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Research and Theory in Human Ecology

Role Identities and Pro-environmental Behavior among Farmers

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Abstract

In this exploratory work, we investigate the relationship between the role identity "farmer" and farmers' land management practices using data from 30 semi-structured interviews with farmers in southeastern Idaho. Guided by social identity principles, we examine how farmers' collective identity influences environmental attitudes and behaviors. Overall, we find that most farmers have implemented some conservation practices on their land, particularly those related to soil and water, and see themselves and other farmers as good environmental stewards. However, we also find that many of their chosen conservation practices required little to no sacrifice, and in addition to benefiting the environment, were also cost-minimizing business decisions. We find that as a group, these farmers' beliefs, attitudes, and behaviors are largely focused on productive efficiency. We argue that this focus often puts them in competition with other social groups, which ultimately reinforces group saliency and adversely affects relations between farmers and other groups seeking to influence farming practices.

Keywords: conservation, farming, group conflict, pro-environmental behavior, role identities, social identity theory

Introduction

Farmers are one of the most important stakeholder groups when it comes to using and affecting natural resources. Over the past 50 years, worldwide agricultural production has approximately tripled (United Nations [UN], 2016). Globally, 40% of total land and 70% of fresh water is used for agricultural purposes

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(Kleinschmidt, 2009). In Idaho, as of the last agricultural census in 2012, about 22% of all available land was classified as farmland, and in the three primary counties in southeastern Idaho—Bingham, Power, and Bannock counties—there is more land in agriculture than in industry (Southeast Idaho Council of Governments, 2013; United States Department of Agriculture [USDA], 2015).

Farmers use natural resources like land and water to grow their crops, and these activities are associated with adverse impacts, including deforestation and water pollution from agricultural run-off (McGuire et al., 2013; UN, 2016). Synthetic fertilizer use has been associated with high levels of nitrate in groundwater, which leads to hypoxia in aquatic ecosystems and contamination of drinking water sources (Nolan et al., 2002). Pesticide use has also contributed to declining biodiversity due to habitat loss and degradation, particularly among natural pollinators such as the monarch butterfly (National Academy of Sciences, 2007). With respect to effects on air and climate, agricultural activities account for 17.4% of greenhouse gas emissions (Kleinschmidt, 2009). It is estimated that by 2050, 70% more food production will be required to sustain the population, further exacerbating these already significant environmental impacts (UN, 2016).

Farming has substantial social, cultural, and economic importance in Idaho, and historically, Idaho was essentially established by agriculture. With the expansion of the railroad in the mid-19th century, settlers moved in to southeastern Idaho because of the fertile land found in the Snake River Valley (Arrington, 1994). The number of settlers increased even faster after the Desert Land Act of 1894, which provided federal funding for dam projects and hence expanded the opportunity for irrigation. In fact, it was not until the 1960s that more people resided in "urban"[2] as opposed to "rural" areas, and it was not until 1962 that Idaho had a US Census Bureau Standard Metropolitan Statistical Area (Arrington, 1994). Currently, Idaho ranks as the 39th state in terms of population, but due to climate conditions in primarily Southern Idaho and the importance of agriculture, ranks second nationwide in irrigation withdrawals (United States Geological Survey, 2016). Agriculture is also a central part of the local culture, from rural school districts releasing students for a week or two to work harvest in the fall to an entire museum devoted to the potato. More recently, agribusiness was identified as the third largest industry in Idaho, accounting for about 31% of total employment and over 100,000 jobs (Idaho Department of Labor, 2014).

Given the prevalence of agriculture in Idaho, and the environmental concessions that often accompany large-scale agricultural activities, it is important for projections of both economic productivity and natural resource sustainability/environmental stewardship to analyze how farmers weigh trade-offs between the two. Fortunately,

2 For the purposes of this discussion, we define "urban" as a place having 2,500 or more inhabitants (USDA Economic Research Service, 2019).

considerable research has begun to address these questions. For example, Pilgeram (2011) found that increases in familial income and educational attainment improve the likelihood that one will engage in more sustainable farming practices. Similarly, Cary and Wilkinson (1997) found that profitability was the largest contributor to conservation-oriented behavior among farmers. Others have found that the expense of implementing and maintaining conservation was a major concern, as well as the perceived effectiveness of these efforts (Porter et al., 2007; Tosakana et al., 2010). This suggests that the cost of conservation efforts is a barrier if farmers believe the methods are more expensive and not particularly effective.

