (Ingold, 2008). So, in contrast to the more static and bounded representations of an environment, including the very concept of network, the notion of line provides us with a way to represent and critically perform – as the environmentalists did – more dynamic figurations of how things join up, grow and develop: it opens up the possibility of understanding, managing, and eventually reconfiguring environments as messy processes permanently enacting new actors, actions and scales.

5. Conclusion

The case study enables us to witness an interesting post-disaster practical and situated re-composition of the world (Stengers, 2010). In the interplay of forces following the spill, a hybrid “collective action” was assembled (Rodríguez-Giralt, 2011) to resist authorities' attempts to minimise the disaster. Crucial to this protest was the realignment of migratory birds and other, more or less improvised, practices of environmental/disaster management. In the face of what environmentalists considered an attempt to downplay the disaster, they “poached” and “subverted” the experimental disposition established by the administrations to follow and monitor the effects of the disaster. Rather than counter-producing solid evidence, they managed to enrich the controversy by adding a more embodied perspective and making migratory birds significant – ecologically as much as politically – as a way of drawing public and scientific attention towards hidden dimensions of the disaster. With these tactics, environmentalists tinkered with the administrative-conservationist assemblage operating in the area, profiting from its cracks and malleability.

This case, thus, speaks of “tactics” of protest in a situation of wild management. One of the most significant tactics was the enactment of birds as lines (Ingold, 2007). Drawing on Ingold's work, I have argued that the notion of line is a powerful resource to speak of how environmentalists practically and empirically redefined birds as vectors of contamination – as ticking-bombs – thereby establishing new environmental and political continuities. The result is a livelier, complex and transitory definition of the disaster and of the “environment” of Doñana, now transformed into a

far more complex and viscous zone of entanglement, with no inside or outside, only openings and passageways. As such, the idea of line is also a fruitful resource for further exploring the enactment, and political reconfiguration, of boundless and livelier non-human agencies.

Tactics and lines, I argue, contribute to a rethinking of environmental management as a densely, polemical and not always coherent social and materially situated practice. They both speak of the importance of considering a wide variety of actors and practices involved in EM, particularly in disaster situations, and of breaking with traditional assumptions of control, coherence and singularity associated to it. In contrast to other traditional (and more “anti-political”) visions of EM, the notions of tactics and lines point at the importance of considering and integrating images of movement, continuity, negotiation, interdependency and multiplicity into EM.

