Society & Natural Resources: An International Journal

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/usnr20

"Story-Networks" of Livestock and Climate Change: Actors, Their Artifacts, and the Shaping of Urban Print Media

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Published online: 10 Jul 2014.

To cite this article: Keith Chun Leem Lee , Joshua Peter Newell , Jennifer Wolch , Nicole Schneider & Pascale Joassart-Marcelli (2014) "Story-Networks" of Livestock and Climate Change: Actors, Their Artifacts, and the Shaping of Urban Print Media, Society & Natural Resources: An International Journal, 27:9, 948-963, DOI: 10.1080/08941920.2014.918227

To link to this article: http://dx.doi.org/10.1080/08941920.2014.918227

Society and Natural Resources, 27:948–963

ISSN: 0894-1920 print/1521-0723 online
DOI: 10.1080/08941920.2014.918227

Routledge
Taylor & Francis Group

"Story-Networks" of Livestock and Climate Change: Actors, Their Artifacts, and the Shaping of Urban Print Media

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Despite widespread media coverage of livestock-related issues and growing scientific evidence linking meat production and climate change, systematic content analysis of this relationship in media coverage has been surprisingly minimal. In this article, we combine actor-network theory with framing theory to develop the basis for "story-networks"—networks of actants and artifacts that shape how a media report or "story" is framed. We coded livestock-related articles from a major U.S. newspaper, the Los Angeles Times*, over the 1999–2010 period to understand how various actants and artifacts shaped different story-networks. Just 5% of all livestock articles addressed connections with climate change; these articles focused on technology, lifestyle, or policy. Distinctive story-networks characterized each category, framing the livestock–climate change linkage as an issue to be addressed through either technological innovation, individual lifestyle choices, or policy action. In each story-network type, varying configurations of actants and artifacts were involved, including the cattle themselves.*

Received 11 August 2012; accepted 21 June 2013.
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Keywords actor-network theory (ANT), climate change, framing theory, livestock, story-networks

With the shift toward large-scale concentrated animal feeding operations (CAFOs), media coverage of livestock production has focused on issues ranging from livestock-borne diseases to workers' rights to greenhouse gas (GHG) emissions. Yet academic literature lacks systematic media content analysis of livestock issues, particularly how the media cover the livestock–climate change connection. Growing evidence for anthropogenic climate change and its connection to livestock production (Steinfeld et al. 2006; Solomon et al. 2007) necessitates deeper understandings of media's role in portraying this linkage. However, continued public uncertainty about anthropogenic climate change threatens the adoption and enforcement of appropriate policies (Leiserowitz 2006; Boykoff 2007). In this article, we examine the media's representations of livestock production as a driver of climate change.

The food system's contribution to climate change is often framed in terms of food miles. However, the global transportation sector emits less than livestock production (Weber and Matthews 2008; Koneswaran and Nierenberg 2008; Foster et al. 2006), which contributes up to 18% of world GHG emissions (Steinfeld et al. 2006). Deforestation associated with grazing and feed production (e.g., corn and soy) contribute to livestock's climate change impact (Gill et al. 2010). Additionally, livestock's digestive systems and manure produce GHGs such as nitrous oxide and methane (Steinfeld et al. 2006). CAFOs also have large heating, cooling, lighting, ventilation, and waste disposal energy demands (Lappé and McKibben 2010).

Media coverage of these linkages contributes to public awareness over climate change and can support or impede structural changes such as developing more sustainable food systems and GHG mitigation policies. In our study analyzing the media's contribution to public understanding of the livestock–climate change connection, we first review prior media analyses. Then we discuss framing theory and actor-network theory (ANT) and their relevance for our study. Third, we outline our methodology and summarize the results of a content analysis of 406 livestock-focused *Los Angeles Times* newspaper articles published from 1999 to 2010, focusing on climate change articles. This analysis addresses three questions:

1. How did *Los Angeles Times* coverage of livestock–climate change linkages shift from 1999 to 2010?
2. Which actors (human or nonhuman) contributed toward news coverage of livestock–climate change-related issues and how did they do so?
3. How were these stories framed?

Finally, we discuss our findings and conclude by reflecting on our theoretical approach and directions for future research.

Climate Change, Livestock and the Media: Frameworks for Understanding

This section reviews media analysis studies and introduces framing theory and ANT. These two theoretical frameworks provide the foundation for the ''story-network'' concept, which we use to describe how different configurations of actors and artifacts create narratives for media stories. This framing solidifies these narratives in the story through repeated messaging over time. News stories and their

characteristics are thus influenced not only by the media but also by the actors and artifacts involved in generating the news.

Media Analysis and Framing Theory

Media analyses focus on how mass media shape public perceptions and attitudes. Their findings illuminate how media's ability to shape public perception depends on how media chooses their primary sources and frames their stories (Bennett 1996; Goodman and Goodman 2005). Several studies have examined climate change media coverage and found it reflects and influences short-term public concern about the issue (Trumbo 1996; Sampei and Aoyagi-Usui 2009; Carvalho and Burgess 2005). Media analyses have also found that the media sometimes convey inaccurate information, possibly to balance two sides of a story. Antilla (2005) concluded that the media would sometimes cite climate skeptics to appear journalistically balanced, often giving undue weight to sensational, less scientific approaches and exaggerating the extent to which issues were debated (Bennett 1996; Goodman and Goodman 2005).