Other studies have identified farming subsidies as a major factor affecting conservation behavior (Aughney & Gormally, 2002; Herzon & Mikk, 2007). In a study of agro-environmental schemes in Europe, however, Burton et al. (2008) found that although such incentives result in farming conservation practices, they have done little to change environmental attitudes. Rather, research has found farmers who engage in conservation practices are often intrinsically motivated because of land or place attachment, the emotional connection between person and place (Ryan et al., 2003), connectedness to nature, defined as the "extent to which an individual feels that he or she is a part of nature" (Gosling & Williams, 2010, p. 298), and/or community norms (Cutforth et al., 2001) rather than an overall pro-environmental orientation.

Here, we define pro-environmental behavior as farmers' land management practices that promote natural resource sustainability in the long term and minimize environmental impact. Prior research has concluded that people who live in rural areas are often more directly affected by their environment than those in urban settings, and therefore experience more targeted environment-related concerns, such as fear of wildfires due to unmanaged forests or loss of resource-based employment (Hamilton et al., 2013; Dunlap, 2010; Molnar, 2010). Research has also found that respondents in rural counties prefer conserving natural resources for the future instead of using them to stimulate more rapid economic development where unemployment is low, revealing a preference for long-term sustainability over short-term growth, when feasible (Hamilton et al., 2010). However, other studies have found that perceived profitability is the most important factor influencing farmers' decision to adopt conservation practices (Cary & Wilkinson, 1997), and that conservation programs that are too rigid and prohibit farmers from using their hard-won skills are often unpopular (Burton et al., 2008). In this research, we seek to further explore how the formation and dynamics of the social identity "farmer" impacts farmers' self-reported environment-related attitudes and behaviors through analyzing interviews with 30 farmers in southeastern Idaho. In particular, we seek to answer the question: How do farmers' role identities as producers of food for a growing population affect their willingness to engage in environmental stewardship and conservation activities?

We begin by reviewing the literature on social identity theory, with an emphasis on role identity and group competition, and the saliency of the farmer identity for people who farm for a living. We then outline our data collection and analysis procedures, including how we recruited participants for our study and the basic demographics defining who we ultimately interviewed, along with how we coded our data and why. We then discuss our overall findings, including how intergroup competition and role responsibility affect farmers' environmental behaviors and land management decisions. We conclude with some thoughts for how the findings from this exploratory work may be used by state natural resource managers to encourage farmers to adopt mutually beneficial environmentally sustainable practices.

Theoretical foundation

The self and behavior

Social identity theory (SIT) posits that one's identity is strongly linked with the group in which one belongs (Turner et al., 1987). As such, group members are more likely to adopt in-group norms rather than norms associated with out-groups (Tajfel, 1982), though to varying degrees depending upon the strength of one's affiliation with a group (McDonald et al., 2012). Past studies have used social identity principles to help explain farmers' environment-related behavior (De Weerd & Klandermans, 1999; Fielding et al., 2008; Groth et al., 2016), as well as people's behavior more generally (Bartels & Onwezen, 2014; Dono et al., 2010). Groth et al. (2016) found that both full-time and part-time farmers in the United States allied with the farmer identity, and De Weerd and Klandermans (1999) found that individual affiliation with farmers as a social group was a good predictor of participatory political action, illustrating the influence of the farmer identity on behavior. Using a combination of the theory of planned behavior and SIT, Fielding et al. (2008) found that in-group dynamics (i.e., group saliency) and in-group/out-group relations affected farmers' decisions to engage in riparian zone conservation practices.

Generally, identity theorists focus on individuals' role identities, which are "the meanings individuals attach to themselves as an occupant of a role in the social structure" (Stets & Biga, 2003, p. 403). In this study, we focus specifically on farmers' role identity and how their role as both producers and land managers affects their environment-related behavior. One of the most salient aspects of how one's individual identity is related to role identity and in-group/out-group relations is how one develops a sense of purpose. In general, people sharing a social identity are more likely to share a sense of purpose, especially when this purpose comes into competition with the purpose of out-group members. Tajfel (1982) argues that in a competitive group situation, especially when this competition is centered on issues of "power, rank, prestige," or "access to resources," in-group attitudes and behaviors

become increasingly unified, while sentiments toward the out-group become increasingly "undifferentiated" and socially stereotyped (p. 13). In this study, we focus specifically on farmers' role identity, and how their shared goal of feeding a growing global population interacts with other goals related to their role identities when considering land management choices with environmental consequences.