References

- ABC, 1998. Doñana: La Contaminación Podría “Exportarse a Través De Las Aves Migratorias, Según La SEO”. *Diario ABC*, August 10, 1998.
- Álvarez Cobelas, M., 1998. Doñana era una fiesta. *Boletín CF+ S*, 0(6).
- Aparicio, A., Escartín, J., Santamaría, L., Valverde, I., 1998. Toxic spill caught Spain off guard. *Nature* 395, 110.
- Asiain, A., Hernández, E., Vega, I., 2008. 40 años en Doñana. *Panda* 104, 8–15.
- Barry, A., 2013. *Material Politics: Disputes along the Pipeline*. John Wiley & Sons.
- Bear, C., Eden, S., 2008. Making space for fish: the regional, network and fluid spaces of fisheries certification. *Social Cult. Geogr.* 9 (5), 487–504. <http://dx.doi.org/10.1080/14649360802224358>.
- Benson, E., 2010. *Wired Wilderness: Technologies of Tracking and the Making of Modern Wildlife*. JHU Press.
- Bingham, N., Hinchliffe, S., 2008. Reconstituting natures: articulating other modes of living together. *Geoforum* 39 (1), 83–87. <http://dx.doi.org/10.1016/j.geoforum.2007.03.008>.
- Birdlife, S., 1998. Donana disaster. C3.Hu. <<http://www.c3.hu/~mme/madar/donana2.htm>> (retrieved 04.02.15).
- Braun, B., 2008. Environmental issues: inventive life. *Prog. Human Geogr.* 32 (5), 667–679. <http://dx.doi.org/10.1177/0309132507088030> (October 1).
- Brown, P., 2013. *Toxic Exposures: Contested Illnesses and the Environmental Health Movement*. Columbia University Press.
- Brown, M., Oschadleus, D., 2008. The Ongoing Role of Bird Ringing in Science—A Review. Presented at the Proceedings of the 12th Pan-African Ornithological Congress.
- Brown, P., McCormick, S., Mayer, B., Zavestoski, S., Morello-Frosch, R., Altman, R.G., Senior, L., 2006. “A lab of our own” environmental causation of breast cancer and challenges to the dominant epidemiological paradigm. *Sci. Technol. Human Values* 31 (5), 499–536.
- Cabello, J.M.A., 2003. Situación actual y propuestas para la mejora de la funcionalidad del corredor fluvial del Guadiamar. In: García Mora, M.R. (Ed.), *Conectividad Ambiental: Las Áreas Protegidas en la Cuenca Mediterránea*. Junta de Andalucía, Sevilla, pp. 139–155.
- Callon, M., Law, J., 1995. Agency and the hybrid collectif. *South Atlantic Q.* 94, 481–507.
- Callon, M., Rabeharisoa, V., 2003. Research “in the wild” and the shaping of new social identities. *Technol. Soc.* 25 (2), 193–204. [http://dx.doi.org/10.1016/S0160-791X\(03\)00021-6](http://dx.doi.org/10.1016/S0160-791X(03)00021-6).
- Callon, M., Rabeharisoa, V., 2008. The growing engagement of emergent concerned groups in political and economic life lessons from the French association of neuromuscular disease patients. *Sci. Technol. Human Values* 33 (2), 230–261.
- Carmona, J. (WWF), 2008. La Catástrofe De Aznalcóllar. X Aniversario: ¿Una Lección Aprendida?. Report. WWF, Madrid.
- Centro Superior de Investigaciones Científicas, 1999. Informes del Grupo de Expertos del Consejo Superior de Investigaciones Científicas y otros Organismos Colaboradores sobre la Emergencia Ecológica del Río Guadiamar. <<http://www.csic.es/hispano/coto/aznalc.htm>>.
- de Certeau, Michel., 1984. *The Practice of Everyday Life*. University of California Press, Berkeley.
- De Lucio, J., 1997. *Espacios Naturales Protegidos del Estado Español*. Comunidad de Madrid, Madrid.
- Doel, M.A., 1996. A hundred thousand lines of flight: a machinic introduction to the nomad thought and scrumpled geography of Gilles Deleuze and F. Lix Guattari. *Environ. Plan. D: Soc. Space* 14 (4), 421–439.
- Ecologistas en Acción, 2008. Crónica de una catástrofe anunciada. Booklet, pp. 1–114.
- El Mundo, 1998. Tocino y Chaves critican el «alarmismo injustificado», May 4, 1998.
- El País, 1998. El CSIC detecta metales del vertido tóxico en cuatro especies de la avifauna de Doñana, October, 3, 1998.
- Elías, Carlos, 2002. Periodismo especializado en medio ambiente: el caso Doñana como paradigma de manipulación informativa. *Rev. Latina Comunicación*