To our knowledge, only Neff et al. (2009) have examined media coverage of livestock–climate change linkages. They analyzed stories in 16 major U.S. newspapers from 2005 to 2008 and concluded that although coverage of food–climate change connections increased over time, it did not reflect the scale of the impact. This coverage focused on food in general rather than on specific food system components. The study found that articles initially allocated responsibility to individuals but over time shifted toward business and government, suggesting a growing salience of food system climate change impacts for political leaders, experts, and advocacy groups. The study did not attempt to identify how different stakeholders might have influenced the newspaper coverage.

Research shows how framing shapes public perceptions and attitudes. Framing theory helps us understand how information is presented and which aspects are included or omitted. Iyengar (1994) divided frames into episodic and thematic framing. Stories framed episodically examine one "episode," rather than the larger processes at work. For example, prior studies demonstrate that episodic media coverage of health problems (e.g., obesity) often blame individuals' eating behavior rather than structural or genetic reasons (Saguy and Almeling 2008; Borra and Bouchoux 2009). In contrast, thematically framed stories provide contextual information about an issue, such as the policies that have made fats and sugars more affordable and readily available. Thematic stories tend to build broad-based public concerns (Iyengar 1994; Wallack et al. 1999) or create pressure for institutional reform (Dorfman et al. 2005), thereby attributing responsibility to government or society. Although few news stories are purely episodic or thematic, one type is usually predominant in each story (Iyengar 1994).

Framing also refers to the narratives news stories employ and reflects how public understandings of different issues are cognitive and cultural (Goffman 1974). Understanding this aspect of framing helps us understand how the media shape opinion (Entman 1993; Scheufele 1999). Gamson et al. (1992) suggest that media framing is influenced by social actors with stakes in different social realities the media present. Trumbo (1996) suggests that framing is dictated by the ability of different parties to communicate messages and the media's discretion in choosing which sources to use. We later employ ANT to make these interactions more nuanced and explicit.

Different frames involve different themes, sources, and actors. Here, we use ''theme'' to refer to the general subject area the media choose to align their stories with. For example, articles about CAFOs could highlight themes such as animal rights issues, workers' rights, or health and nutrition, depending on the angle and sources employed. A manufacturer can be generous for providing a low-priced item or, conversely, be irresponsible for cutting costs on pollution abatement. Frames shape our understanding of who is responsible; they direct the public to pressure certain responsible parties (Wallack et al. 1999). By studying livestock-related stories, we can understand how news is framed and, accordingly, who is made responsible.

Actor-Network Theory

ANT was developed in the 1980s by Bruno Latour, Michel Callon, and John Law (Law 1998; Callon and Latour 1981; Latour 1993) and views the world as comprising multiple actor-networks that are heterogeneous, complex, and dynamic (Castree 2002). This perspective breaks down traditional dualistic boundaries (e.g., nature/culture, structure/agency) that shape how most knowledge is constructed. Actor-networks include assemblages of human and nonhuman actants, which can include everything from people and plants to institutions and scientific research. Networks are made ''real'' not necessarily by actants' intrinsic properties but by actants' positions relative to each other. Actor-networks' success depends on the ability to enroll other actants through translation: an actor's ability to exert authority over another in speech or action (Callon and Latour 1981).

ANT's potential to transcend nature–society dualism partly explains its allure. It helps resist such dualisms by providing a relational vocabulary, providing neutral ground between natural and social sciences (Ivakhiv 2002). Nature is understood as neither ''natural'' nor ''social'' but as a hybrid. ANT is therefore ''co-constructionist,'' seeking to identify how relations and entities come into being together (Murdoch 1997). ANT also challenges how we think about actants with respect to power. We generally conceive power based on what we perceive to be intrinsic resources and liabilities of these actants. ANT turns this conception on its head by ascribing power not to the actants themselves but to the links that bind actants and entities together (Murdoch 2000).

ANT can augment framing theory by identifying actants, who they influence, and what artifacts they use to enroll other actants in their story-networks. In this article's context, actants include humans, animals, and objects that have agency in shaping story-networks by contributing to or having a stake in the events or circumstances covered by the media. We distinguish among these three using the terms ''actors,'' ''animal actants,'' and ''artifacts,'' respectively.

ANT differs from traditional communication models (Shannon and Weaver 1949; Berlo 1960) that consider the process to be linear and shaped by media, which reframes existing information for the public. Couldry (2008) highlights that ANT can blur dualistic boundaries between media institutions and broader society and show how media power is spatially dispersed in actor-networks. However, ANT's treatment of power, especially between actants, has been critiqued as insufficient (Fine 2005; Castree 2002; Rudy 2005). In particular, ''social'' rather than ''natural'' actants have been demonstrated to have more ''power'' (Castree 2002)—through a surplus of money, for example (Massey 1993; Hudson 2001, quoted in Fine 2005).

This critique is important when considering media discourses as outcomes of contestation among different actants (Gamson et al. 1992). More fully understanding

these outcomes requires a version of ANT that interrogates power more subtly and explicitly. In addition to actants' individual characteristics, their positions within networks, network structure, and the type and terms of their connections are important in determining the kinds of power exerted and the outcomes of actant interaction (Rocheleau 2011; Rocheleau and Roth 2007). Similarly, Hobson (2007) suggests that animal agency is shaped by their placement in different networks, that is, their relationships with other actants.

In our analysis of livestock–climate change articles, we draw upon these elaborations on ANT and framing theory to conceptualize news stories as "story-networks"—webs of actants and artifacts with different degrees of power to influence stories' framing and their communicated messages. The media is an actant that others have to pass through and, thus, is intrinsically endowed with power. However, the story-network's actants are also vital; they shape the story's framing, its different themes, and the sources that inform it, thus shaping the meaning of events for the broader public. Our research seeks to understand what kinds of messages are reaching the public about livestock and climate change. To this end, we combine ANT and framing theory to identify and examine key actants associated with different frames and themes. The relationships between actants explain the story-network; we focus on the ways in which different actants exert power and how this influences the framing of the story.