The farmer identity

One's social identity is related to the role expectations of the social group in which one belongs. These expectations are situated within and shaped by broader structural and contextual influences. For example, farmers represent a specific role within both global food production as a professional activity and in the rural communities in which they live. Stenholm and Hytti (2014) argue that this role of farmer is socially constructed based on social norms and farmers' experience with institutions, resulting in two distinct professional social identities: the producer and the entrepreneur. The producer identity emphasizes profit as a means to legitimacy. The entrepreneur identity promotes competition between farmers in an attempt to become "the biggest and the best" (Stenholm & Hytti, 2014, p. 133). Similarly, McGuire et al. (2013) argue that the "good farmer identity" in American culture is reliant on one's ability to maximize production. This production-oriented good farmer identity emerged from government incentive programs that rewarded increases in agricultural production. According to Burton (2004), this emphasis on "production-oriented roles came to symbolise, both to farmers and to the country, the notion of good farming practice and enabled farmers to claim a high social position as caretakers of the nation's food supply" (p. 195). This is most apparent when looking at current farming practices and structure compared with the past. The majority of farms today are large-scale industrial operations, even for the 97% that are still deemed "family farms" (Leonard, 2014). They are growing larger and producing more, while smaller farms are disappearing due to their inability to compete (Leonard, 2014). Most of this shift can be attributed to the purchasing of midsize farm land by larger farming operations. For instance, in 1987, midsize farms accounted for 47% of all cropland. By 2012, this figure dropped to 29%, while large farms increased by 21% during this same time period (MacDonald & Hoppe, 2017). This creates a competitive environment, one where failure to advance and grow often results in the loss of one's heritage. Meanwhile, other social groups are advocating environmental policies that would further limit farmers' ability to expand.

According to Tajfel and Turner (1979), when groups are in competition with each other, the result may be heightened bias in favor of one's in-group. In the case of farmers, we expect to find that one's affiliation with the farming group will affect their relationship with other groups, especially those deemed a threat to productive capacity. Farming activities may come into conflict with neighboring residents due

to urban encroachment. Urban settlements are in ever-closer proximity to farms, resulting in conflicts between farmers and neighbors, often stemming from concerns related to farming practices, such as chemical spraying, dust, odors, and noise, as well as those introduced by urban encroachment, such as littering, vandalism, and trespassing (Hammond et al., 2010). Other conflicts arise from the use of genetically modified or genetically engineered crops, which certain individuals and various environmental and public health groups oppose (Gerasimova, 2016). Farming also requires, and often compromises, the quantity and quality of natural resources, which results in conflict between farmers and other social groups, such as environmental groups and regulatory agencies (Henle et al., 2008). Therefore, group conflict with groups that seek to regulate environmental behaviors may prove to be one of the most important factors related to these farmers' environmental attitudes, broadly defined as feelings, beliefs, or opinions about the environment, and their subsequent pro-environmental behavior. Conversely, conservation efforts that align with this identity, such as those that provide incentives to improve water efficiency or prevent soil erosion, may better align with this production-oriented identity, making their adoption more attainable. These are practices that also improve such things as agricultural run-off, which may also decrease public concerns about certain aspects of agricultural production, hence decreasing conflict between farmers and other social groups. Here we seek to shed light on how farmers as a social group perceive other competing groups, and whether the farming identity is related to farmers' willingness to engage in behavior to improve the environment. Given the structure of large-scale agricultural production and farmers' role within this structure, we anticipate that there are barriers to adopting certain conservation practices. We also anticipate, however, that other practices which improve productive efficiency will be more readily adopted by farmers.

Data and methods

Our data for this study consist of 30 semi-structured in-depth interviews conducted as part of the Managing Idaho's Landscapes for Ecosystem Services (MILES) Idaho's Farmers Research Project. We collected the sample using convenience-sampling methods, recruiting participants by distributing flyers in local businesses or community hang-outs where we knew farmers spent time, as well as by identifying farmers listed as members of farming associations online, or through personal contacts and calling them to ask if they would be willing to be interviewed. The majority of the farmers we contacted agreed to participate, even those we cold-called based on phone numbers found on the internet, and we conducted the interviews from June to August 2015. In order to meet our criteria for inclusion in the study, we confirmed that each farmer we interviewed farmed at least 100 acres and was the sole or partial owner and decision-maker on the farm they managed. Our geographic area of interest was within an approximately 100-mile radius to

Pocatello, Idaho, which was one of the three state sites defined by the MILES project. We chose to interview 30 farmers in order to achieve saturation in responses, which was sufficient within our analysis, which was likely given the homogeneity of both our sample and land management practices in the area. Our interview protocol included themes related to the impact that farming activities may have on natural resources (or ecosystem services), farmers' observations of environmental change on their land and their level of climate concern, and farmers' participation in conservation programs, as per the MILES project's main research objectives, among a few other more general questions. Each interview was conducted by one or two members of the research team, which consisted of one faculty member, one graduate student, and two undergraduate research assistants. We then transcribed and analyzed the recorded interviews, which ranged from approximately 30 minutes to two hours in length.