- Social, 47. <<http://www.ull.es/publicaciones/latina/2002/latina47febrero/4708elias.htm>> (retrieved 01.12.14).
- Ellis, R., Waterton, C., 2004. Environmental citizenship in the making: the participation of volunteer naturalists in UK biological recording and biodiversity policy. *Sci. Public Policy* 31 (2), 95–105.
- Emel, J., Wilbert, C., Wolch, J., 2002. Animal geographies. *Soc. Animals* 10 (4), 407–412.
- Estevan, A., 1998. Los lodos tóxicos de Aznalcóllar y el desarrollo sostenible de Doñana. *Habitat*, 1–8. <<http://habitat.aq.upm.es/boletin/n6/aaest.html>>.
- Fearnley, L., 2013. The birds of Poyand Lake. Are birds avian flu wild or domestic? Chinese farmers say both. *Limn* 1 (3), 33–37.
- Fernández, J., 1999. El ecologismo español. Alianza Editorial, Madrid.
- Fernández, J., Pradas, R., 1996. Los Parques nacionales españoles (una aproximación histórica). Organismo Autónomo Parques Nacionales, Madrid.
- Fernández Reyes, R., 2001. Periodismo Ambiental y Ecologismo: Tratamiento Informativo del Vertido de Aznalcóllar en El País, Edición de Andalucía (1998–1999). Departamento de Periodismo.
- Ferrer, N., 1998. La catástrofe anunciada de Doñana. *Ecol. Polít.* 15, 89–94.
- Garrido, Héctor., 2008. Guadimar, Ciencia, Técnica y Restauración. El Accidente Minero Diez Años Después. CSIC, Madrid.
- Gramaglia, C., 2013. Sentinel organisms. French toxicologists make the humble mollusk into a sentinel of pollution. *Limn* 1 (3), 26–30.
- Greenpeace, 1999. Doñana: Un Año Después De Vertido De Aznalcóllar. Internal Report Madrid: Greenpeace.
- Grimalt, J.O., Ferrer, M., Macpherson, E., 1999. The mine tailing accident in Aznalcóllar. *Sci. Total Environ.* 242 (1–3), 3–11.
- Hanna, K.S., Clark, D.A., Slocombe, D.S., 2007. Transforming Parks and Protected Areas: Policy and Governance in a Changing World. Routledge.
- Heidegger, M., 1971. Poetry, Language, Thought (A. Hofstadter, Trans.). Harper and Row, New York.
- Hernández, L.M., Gómara, B., Fernández, M., Jiménez, B., Gonzalez, M.J., Baos, R., et al., 1999. Accumulation of heavy metals and As in wetland birds in the area around Doñana National Park affected by the Aznalcóllar toxic spill. *Sci. Total Environ.* 242 (1), 293–308.
- Hinchliffe, Steve, 2008. Reconstituting nature conservation: towards a careful political ecology. *Geoforum* 39 (1), 88–97. <http://dx.doi.org/10.1016/j.geoforum.2006.09.007> (January).
- Hiraldo, F., Ramo, C., Sempere, M., Bravo, M.A., Máñez, M., Laffitte, R., 2003. Resultados de la investigación en el Parque Nacional de Doñana 2002, 1–104.
- Ingold, T., 2007. Lines. A Brief History. Routledge, London.
- Ingold, T., 2008. When ANT meets SPIDER: social theory for arthropods. In: Knapepett, C., Malafouris, L. (Ed.), Material Agency Ed. Springer, New York, pp. 209–215.
- Ingold, T., 2010. Bringing things back to life: creative entanglements in a world of materials. *World* 44 (July), 1–25.
- Ingold, T., 2011. Being Alive: Essays on Movements, Knowledge and Description. Routledge, London.
- Junta de Andalucía, 1998. Disposición Proyecto Control y Permeabilización de la Marisma de doñana frente al Río Guadalquivir, al Brazo de la Torre y Entremuros, 1–2.
- Junta de Andalucía, 1999a. Informes científicos sobre el seguimiento de accidente de Aznalcóllar. Junta de Andalucía. Consejería de Medio Ambiente, Sevilla.
- Junta de Andalucía, 1999b. El accidente minero de Aznalcóllar. Medio Ambiente en Andalucía. Informe 1998. Junta de Andalucía, Consejería de Medio Ambiente, Sevilla.
- Junta de Andalucía, 2003. Corredor Verde del Guadimar: del desastre ecológico a la declaración de un nuevo espacio natural protegido. J. de Haro Artes Gráficas, Sevilla.
- Keck, F., 2014. Birds as sentinels for pandemic influenza. *BioSocieties* 9 (2), 223–225.