Methodology

Our methodological model assumes story-networks comprise multiple actants and the media. Different degrees and types of power held by each actant shape these networks and interact with the media to shape news articles. We identify the key actants in media coverage of livestock issues and assess how frequently they are cited or referenced, using them as gateways into the actor-networks underlying different news stories. We draw conclusions about how actants' relationships to each other and the media affect their representation. Finally, we assess whether and how these effects interact with the media to impact how articles frame livestock–climate change issues.

Specifically, we examined newspaper articles in the *Los Angeles Times*. This newspaper was selected for three reasons. First, the *Times* is a major national media outlet, with a searchable online archive. Second, California is the nation's leading agricultural state, making its media sensitive to issues affecting that sector. Third, focusing on a single media source helped to some extent to hold constant differences in editorial philosophy and strategy. We used electronic search engines to identify articles, determined their annual frequency, and quantified different coded actants. To keep the amount of data manageable, we systematically searched for livestock-focused, full-text news articles and editorials of any length (except for letters to the editor) published between January 1, 1999, and December 31, 2010, excluding articles that only tangentially referred to livestock. We selected these years as they span a period when scientific awareness of livestock–climate change linkages was growing steadily.

We identified six themes from reading the articles: (1) climate change; (2) animal welfare; (3) workers' rights and safety; (4) human health and nutrition (including food safety); (5) environmental impacts (excluding climate change); and (6) business and technology. We tabulated the total number of articles in each theme for each of the study period's 12 years to identify trends and changes in issue coverage over time. As our aim was to explore how the media portrayed livestock–climate change connections, we focused primarily on climate change-related articles.

Coding Actants

To understand what voices livestock-related articles exposed the public to and which voices influenced the livestock–climate change discourse, we quantified three types of actants quoted or mentioned in the *Los Angeles Times*. We termed human actants as ''actors,'' defining actors as human individuals or organizations that had a stake in, or would be affected by, the event that led to the article. All human actors also received another code based on their affiliation. These included ''state,'' ''private sector,'' ''academic,'' ''industry association'' (i.e., associations representing the livestock industry's interests) or ''public interest'' (including nongovernmental organizations [NGOs] and other members of civil society).

We also counted animals, both when the media portrayed them as having agency and when they were mentioned in general. Lastly, we included key nonhuman actants (for example, a new piece of legislation, or a journal article); these were termed ''artifacts.'' We coded and counted actants once, even if they were mentioned multiple times in an article. Following Iyengar (1994), we also coded each article as episodic or thematic. To identify how the media represented livestock–climate change linkages, we identified the actants that referenced these linkages. We coded those that acknowledged the linkages as a problem as ''positive,'' those that acknowledged only some of the linkages or did not necessarily view climate change as a problem as ''neutral,'' and those that expressed skepticism over livestock's climate change impacts as ''negative.'' All coding was done using Atlas.ti software (Scientific Software Development 2012).

Results

We divide our findings into four areas: changes in the frequency of livestock-related articles over time, the number and types of actants we identified in climate change articles, how these articles were framed, and different actants' attitudes to climate change-livestock linkages.

Media Themes Over Time

Our analysis of livestock coverage in *The Los Angeles Times* from 1999 to 2010 (Figure 1) by general theme reveals that climate change articles were least common ($n = 19$, 5%) and appeared irregularly over the study period. Although 2003 saw some coverage, coverage only increased and peaked in 2007 and 2008 with articles covering climate change mitigation policy, diet change, and methane capture technology. However, their number decreased to near zero in 2009 and 2010. Meanwhile, the annual total of livestock-related articles increased from 14 in 1999 to 72 in 2010, suggesting that climate change lagged other livestock-related themes in attracting media coverage. Otherwise, health articles were most frequent (43%), followed by animal welfare (26%), environmental impacts (10%), business and technology (9%), and workers' rights and safety (7%).

Explaining the trends in climate change article frequencies is difficult without further research or being unduly speculative, especially when events mentioned in the articles were triggered by factors external to articles' contents. For example, the sudden growth in climate change stories in 2008 could be linked to the release of the United Nations (UN) Food and Agriculture Organization (FAO)