In looking at demographic characteristics, all of the respondents in the sample we compiled were male and white, which is representative of farmers in the area as most farms were established in the first part of the 20th century when opportunities for land ownership favored white men. Locally, the culture is still quite religious and conservative; 25 of the 30 respondents identified as politically conservative, while the other 5 self-identified as an independent/moderate, and though we did not ask explicitly about religious affiliation, most of our respondents mentioned attending church or their belief in God. The median age of respondents was 55 years, ranging from 27 to 78 years of age. The median household size was two persons, ranging from one to eight. All of the respondents had knowledge of the day-to-day operations of their farms, with all but two having direct ownership (these two were children of the owners). The respondents represented a broad range of farm sizes, from 110 to 25,000 acres, with a mean of 3,618 and a median of 1,600 acres. The majority of respondents (28) relied either entirely or mostly on irrigation practices to successfully grow their crops. The two that were able to dry farm were from a particular area that receives more precipitation and farmed crops, such as wheat, which are more amenable to dry farming than many other more water-intensive crops in the region, such as potatoes or sugar beets. The majority of respondents were born into farming (26), while only four reported being first-generation farmers. Again, this is typical of the area, as land prices currently make it prohibitively expensive to start a competitive farm from scratch, especially since the state of Idaho stopped issuing new irrigation permits in the early 1990s. The main crops grown were wheat, potatoes, sugar beets, alfalfa, corn, and hay, which is typical of southeastern Idaho.

With respect to our data analysis process, we began with a fairly open coding plan by having each member of the research team read through the interviews and note important themes related to environmental observations, attitudes, and behaviors. We then went back through the data with specific coding categories in mind, based on our original research questions when embarking upon the project,

such as farmers' perceptions of environmental change, levels of climate concern, environment-related behavior, and perceived threat from other groups. One of the themes we began noticing in relation to environment-related behavior was the manner in which the respondents discussed their role in food production, and in particular how often they brought up their perceived responsibility to produce food for the global population almost as an excuse or justification for choosing not to implement certain conservation practices on their land. This theme emerged from responses to various questions about participation in environmental sustainability initiatives. It also became evident through analysis that the farmers perceived the responsibilities of their role to be in direct conflict with the objectives of other groups, namely environmentalists and regulatory agencies. We have analyzed the data in the first two categories mentioned above in previously published research (Running et al., 2017). In this paper, we focus on the latter two categories listed, including how farmers' role as farmers affects their environment-related behavior and what happens when this role puts them in conflict with other groups' priorities.

Results and discussion

Environmental behavior among farmers

Almost all of the farmers we interviewed had implemented conservation efforts on their farms, particularly those related to soil and water. These efforts could be categorized as conservation-oriented behavior, though farmers explained their motivation for doing so in terms of business advantage, since one has to have good soil and a sufficient amount of water in order to grow a crop. Dale, a 63-year-old wheat, sugar beet, potato, and sweet corn farmer[3] put it this way:

> Everything we do, we have to sustain this land. Everything we do is trying to keep the highest productivity, the healthiest land that we can keep in order to produce for the next year, for the next generation, for those who will come along.

Later on in his interview, Dale also emphasized his stewardship toward his land again, explaining:

> We feel like we are good stewards of the soil. We've planted wind breaks. I've planted probably 5,000 trees in my lifetime. Not that all of them lived, but the majority of them have. So, we are trying to do things that will help save the ground.

3 All names are pseudonyms to protect the identity of the respondents.

Similarly, Greg, a 58-year-old wheat, potato, and alfalfa farmer described his land stewardship choices and his decision to participate in one conservation-related program this way:

> We took advantage of some government programs to change from flood irrigation to sprinkler irrigation, cause it's more efficient use of water. But, so sprinkler systems and all those are conservation measures according to the government. Whether those were wise ones or not, I don't know. Some of the things we do is we don't plow anymore. That helps with soil erosion so that you don't have any clean fields.

Another theme that frequently came up when we asked each farmer whether they had adopted any conservation measures was an intentional caution in regard to chemical use. Many of the farmers we spoke to were concerned about the effects of chemical pesticides and fertilizers, though this concern often seemed to center on their ability to sell and profit from their crops and regulatory uncertainty rather than their overall environmental impact. Baldwin, a 67-year-old hay and feed grain farmer remarked:

> Yeah I'm a little concerned, of course you don't know what's going on the corporate world as far as fertilizer and chemicals, and everything else. And the environmental, EPA and everything is going to try and change or make things harder to grow crops.
>
> These guys that want to farm all the time, they want to stay in business, and they don't want to jeopardize their farm. If they put the wrong chemical on their ground, there is a chance they won't be able to get a potato crop on the same ground next year because they put the wrong chemical on their wheat to kill the weeds or something.