- Keck, F., Lakoff, A., 2013. Preface: sentinel devices. *Limn* 1 (3), 2–4.
- Krause, F., 2015. Making a reservoir: heterogeneous engineering on the Kemi River in Finnish Lapland. *Geoforum* 66, 115–125.
- Krauss, W., 2009. Migratory birds, migratory scientists, and shifting fields: the political ecology of a Northern Coastline. *Multi-Sited Ethnogr.: Problems Possibilities Trans. Res. Methods*, 146–160.
- Lafuente, A., 2013. Ciencia ciudadana: los itinerarios amateur, activista y hacker. Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado. <<http://pruebas-1.pntic.mec.es/multiblog/intef/2013/07/31/ciencia-ciudadana-los-itinerarios-amateur-activista-y-hacker/>>.
- Latour, B., 1987. Science in Action: How to Follow Scientists and Engineers through Society. Harvard University Press.
- Latour, Bruno., 1997. Trains of thought: piaget, formalism, and the fifth dimension. *Common Knowl.* 6 (3), 170–191.
- Latour, Bruno, 1999. On recalling ANT. In: Law, J., Hassard, J. (Eds.), Actor Network Theory and After. Blackwell Publishing, Oxford, pp. 15–25.
- Latour, B., 2004. Why has critique run out of steam? From matters of fact to matters of concern. *Crit. Inquiry* 30 (2), 225–248.
- Latour, B., 2011. Networks, societies, spheres: reflections of an actor-network theorist. *Int. J. Commun.* 5, 796–810.
- Law, J., Lynch, M., 1988. Lists, field guides, and the descriptive organization of seeing: birdwatching as an exemplary observational activity. *Human Stud.* 11 (2), 271–303.
- Lefebvre, H., 1991. The Production of Space. Blackwell, Oxford.
- Lippert, I., 2015. Environment as datascape: enacting emission realities in corporate carbon accounting. *Geoforum* 66, 126–135.
- Lorimer, J., 2008. Counting corncrakes the affective science of the UK Corncrake Census. *Soc. Stud. Sci.* 38 (3), 377–405.
- Lulka, D., 2004. Stabilizing the herd: fixing the identity of nonhumans. *Environ. Plan. D* 22, 439–464. <http://dx.doi.org/10.1068/d298>.
- Manceron, V., 2013. Recording and monitoring: between two forms of surveillance. *Limn* 1 (3), 21–23.
- Manning, A.D., Fischer, J., Felton, A., Newell, B., Steffen, W., Lindenmayer, D.B., 2009. Landscape fluidity – a unifying perspective for understanding and adapting to global change. *J. Biogeogr.* 36 (2), 193–199.
- Marres, N., 2012. Material Participation: Technology, The Environment and Everyday Publics. Palgrave Macmillan, Basingstoke.
- Marres, N., Lezaun, J., 2011. Materials and devices of the public: an introduction. *Econ. Soc.* 40 (4), 489–509.
- Massey, D., 2006. Landscape as a provocation: reflections on moving mountains. *J. Mater. Cult.* 11 (1–2), 33–48. <http://dx.doi.org/10.1177/1359183506062991>.
- Meharg, A.A., Pain, D.J., Ellam, R.M., Baos, R., Olive, V., Joyson, A., et al., 2002. Isotopic identification of the sources of lead contamination for white storks (*Ciconia ciconia*) in a marshland ecosystem (Donana, SW Spain). *Sci. Total Environ.* 300 (1), 81–86.
- Menor de Gaspar, Y., Pérez, C., 1998. Doñana, una catástrofe anunciada. La catástrofe ecológica de Doñana es de una gravedad sin precedentes. *Gaia: Ecol. Desarrollo* 14, 16–23.
- Montes, C., 2002. Lecciones aprendidas en tres años de restauración de ecosistemas en el Corredor Verde del Guadimar. *Rev. Ecosist.* 11 (1).
- Murdoch, J., 2006. Post-structuralist Geography: A Guide to Relational Space. Sage, London.
- Nadaï, A., Labussière, O., 2010. Birds, wind and the making of wind power landscapes in Aude, Southern France. *Landscape Res.* 35 (2), 209–233.
- Olano, I., 1998. Doñana: una pérdida anunciada. *Daphnia* 13, 7–9.
- Pastor, N., Baos, R., López-Lázaro, M., Jovani, R., Tella, J.L., Hajji, N., et al., 2004. A 4 year follow-up analysis of genotoxic damage in birds of the Doñana area (south west Spain) in the wake of the 1998 mining waste spill. *Mutagenesis* 19 (1), 61–65.