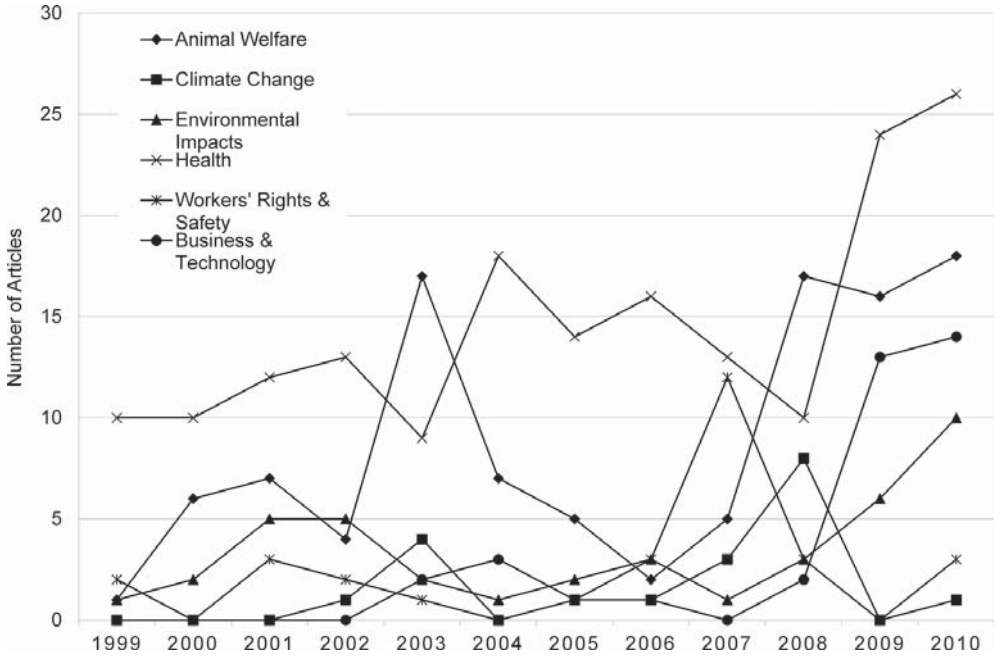

Figure 1. Annual number of articles by theme.

report, *Livestock's Long Shadow,* or Al Gore's Academy Award for his climate change documentary, *An Inconvenient Truth*.

Actants and Artifacts

Among human actants, climate change articles most commonly featured state actors, which comprised 18% of all actants. This reflected the prominence of policy- and legislation-related news stories in this theme. Next most frequent were public interest actors, such as environmental NGOs, and livestock industry associations (11% each). Private-sector actors, mainly food services and energy companies, comprised 10%. Academics represented 8% of all actants and were cited in connection with their research on livestock's climate change impacts and mitigation. Animals comprised 28% of the total. Artifacts in the climate change theme made up the remainder (15%) and included studies and reports, technologies such as biogas energy and grass-based feeding strategies, new policies, and a documentary.

Framing Analysis

The climate change articles can be roughly divided into three categories; each solidifies a different facet of the livestock–climate change nexus for the public. The first category of articles ($n = 6$) emphasized technological innovations for climate change mitigation (e.g., bioengineering of feed and cattle and biodigesters for manure). The second category ($n = 4$) highlighted lifestyle changes that reduce individuals' carbon footprints, such as lowering beef consumption and buying locally. The third category ($n = 9$) covered climate change policy, focusing on regulations and legislation. We further categorized the actants identified in the climate change theme and present their distribution among these three categories in Table 1.

Table 1. Proportional distribution of actants in climate change theme by type and story-network

Actant type	Number of actants by story-network				Percent of total actants	Percent of actants by story-network		
	Technology	Lifestyle	Policy	Total		Technology	Lifestyle	Policy
State	7	3	9	19	18	37	16	47
Livestock industry association	2	1	8	11	11	18	9	73
Academic	5	3	—	8	8	63	38	—
Animal								
General animal	9	3	2	14	13	64	21	14
Animal actor	4	9	2	15	14	27	60	13
Private sector								
Energy utility	2	1	—	3	3	67	33	—
Beef/dairy company	2	—	—	2	2	100	—	—
Energy technology/services	1	1	—	2	2	50	50	—
Food services company	—	2	—	2	2	—	100	—
Car company	1	—	—	1	1	100	—	—
Public interest								
Environmental NGO	1	—	5	6	6	17	—	83
Social justice NGO	1	—	1	2	2	50	—	50
Business development NGO	1	—	—	1	1	100	—	—
Consumer advocacy group	—	—	1	1	1	—	—	100
Public policy think tank	—	—	1	1	1	—	—	100
Artifact								
Study/report	1	3	2	6	6	17	50	33
CC mitigation technology	3	—	—	3	3	100	—	—
Policy	—	—	3	3	3	—	—	100
Consumer practice	—	2	—	2	2	—	100	—
Beef production technology	—	1	—	1	1	—	100	—
Film	—	1	—	1	1	—	100	—
Total	40	30	34	104	100			

Episodic stories comprised 32% of the climate change articles. The low percentage contrasts with Iyengar's (1994) finding that typical news stories are episodic. Half of the technology and lifestyle articles were episodic; these highlighted specific actors' development of mitigation technologies, or individuals' actions or responses concerning lifestyle changes. The sole episodic policy article was about Tom Vilsack's appointment as Secretary of Agriculture, focusing on his track record and expected agricultural policy. Artifacts commonly featured in episodic articles included technology (processes, equipment) and items individuals easily relate to, such as diets.

Thematic technology and lifestyle articles provided more background than episodic articles on technological innovation or behavioral change and involved more academic, state, and public interest actors. Thematic policy articles discussed legislative issues and mainly referenced state actors. They often featured academics in connection with their research and NGO representatives who advocated or expressed support for certain reforms, often referring to their own research. Common thematic artifacts included academic studies and reports, new technologies, and techniques for farming that might be incorporated into legislation.

Attitudes of Actants to the Climate Change–Livestock Linkage

Many articles made statements or quoted actors acknowledging the linkage between livestock and climate change as problematic (54%; coded as ''positive''). Most were academics who discussed emissions data, reduction approaches, and livestock's contribution to climate change. Just one private-sector actor supported the linkage: Bon Appétit Management Co., a self-described sustainable food services company (Weiss 2008). State actors often referred to livestock–climate change connections; these references were about half positive and half neutral. Different sectors and levels of the government tended to disagree on whether the connection warranted action. For example, then California Attorney General Jerry Brown threatened to sue the U.S. Environmental Protection Agency (EPA) for not regulating GHG emissions from farm equipment, aircraft, and ships (Sahagun 2008).