A few farmers also revealed genuine concern for the health of people and other life when discussing their chemical use, as well. Robert, a 64-year-old wheat, potato, sugar beet, alfalfa, and safflower farmer told us he had changed chemical practices in order to reduce harm to bees. Another farmer had strong feelings about farmers' responsibilities toward their communities when applying chemicals on their fields. Zack, a 65-year-old alfalfa farmer described what he considered best practice regarding chemical application this way:

> Sometimes they put this acid on the grain stubble, and sometimes I think you are smart to get in your car and drive away. Quite a few of these chemicals they put on the fields these days besides the acid, they will post and say do not enter because there's a hazardous product out there for 24 hours or 36 hours. The only one comment I would make is that some of these farmers that put on the acid, I think they should have to come and tell the people within say a one or two-mile radius the day before and say we're spraying this field with acid tomorrow and we want you to know that.

Other farmers, however, were more concerned about outside groups taking away the chemicals they needed to keep their crops free of pests. Allan, a 58-year-old barley, wheat and potato farmer told us:

> You know, I am worried about continued availability of fertilizers; which can allow us to push our yields. I am worried about making sure that we do have chemicals if we end up with pests that we cannot control any other way. That we have not cut ourselves so tight with regulations that nobody continues to try to make something to deal with funguses and insects and whatever else might be out there trying to stop us from growing a good crop.

Similarly, Evan, a 62-year-old wheat, barley, alfalfa, and mustard farmer expressed frustration that regulatory bodies were taking away chemicals he considered effective, particularly in controlling bugs, in order to protect the overall environment. He said:

> The thing I do notice, and we don't really know, is the bugs. I don't know why. I tell everybody it's cause DDT finally wore off. But they have taken a lot of the chemicals away from us that worked on these bugs, ones that live in the ground, the wire worm, those type of things. We have got to control them; because they can devastate a crop. I've had them take 40% of a wheat field.

Thus, though some of the farmers recognized the risk of chemical exposure, and expressed a preference for transparent application and responsible use, when regulations interfered with their ability to keep their crops bug-free, farmers typically resented the power of out-group regulators to curb their access to effective products.

Farmers and intergroup competition

Twenty-six of the 30 participants grew up on a farm, which is typical of farmers in southeastern Idaho. In the course of our interviews, we noted how strongly our respondents identified as farmers, and how often it came up. For example, our respondents generally spoke in terms of the collective (i.e., farmers, us, we, etc.), when discussing farming-related activities. This did not appear to differ depending on whether one was born into a farming family or not, though our sample does not provide much diversity in this area (only four farmers were not born into a farming family). Another clue that highlighted how important farming was to our respondents was how many of them told us it was important that their land remain in agriculture after they retired; 21 had specific plans to sell or pass on their farm to family members.

In general, social scientists have found that strength of association with a social group is an important factor in explaining behavior, especially behavior that promotes that group's interests when it comes into competition with the interests of another group (Tajfel & Turner, 1979). This behavior is thought to exist on a continuum, with one extreme emphasizing no group influence and the other exhibiting almost total group influence on behavior, with two major factors determining where on the continuum a behavior may lie: the amount of *competition* and *stratification* between competing groups that exists. In the case of farmers as a group, we found that they occupy a very salient and distinctive place within their communities, often due to their familial and historical ties. This also relates to the prominence of the identity. This is summed up well by Lane, a 52-year-old potato and sugar beet farmer:

> I think it's a way of life, and I think family farms provide community with good people that love the community and that love the environment.

Again, however, this strong identification can also lead to a great deal of perceived stratification between their social group and others, as well as perceived group competition. With respect to group competition, most of our respondents communicated that regulatory agencies/government were a concern, and constrained their ability to farm successfully. This theme emerged from various questions throughout the interviews. For example, our respondents often mentioned constraining forces in regard to climate change legislation and/or environmentalists. When discussing emission regulations on his farming equipment, Eddy, a 55-year-old wheat and hay grower, remarked:

> Their exhaust will have to be cleaner than the air they are taking in. Which all sounds really good and everything, but it tripled the cost of an engine in a tractor. So those regulations all sound real good and it's good to have the air cleaned up; but nobody ever analyzes the cost of what we are doing.

Ian, a 61-year-old wheat, potato, and sugar beet farmer, also expressed frustration with environmental regulations, and explicitly brought up both some of the trade-offs between food production and limiting environmental impact, as well as concerns about economic competition with less regulated countries. Ian explained:

> You know, I do think—and I sound like a guy that hates regulations—but I see documentaries where India and China haven't taken steps to regulate the output of huge factories, rubber factories and that, and it's a mess. So, I think there's a place for regulation. I just think that we need to be middle of the road somewhere. I think Al Gore would just stop production of food and would have us all going back to doing it by hand and if we did that, it would be really the safe way to go, but people would die of starvation.