- Petryna, A., 2013. The origins of extinction. The troubling story of “the Chernobyl zone” – a sentinel of radiation’s effect on wildlife. *Limn* 1 (3), 50–53.
- Philo, C., 2005. Spacing lives and lively spaces: partial remarks on Sarah Whatmore’s Hybrid Geographies. *Antipode* 37 (4), 824–833.
- Preuss, N.O., 2001. Hans Christian Cornelius Mortensen: aspects of his life and the history of bird ringing. *Ardea* 89 (1), 1–6.
- Rabeharisoa, V., Moreira, T., Akrich, M., 2014. Evidence-based activism: patients’ users’ and activists’ groups in knowledge society. *BioSocieties* 9 (2), 111–128.
- Reinert, H., 2013. The care of migrants: telemetry and the fragile wild. *Environ. Hum.* 3, 1–24.
- Rodríguez-Giralto, I., 2011. Social movements as actor-networks: prospects for a symmetrical approach to Doñana’s environmentalist protests. *Convergencia, Revista de Ciencias Sociales* 56, 13–35.
- Rojas, D., 2015. Environmental management and open-air experiments in Brazilian Amazonia. *Geoforum* 66, 136–145.
- Sauri, D., Domingo, V., Romero, A., 2003. Trust and community building in the Doñana (Spain) toxic spill disaster. *J. Risk Res.* 6 (2), 145–162. <http://dx.doi.org/10.1080/1366987032000078910>.
- Schillmeier, M., 2011. Unbuttoning normalcy – on cosmopolitical events. *Sociol. Rev.* 59 (3), 514–534.
- Schmidt, G., 2000. El corredor verde: la mejor opción para doñana y su entorno. *Medio Ambiente* 34, 40–41.
- SEO/Birdlife, 1998. Doñana: Preliminary Environmental Assessment. <<http://www.c3.hu/~mme/madar/donana2.htm>>.
- Simón, M., Ortiz, I., García, I., Fernández, E., Fernández, J., Dorronsoro, C., Aguilar, J., 1999. El desastre ecológico de Doñana. *Edafología* 5, 153–161.
- Stengers, I., 2010. Including nonhumans in political theory: opening Pandora’s box? In: Braun, B., Whatmore, S. (Eds.), Political Matter: Technoscience, Democracy and Public Life. University of Minnesota Press, Minneapolis, pp. 3–32.
- The Guardian, 1999. Toxic timebomb, January 6. <<http://www.guardian.co.uk/society/1999/jan/06/guardiansocietysupplement7>>.
- Tironi, M., Farías, L., 2015. Building a park, immunising life: environmental management and radical asymmetry. *Geoforum* 66, 167–175.
- Valverde, J.A., 2003. Memorias de un biólogo heterodoxo, vol. 1. Editorial CSIC-CSIC Press.
- Vega, I., Bartolomé, J., 1998. Doñana envenedada. Una rotura en la mina de Aznalcóllar contamina Doñana y su entorno. *PANDA* 61, 4–11.
- Whatmore, S., 2002. Hybrid Geographies: Natures, Cultures, Spaces. Sage, London.
- Whatmore, S., Thorne, L., 2000. Elephants on the move: spatial formations of wildlife exchange. *Environ. Plan. D: Soc. Space* 18 (2), 185–203.
- Whitehouse, A., 2009. A disgrace to a farmer: conservation and agriculture on a nature reserve in Islay, Scotland. *Conserv. Soc.* 7 (3), 165. <http://dx.doi.org/10.4103/0972-4923.64733>.
- WWF-Spain/Adena, 2002. Mining in Doñana: a Learned Lessons (WWF/Adena, Madrid). Report. WWF, Madrid.
- Wylie, S.A., Jalbert, K., Dosemagen, S., Ratto, M., 2014. Institutions for civic technoscience: how critical making is transforming environmental research. *Inf. Soc.* 30 (2), 116–126.

Zimmerer, K.S., 2000. The reworking of conservation geographies: nonequilibrium landscapes and nature-society hybrids.

Israel Rodríguez-Giralt is lecturer in Social Psychology at the Open University of Catalonia. His research aims at connecting the Study of Social Movements and

Science and Technology Studies. His more recent research focuses on the processes/practices mediating political participation/mobilization in public controversies around social care policies. He has published in several journals and edited volumes. He is currently co-editing a *Sociological Review Monograph* (2014) on Disasters and Politics.