Trumbo's (1996) analysis of a decade of climate change coverage in five major U.S. newspapers suggests that the private sector would downplay or disregard the connection's significance. Our study supports this because most private-sector actors acknowledged the linkage by emphasizing opportunities involving end-of-pipe mitigation strategies such as manure-based energy generation. However, they did not address indirect sources of emissions (e.g., deforestation), which require systemic changes (e.g., curtailing livestock production), or necessarily acknowledge livestock production as a problematic cause of climate change. These actors were therefore identified as neutral (27%).

Trumbo (1996) suggests that governmental support of climate change policies follows a cycle where support for such policies wanes as the costs become clearer. Our findings suggest this varies by level of government. For example, several articles highlighted California's leadership in implementing state-led climate initiatives despite the costs. In contrast, other contemporaneous articles discussed politicians' use of economic arguments to oppose federally proposed climate change policies. The following header is an apt example: ''Of greenhouse gases and greenbacks, Senate debate on a proposal to impose pollution regulations is likely to center on the financial stakes'' (Simon 2008).

Actors coded as having negative attitudes (19%) were generally livestock industry members and either publicly questioned livestock's climate change impacts (Shogren 2003) or lobbied against climate change legislation. For example, the industry responded to a U.S. EPA report on livestock's climate and air pollution impacts by immediately criticizing the costs of possible pollution fees (Associated Press 2008). This illustrates how industry might disregard climate change and instead focus on and distort the costs of proposed reforms. Government's tendency to back down when faced with such opposition (Trumbo 1996) presents obstacles to structural reforms. This places greater responsibility for climate change mitigation on individuals and NGOs.

Discussion

Given livestock production's major contribution to climate change (Koneswaran and Nierenberg 2008; Steinfeld et al. 2006), the scarcity of articles in relation to our sample's other themes is disturbing. It is unclear whether this is due to (1) a perception that such stories do not sell newspapers, (2) a paucity of newsworthy material related to this theme, or (3) climate change advocates being ineffective at building relationships with the media. Our study provides some evidence for the last possibility. Only half of the actants (primarily academics) in the theme acknowledged the climate change–livestock linkage, although media attempts at journalistic balance may have been responsible. Also supporting (3) is that academics were the minority not only in the climate change theme, but also in the animal welfare, workers' rights and safety, and environmental impacts themes.

Why news coverage of climate change–livestock issues after 2008 suddenly declined remains unclear. The 2009 ''Climategate'' controversy[1] may have affected the legitimacy of climate change science in the American public's eyes, at least in the short term. Another possibility is that the Great Recession drew attention toward economic issues. Nevertheless, our findings suggest that academics and other climate change advocates could build closer relationships with media, using strategies such as press releases or collaboration on producing educational material with mainstream appeal.

We divided the climate change articles into three categories: technology, lifestyle, and policy. Each category can be considered a group of story-networks that share similar configurations of actants. Different configurations of actants in relation to each other (and to the media) provide each group of story-networks their common characteristics, enabling their identification as a distinct category within the livestock–climate change nexus. These categories are stabilized through repetition and reproduction, in the process shaping public understandings of what should be done about livestock and climate change.

Story-networks in the technology category, for example, included private-sector actants (e.g., energy utilities, beef producers, and food service companies) in addition to a number of artifacts (e.g., the technologies they developed and the studies they relied upon). These artifacts reveal the enrollment of other actants (e.g., scientists), who were not prominent in the story but nonetheless instrumental in developing the technology. Additionally, by mitigating bovine climate change impacts, private-sector actors exerted a ''taming'' effect[2] on cattle, their manure, microbes, and other actants involved in the release of greenhouse gases. Stuart (2011) described how such actants occasionally destabilize (i.e., threaten the legitimacy of) the

industrial food system with disease outbreaks; these actants' contribution to climate change constitutes a similar, but less direct, destabilization that nonetheless requires ''taming.'' Media's focus on mitigation technologies, however, draws attention away from actants responsible for organizing individual animals into CAFOs and multiplying their individual emissions, consumers demanding cheap beef, government subsidies for cattle feed production, and actants driving indirect impacts such as land-use change. These actants are in fact the root causes of livestock-linked climate change, but escape responsibility in the media, as we show next.

By shifting blame to bovine digestive systems and by deploying GHG mitigation technology, this story-network configuration helps preserve a hegemonic industrial livestock production system. Certain articles played up animals' agency in causing climate change by focusing on their inherent biological properties, that is, their digestive systems and direct emissions from manure. Human actants' roles (e.g., demand for meat, deforestation, CAFOs) received far less attention. In contrast, media in health-related story-networks rarely blamed the biological characteristics of animals for causing heart disease and other meat-related health conditions. Articles that represented animals as actants placed responsibility for GHG emissions on livestock and discussed production-oriented technological fixes rather than food system-level reform. Other scholars have also observed such responsibility shifting in the industrial food system (Stuart 2011; Gouveia and Juska 2002).

Lifestyle-focused stories provided another example of a network configuration that yields a different interpretation of what should be done. Though the media continued to mention animals' agency, climate change mitigation became a matter of individual consumer choice: Either eat less meat or switch to ''greener'' alternatives such as grass-fed beef. These story-networks suggested that consumers exert economic power over private-sector actants. For instance, Bon Appetit's promotion of a low-carbon diet was a response to increased consumer concern about the climate. Consumer awareness can be linked to actants like the United Nations Intergovernmental Panel on Climate Change, which urged consumers to reduce meat consumption and suggested that governments start campaigns to reduce national meat consumption (*Los Angeles Times* 2008).

However, the absence of such national campaigns, reflected by this category's minimal number of state actors, suggests continued government subsidies for meat production. The beef lobby's strength (*Los Angeles Times* 2007) reflects the continuation of economic power forged by private-sector–state relations. These actant connections lead to the reaffirmation of faith in markets, thereby obscuring needed system-level food production reforms. There is a tendency for climate change mitigation to be framed as a matter of individual choice, when in fact structural change through democratic participation and political leadership is equally, if not more, important (Maniates 2002).