In this case, Al Gore[4] and the climate change activists were being portrayed as a direct threat to farmers' noble efforts to feed the world. Others brought up frustration with environmentalists and their competing interests in regards to water regulation. In response to a question about the environmental changes he had noticed and where his competition for necessary resources were coming from, Ben, a 78-year-old tree farmer, commented:

> Some of it is coming from having to send more water down the river for the salmon. Some years we really need it bad; but the environmentalists have got it bottled up to where we gotta give it to the salmon.

Throughout our interviews, these concerns about expenses imposed due to regulations and worry about long-term water availability were mentioned frequently, often in the context of competition with other interests, including environmentalists' objections to chemical application and GMO (genetically modified organism) technology, and warnings about how these barriers could adversely affect food production. In these instances, farmers often painted an "us versus them" mentality, with the "them" portrayed as well-meaning but silly city folks without intimate knowledge of the natural environment. Wayne, a 40-year-old wheat, potato, sugar beet, and hay farmer explained his frustration with these "out-groups" this way:

> because it's very scary when different environmental groups and different government agencies want to come out and tell you what's wrong or what's right when it's not even their area of expertise. It's very scary. I worry a lot about our water rights. I worry about a lot of the rules and regulations that they pass, and at the end of the day, they're all a joke because there's no one to enforce them. If they'll let the farmers be farmers, and the pencil pushers be pencil pushers, everyone will just get along just fine. But, there's just a lot of things that you know, they talk about soils, they've never gone out. They've never even kneeled down on their hands and took a handful of soil. They've grown tomatoes that they got at Costco. It's ridiculous. Nobody cares about the dirt like the guy making a living off the dirt.

The fact is, farming is a volatile industry. Farms in southeastern Idaho are becoming fewer and larger because owners of larger farms are purchasing many of the smaller farms (USDA, 2015). Farmers' profit margins are becoming increasingly squeezed, they must quickly adapt to the whims of the global marketplace, and they are being forced to become more efficient in order to stay competitive (Dimitiri et al., 2005). These shared obstacles seem to strengthen farmers' identification with each other, though, which was illustrated by our respondents talking with sympathy about the challenges their fellow farmers faced. But these challenges also may contribute to their shared dislike and distrust for regulatory oversight related to a number of issues such as chemical oversight and exclusion, environmental standards, and

4 Al Gore is a former United States Vice President and Congressman who is a climate change educator, author and activist, as well as the joint recipient of the 2007 Nobel Peace Prize (NobelPrize.org, 2019).

conservation practices. Farmers seemed to blame these other social groups for the regulatory oversight that they view as stemming from the irrational worries of those with little knowledge of the demands involved in growing a crop.

Farmers' role in food production

Beyond what was discussed when we asked respondents about how they made decisions about applying pesticides and fertilizers, or participating in conservation programs, mentions of their duty to feed the world often came up in reference to new seed technology. Farmers frequently lamented how divorced average consumers are from the act of growing food, including the environmental benefits of genetically engineered seeds which both increase efficiency and reduce the need for chemical inputs. In discussing GMO technology for agriculture, Eddy, a 55-year-old wheat and hay farmer, told us:

> I think if we take them away, the poorest people in the world are the ones that are going to suffer. Because of lack of supplies, they will be the last people to be able to buy and eat. It is easy for us to get on our high horse and say we're not going to have any when we know we are going to be fed and not be concerned about people in the world that won't be.

Oliver, a 59-year-old barley farmer, expressed a similar sentiment:

> You know I'm actually in favor of genetically modified crops, just because they predict by the year 2050 there will be 9-plus billion people in the world, and there's going to be starvation if we don't, if the farmers can't raise the food. And God's not making any more farm land … as you know there's becoming less and less farm land all the time with urban encroachment and things, so the remaining and existing farmers have to increase more and more food in order to feed a growing population.

The point these farmers seemed to be highlighting is that farmers serve an important function in society. We all need food, and farmers provide that food, and their work is even more important in a time where the value of farms is increasing and the number of farms is diminishing. Nationwide, the number of farms worth over USD500,000 increased from 1,300 to 2,000 between 2004 and 2013, while the total number of farms decreased by 500 in the same time period (USDA National Agricultural Statistics Service Northwest Regional Field Office, 2014). This trend suggests that power over the food supply is being distilled down to an increasingly smaller group, which SIT would predict is likely to increase the saliency of group norms among farmers resulting in more cohesion (Tajfel & Turner, 1979). Forsyth and Danisiewicz (1985) also point out that professions the public recognizes as "essential," "exclusive," and "complex" are particularly powerful as a group (p. 65). Farms are most certainly essential and complex, and as farms decrease in number, farmers are becoming scarcer. Farmers did seem to be aware of these shifts, and one

of the points they made in defending their societal usefulness in the face of these declines was by emphasizing their valuable role in keeping food production stable and food prices affordable. Eddy lamented:

> I wish they would do more to preserve the small farms. I think that is a resource we are sorely going to miss. I think that we are setting up for a famine. If you have a small number of farmers and times get really tough and they can't make it go, I think it's going to make a huge impact on our food supply. Whereas, if you had a lot of farmers and some of them had struggles they'd help each other out and find ways of getting by.

In addition, Greg conveyed to us his perspective on the service farmers perform for American consumers:

> As farmers, I think we have kept food cheap in this country, comparatively. I mean you can complain all you want about, oh my gosh I can't believe how much grapes are [etc.]. But overall, we still get to use the majority of our money on other things besides food.

Thus, in addition to strongly identifying as farmers, it seems clear that these farmers are also highly aware of the much-needed role they occupy in food production. This may then help explain why they become so frustrated when perceiving threats to their ability to produce. Dale described his objection to the public's emotion-based rejection of genetically modified potatoes this way:

> We tried some GMO potatoes back in the 1990s. They are very good. The only reason why they got taken off the market is because of the emotional thing that they did in Europe. Nothing was based on science. That technology was a great technology.

Previous efforts that look at responses to identity threats assert that individuals tend to address these threats through a process of normalization and/or invalidation (Bernett & Breakwell, 2001; Halpern-Flescher et al., 2001; Lima et al., 2005). In utilizing these processes, farmers emphasize the positive effects of their own land management practices while ignoring or invalidating activities or beliefs that may inhibit production and hence threaten both their identities as farmers and their ability to run a profitable farming business. Ultimately, identity theory predicts that individuals with strong social identities will respond negatively to any activity that threatens their group's goals (McDonald et al., 2012; Tajfel 1982). This then helps explain why farmers, with their strong identity as such, see groups like regulatory agencies or environmentalists as competing with their interests and threatening their productivity and credibility. This also suggests that members of these groups who seek to encourage different behaviors among farmers would be better served by recognizing and showing appreciation for farmers' expert knowledge of their land, their sincere care for its long-term health, and the service they provide the rest of us by producing food.

Conclusion

Using data from 30 semi-structured interviews with farmers in southeastern Idaho, we analyzed how farmers' role identities influence their environment-related attitudes and behaviors. We used social identity principles to understand how and why people who identify as farmers are sometimes hostile to regulatory agencies and/or environmental groups, even though in many cases their overall environmental values are quite similar. Ultimately, we found that farmers' antagonism toward these groups is likely the result of perceived competition and threats to productivity, as well as a general sense of being labeled as negligent environmental stewards, despite a strong commitment to their land's health being central to their own identity as farmers.

The farmers we interviewed expressed the belief that other social groups constrain their ability to execute their role as food provider. Current economic dynamics such as changes in farm size and the dwindling number of farmers likely contribute to this perception. It also aligns with Tajfel and Turner's (1979) explanation that group conflict stems from "antagonism between dominant and subordinate groups," based on the unequal distribution of resources, particularly when concerns of self-esteem or worth are also at play (p. 38). In a society where agriculture has become the focus of much environmental research and scrutiny, it may be difficult for farmers to trust people who do not farm for a living for a number of reasons. For one, people in these groups are often trying to control natural resources that farmers need to grow their crops, especially as populations grow and demand for scarce resources increase. Additionally, through this control, these groups may infringe on farmers' ability to inexpensively and efficiently produce their commodities. Finally, this competition puts farmers' identities at risk through the possibility of losing access to the natural resources they need, and thus their productive capacity. This ultimately results in farmers feeling unfairly maligned as negligent environmental stewards, even though they are the ones outside, with their fingers on the pulse of their land, as they strive to provide for out-of-touch urban people who think food comes from grocery stores and that preserving salmon habitat is more important than preserving multi-generational farms.

We base these conclusions on the fact that most farmers we talked to do engage in conservation efforts. They also talk about their land with respect and gratitude and express concern about long-term land and resource sustainability. Additionally, they speak sincerely about loving their jobs because they provide a chance to work outside and know their local environmental intimately, in this way exhibiting positive sentiments about the environment.

Although our sampling methodology and analysis do not lend to generalizable findings, this exploratory work should provide insights to guide future research efforts examining farmers' environment-related behavior and their participation in conservation programs. Future studies should further evaluate the causes and consequences of intergroup conflict with environmental groups and regulatory agencies, as well as with other stakeholder groups such as industries and suburban developers. Many of the farmers we interviewed expressed extreme distrust toward these groups, which suggests future efforts—especially those that require voluntary cooperation—should prioritize building trust between farmers and government agencies before expecting positive outcomes. One approach for doing this may be to explicitly incorporate farmers' input within the regulatory process. This will likely require more collaboration and contact between farmers and government or conservation-oriented groups (which takes time), ideally underpinned by mutual respect for each other's personal as well as collective goals. But our findings reveal that farmers sincerely care about their land, and also empathize with other farmers and generally are committed to being good neighbors and citizens in their rural communities. As such, we believe there is much potential for government regulators, environmentalists, and farmers to work together to overcome intergroup conflict and promote and implement sustainable land management practices in the coming years.