Story-networks in the policy category involved two-way connections between state and livestock-industry actors. Pro-mitigation state-level actions pressure industry by enrolling academic studies on climate change and promoting end-of-pipe reduction policies. Industry actants respond through lobbyists by threatening to block such policies unless they are watered down. These oppositional efforts center the debate on the economic costs of reform, thereby enrolling consumers accustomed to low beef prices and those employees dependent on the livestock industry. As a result, policy and legislation articles focused primarily on the economic costs and

benefits of climate change mitigation, detracting from the needed industrial food system reforms.

The media shape story-networks through the act of investigation and by marshaling actants in the service of a story. Story-networks are shaped by the journalist's interests, the actants whose interests are at stake, and the demands of the general audience. Despite the prominence of the three categories already discussed, some articles briefly problematized the entrenched industrial livestock production system. For example, one article stated:

> Cows lived in harmony with the atmosphere for thousands of years. Then humans developed a taste for the animals and their dairy products, and nature's equilibrium was disturbed. Simple barnyard creatures were transformed into agents of climate change, not by their own doing, but because people dramatically multiplied their numbers so they would produce more milk, cheese and meat. (Polakovic 2003)

Nonetheless, the article chiefly discussed promising technologies for reducing individual animals' emissions, rather than industry structure per se. The article's title, "Getting the Cows to Cool It," aptly reflects this shift of responsibility.

The configuration of actants in a story-network shapes how responsibility is allocated (Gouveia and Juska 2002) and predisposes a story to episodic or thematic framing. Technology- and lifestyle-oriented stories are easier to frame episodically; the opposite is true for policy articles. However, by influencing the media's perception of how best to sell a story, the public can strongly influence the story's ultimate framing. Although media may portray certain actants as responsible for change, change is also attributable to other actants in the story-network. Illustrative of this is Bon Appetit's apparent game-changing promotion of a low-carbon diet (Weiss 2008) due to consumer concern over climate change.

Besides animal welfare, climate change articles had a higher proportion of episodic articles than other themes. Episodic stories primarily covered technology and lifestyle change, thereby framing climate change mitigation as a matter of individual choice and action. Emphasizing organic or local food purchasing as a lever for change (Pollan 2010) is an example of this. Due to the schism in the American public's opinion toward climate change (Leiserowitz 2006), presenting livestock–climate change issues in terms of individual choice and action rather than employing a normative, policy-oriented approach is arguably the least controversial option. In general, our findings reflect those of Neff et al. (2009), who similarly discuss contrasts in media between framing climate change mitigation as individual choice versus institutional responsibility.

Episodic articles may be easier to relate to and, in theory, be better for raising awareness of the livestock–climate change interactions. However, this may not be the most appropriate strategy. Portraying climate change mitigation as a matter of individual choice is problematic, as already discussed, since this may undermine the importance of structural change. Therefore, the media should frame climate change–livestock linkages at both individual and system levels.

About half of the time animals were portrayed as actants with agency in the climate change theme versus more general references where the media did not explicitly assign them agency. However, even when the media did not treat animals as actants, human actors occasionally spoke on their behalf, providing animals with a proxy

voice. ANT enables us to recognize this as an example of nonhuman actants exerting their influence through their respective actant networks. This is clearest in the campaigns of animal rights activists, but a livestock industry association member provides a more subtle example: ''It's a natural process that a ruminant animal goes through . . . There's not much you can do about it. If you want to control methane emissions in the world, controlling it from cows has to be pretty low on the totem pole'' (Polakovic 2003). This statement illustrates how human dependency on the domesticated relationship with cows allows the latter to enroll human actors in their defense against disproportionate blame for climate change. It is ironic, however, that the very same relationship is also responsible for multiplying the once limited agency of individual animals in causing climate change.

This example reveals the complexity of actant relations in story-networks and catalyzes a deeper examination and untangling of nonhuman actants' roles in the making of news, as well as the contrasting effects different actants may have on reader perceptions and behavior. Ultimately, this may shift public perceptions and behavior of the livestock–climate change connection. A possible effect might be to unite the interests of animal rights and welfare activists and climate change advocates. ANT, by emphasizing both nonhuman and human actants, can be used to introduce even greater nuance to our understandings of the media. Used in conjunction with framing theory, ANT provides a foundation for the story-network approach. This permitted us to highlight how it is not just the media, but also the interaction of various actants in power-infused relationships that helps attribute responsibility to different actors in society.

Conclusion

More research investigating relationships between the media and livestock–climate change-related actants is necessary. Additional research could expand the geographic range of this study, which focused on one newspaper. Although it is a national media outlet, the *Los Angeles Times* focuses much of its coverage on Southern California. It is also a relatively liberal newspaper in terms of editorial policy. Future studies could focus on additional newspapers and locations to understand how coverage of the issue varies by geography and political alignment. Online news articles, readers' comments, and their integration with social media provide rich data sources for future understandings of how media portrayals of livestock and climate change affect public perceptions and attitudes.

Second, it would also be beneficial to investigate relationships between the media and different actants to help us better understand how these relationships have developed over time, and how media framing influences public opinion and behavior. ANT allowed us to identify and quantify the key actants involved in news generation. As each actant is a network unto itself, the relative influence of each actant can be assessed by tracing the components of actants' individual networks. Ethnographic and institutional work would expand our understanding of how networks of actants evolve and shape the media.

By combining ANT with framing theory, we provide the theoretical framework and language of story-networks to understand and describe media content, to identify key actants and their linkages within the articles, and to reveal how and from whom journalists obtain their information. When combined with framing theory, ANT allowed us to link key actants with each article's framing and content, shedding

light on why certain frames or biases may exist. Although we attempted to bring both living and nonliving actants into the analysis, we focused primarily on human actants. Further research should therefore delve deeper into the role of nonhuman actants, especially animals.

Acknowledgments

The authors express their gratitude to the anonymous reviewers for their insightful comments and suggestions.

Notes

1. This involved an e-mail hacking at the University of East Anglia's Climatic Research Unit, leading to allegations that scientists had manipulated climate change data to suppress critics. Subsequent investigations found no evidence of fraud or misconduct.
2. Gouveia and Juska (2002, 375) employ "taming" as a metaphor that describes an actor's exertion of power over another that captures "the coercive nature of disciplining technologies deployed . . . to manufacture consent among humans and non-humans."

References

Antilla, L. 2005. Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environ. Change* 15(4):338–352. doi:10.1016/j.gloenvcha.2005.08.003.

Associated Press. 2008. Livestock farmers raise stink over EPA report. *Los Angeles Times Articles*, December 6. http://articles.latimes.com/2008/dec/06/business/fi-cowtax6 (accessed 31 March 2014).

Bennett, W. L. 1996. *News: The politics of illusion*, 3rd ed. White Plains, NY: Longman.

Berlo, D. K. 1960. *The process of communication; An introduction to theory and practice*. New York: Holt, Rinehart and Winston.

Borra, S. T., and A. Bouchoux. 2009. Effects of science and the media on consumer perceptions about dietary sugars. *J. Nutr.* 139(6):1214S–1218S. doi:10.3945/jn.108.097915.

Boykoff, M. T. 2007. From convergence to contention: United States mass media representations of anthropogenic climate change science. *Trans. Inst. Br. Geogr.* 32(4):477–489. doi:10.1111/j.1475-5661.2007.00270.x.

Callon, M., and B. Latour. 1981. Unscrewing the Big Leviathan: How actors macro-structure reality and how sociologists help them to do so. In *Advances in social theory and methodology: Toward an integration of micro-and macro-sociologies*, 277–303. London: Routledge and Kegan Paul.

Carvalho, A., and J. Burgess. 2005. Cultural circuits of climate change in U.K. broadsheet newspapers, 1985–2003. *Risk Ana.* 25(6):1457–1469. doi:10.1111/j.1539-6924.2005.00692.x.

Castree, N. 2002. False antitheses? Marxism, nature and actor-networks. *Antipode* 34(1): 111–146.

Couldry, N. 2008. Actor network theory and media: Do they connect and on what terms? In *Connectivity, networks and flows: Conceptualizing contemporary communication*, ed. A. Hepp, F. Krotz, S. Moores, and C. Winter, 93–111. Cresskill, NJ: Hampton.

Dorfman, L. E., L. Wallack, and K. Woodruff. 2005. More than a message: Framing public health advocacy to change corporate practices. *Health Educ. Behav.* 32(3):320–36. doi:10.1177/1090198105275046.

Entman, R. M. 1993. Framing: Toward clarification of a fractured paradigm. *J. Commun.* 43(4):51–58. doi:10.1111/j.1460-2466.1993.tb01304.x.

Fine, B. 2005. From actor-network theory to political economy. *Capitalism Nature Socialism* 16(4):91–108. doi:10.1080/10455750500376057.

Foster, C., K. Green, M. Bleda, P. Dewick, B. Evans, A. Flynn, and J. Mylan. 2006. *Environmental impacts of food production and consumption: A report to the Department for Environment, Food and Rural Affairs*. London: Defra.

Gamson, W. A., D. Croteau, W. Hoynes, and T. Sasson. 1992. Media images and the social construction of reality. *Annu. R. Sociol.* 18(January):373–393. doi:10.2307/2083459.

Gill, M., P. Smith, and J. M. Wilkinson. 2010. Mitigating climate change: The role of domestic livestock. *Animal* 4(3):323–333.

Goffman, E. 1974. *Frame analysis: An essay on the organization of experience*. New York, NY: Harper & Row.

Goodman, A., and D. Goodman. 2005. *The exception to the rulers: Exposing oily politicians, war profiteers, and the media that love them*. New York, NY: Hyperion.

Gouveia, L., and A. Juska. 2002. Taming nature, taming workers: Constructing the separation between meat consumption and meat production in the US. *Sociol. Rur.* 42(4):370–390.

Hobson, K. 2007. Political animals? On animals as subjects in an enlarged political geography. *Polit. Geogr.* 26(3):250–267. doi:10.1016/j.polgeo.2006.10.010.

Ivakhiv, A. 2002. Toward a multicultural ecology. *Organization & Environment* 15(4):389–409. doi:10.1177/1086026602238169.

Iyengar, S. 1994. *Is anyone responsible?: How television frames political issues*. Chicago, IL: University of Chicago Press.

Koneswaran, G., and D. Nierenberg. 2008. Global farm animal production and global warming: Impacting and mitigating climate change. *Environ. Health Perspect.* 116(5):578–582. doi:10.1289/ehp.11034.

Lappé, A., and B. McKibben. 2010. *Diet for a Hot planet: The climate crisis at the end of your fork and what you can do about it*. New York, NY: Bloomsbury USA.

Latour, B. 1993. *We have never been modern*. Cambridge, MA: Harvard University Press.

Law, J. 1998. After ANT: Complexity, naming and topology. *Sociol. Rev.* 46(S):1–14.

Leiserowitz, A. 2006. Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change* 77(1–2):45–72. doi:10.1007/s10584-006-9059-9.

Los Angeles Times. 2007. Pollution on the hoof. October 15. http://articles.latimes.com/2007/oct/15/opinion/ed-methane15 (accessed March 31, 2014).

Los Angeles Times. 2008. What's not for dinner. September 9. http://articles.latimes.com/2008/sep/09/opinion/ed-meatless9 (accessed March 31, 2014).

Maniates, M. 2002. Individualization: Plant a tree, buy a bike, save the world? In *Confronting consumption*, ed. T. Princen, M. Maniates, and K. Conca, 43–66. Cambridge, MA: MIT Press.

Massey, D. 1993. Power-geometry and a progressive sense of place. In *Mapping the futures: Local cultures, global change*, ed. J. Bird, B. Curtis, T. Putnam, and L. Tickner, 59–70. London: Routledge.

Murdoch, J. 1997. Inhuman/nonhuman/human: Actor-Network Theory and the prospects for a nondualistic and symmetrical perspective on nature and society. *Environ. Plan. D* 15:731–756.

Murdoch, J. 2000. Networks—A new paradigm of rural development? *J. Rural Stud.* 16(4):407–19.

Neff, R. A., I. L. Chan, and K. C. Smith. 2009. Yesterday's dinner, tomorrow's weather, today's news? US newspaper coverage of food system contributions to climate change. *Public Health Nutr.* 12(7):1006.

Polakovic, G. 2003. Getting the cows to cool it. *Los Angeles Times*, June 7. http://articles.latimes.com/2003/jun/07/local/me-cowgas7 (accessed 31 March 2014).

Pollan, M. 2010. The food movement, rising. *NY Rev. Books*, June 10. http://www.nybooks.com/articles/archives/2010/jun/10/food-movement-rising (accessed 31 March 2014).

Rocheleau, D. 2011. Rooted networks, webs of relation, and the power of situated science: Bringing the models back down to Earth in Zambrana. In *Knowing nature: Conversations at the intersection of political ecology and science studies*, ed. M. J. Goldman, P. Nadasdy, and M. D. Turner, 209–226. London: University of Chicago Press.

Rocheleau, D., and R. Roth. 2007. Rooted networks, relational webs and powers of connection: Rethinking human and political ecologies. *Geoforum* 38(3):433–37.

Rudy, A. 2005. On ANT and relational materialisms. *Capitalism Nature Socialism* 16(4):109–25.

Saguy, A. C., and R. Almeling. 2008. Fat in the fire? Science, the news media, and the 'obesity epidemic.' *Sociol. Forum* 23(1):53–83. doi:10.1111/j.1600-0838.2004.00399.x-i1.

Sahagun, L. 2008. State may sue EPA over pollution. *Los Angeles Times Articles*, August 1. http://articles.latimes.com/2008/aug/01/local/me-briefs1.S1 (accessed March 31, 2014).

Sampei, Y., and M. Aoyagi-Usui. 2009. Mass-media coverage, its influence on public awareness of climate-change issues, and implications for Japan's national campaign to reduce greenhouse gas emissions. *Global Environ. Change* 19(2):203–12. doi:10.1016/j.gloenvcha.2008.10.005.

Scheufele, D. A. 1999. Framing as a theory of media effects. *J. Commun.* 49(1):103–122. doi:10.1111/j.1460-2466.1999.tb02784.x.

Scientific Software Development. 2012. *ATLAS.ti* (version 6.2). Berlin: Scientific Software Development.

Shannon, C. E., and W. Weaver. 1949. *The mathematical theory of communication*. Urbana, IL: University of Illinois Press.

Shogren, E. 2003. EPA plans farm pollution amnesty. *Los Angeles Times Articles*, September 25. http://articles.latimes.com/2003/sep/25/nation/na-pollute25 (accessed 31 March 2014).

Simon, R. 2008. Of greenhouse gases and greenbacks. *Los Angeles Times Articles*, June 2. http://articles.latimes.com/2008/jun/02/nation/na-climate2 (accessed 31 March 2014).

Solomon, S., D. Qin, M. Manning, M. Marquis, K. Averyt, M. M. B. Tignor, H. LeRoy Miller, Jr., and Z. Chen, ed. 2007. *Climate change 2007: The physical science basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press.

Steinfeld, H., P. Gerber, T. D. Wassenaar, V. Castel, and C. de Haan. 2006. *Livestock's long shadow: Environmental issues and options*. Rome, Italy: United Nations Food and Agriculture Organization.

Stuart, D. 2011. 'Nature' is not guilty: Foodborne illness and the industrial bagged salad. *Sociol. Rur.* 51(2):158–174. doi:10.1111/j.1467-9523.2010.00528.x.

Trumbo, C. 1996. Constructing climate change: Claims and frames in US news coverage of an environmental issue. *Public Understand. Sci.* 5(3):269–283. doi:10.1088/0963-6625/5/3/006.

Wallack, L., K. Woodruff, L. E. Dorfman, and I. Diaz. 1999. *News for a change: An advocate's guide to working with the media*. Thousand Oaks, CA: Sage.

Weber, C. L., and H. S. Matthews. 2008. Food-miles and the relative climate impacts of food choices in the United States. *Environ. Sci. Technol.* 42(10):3508–3513. doi:10.1021/es702969f.

Weiss, K. R. 2008. With low-carbon diets, consumers step to the plate. *Los Angeles Times Articles*, April 22. http://articles.latimes.com/2008/apr/22/local/me-lowcarbon22 (accessed 31 March 2014).