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From Symbol to (Some) Substance: Costa Rica's Carbon Neutral Pledge

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Abstract

In 2007, Costa Rican politicians announced that the country would be carbon neutral by 2021. This paper investigates whether this pledge has moved beyond a symbolic commitment and, if so, how. Data consist of interviews conducted with officials in Costa Rica's industry, government, science, and civil society as well as archival research. The findings show that carbon emissions declined after the pledge, but the effects of the great recession mean these declines cannot be directly attributed to the pledge. However, since 2007, there have also been numerous political changes that may contribute to future emissions reductions. Future research on symbolic politics would benefit from investigating how political acts can change from symbolic to more substantive over time as social groups grapple with how to act to fulfill the stated aims. This case study provides an important historical analog for understanding the aftermath of other nations' pledges made at the 2015 global climate meeting.

Keywords: carbon neutral, case study, climate change, Costa Rica, symbolic politics

Introduction

In recent years, the response to climate mitigation has taken on a more polycentric form (Ostrom, 2010), as groups at diverse levels of scale have adopted strategies to curtail greenhouse gas emissions (Ehrhardt-Martinez et al., 2015). As part of this trend, several nations have made pledges to become carbon neutral in the future (Flagg, 2015). These nations aim to reduce emissions and balance remaining emissions with carbon sequestration or offsets (Fukuda and Tamura, 2010). Given the ambition of carbon neutrality pledges, these commitments represent an encouraging move, a potentially bright spot in climate mitigation efforts, but it is their ambition that also opens them to criticism. If mitigation pledges are not

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followed with meaningful, substantive actions to help meet the goals, then pledges are examples of symbolic politics—commitments based on rhetoric rather than clear objectives to help realize the goal.

This paper investigates what happened in Costa Rica after elites announced this pledge in order to examine the extent to which the pledge has moved beyond a symbolic political act to produce substantive effects. Investigating Costa Rica's pledge presents the opportunity to analyze an environmental action in a developing country that is one of the smallest contributors to global greenhouse gas emissions (Brechin, 2016) but that is nonetheless pursuing an ambitious mitigation response. Prior to its work on carbon neutrality, Costa Rica generated about 90% of its electricity from renewable sources (Nandwani, 2006) and had pursued several other notable initiatives, including abolishing its army, developing an extensive national parks program, and mediating a regional conflict (Evans, 1999). Therefore, the analysis of the post-pledge context should uncover some important lessons for those interested in the politics of this nation and its response to climate change.

In addition, exploring the aftermath of Costa Rica's pledge may offer insights that are important beyond this case. The adoption of the 2015 Paris Agreement, which includes a pledge-and-review structure for nations' nationally determined contributions (NDCs) (Dimitrov, 2016; Keohane & Oppenheimer, 2016), has brought national pledges to the center stage of global climate politics. The lessons learned from this study of Costa Rica's pledge, made nearly 10 years before the Paris Agreement, may reveal insights into what may happen in the years following other nations' NDCs.

The first section below provides a literature review on the concept of symbolic politics. The next section provides background information on the circumstances under which Costa Rica's pledge was made. Then, after a discussion of the methods, the paper discusses three key dimensions of the post-pledge context. The discussion reviews the lessons learned from this case and the conclusion discusses the implications these findings have for broader research.

Literature review

Previous research on symbolic politics has focused on several areas, including the characteristics of symbolic politics, the circumstances under which they are used, and how symbolic politics differ from other politics. According to Matten (2003), what makes a piece of legislation symbolic is that, from the start, it is known that the stated legislative goal cannot be achieved. Symbolic politics are either "sheer rhetoric" or they are put together in a manner that makes it impossible for their goals to be met (Matten, 2003, p. 216). In this view, symbolic politics are not accidental—it is clear from the start that their objectives will not be fulfilled.

For Ovink et al. (2016), leaders use symbolic political acts as a means to send messages to particular audiences. More specifically, they may use symbolic politics to attract voters who care about a particular issue, respond to an issue on which there has been little other action, and/or to illustrate their positions on an issue or on a group of people (Ovink et al., 2016). For Wysong et al. (1994), symbolic politics allow leaders to show that they have responded to a socially constructed threat. The DARE (Drug Abuse Resistance Education) educational program in the US, which was designed to keep kids off drugs, is an example of symbolic politics since the program was used to offer "reassurance" that leaders had responded to the drug "problem" (Wysong et al., 1994, p. 462). Similarly, Newig (2007) finds that symbolic legislation is often used when attention around a social issue is very high. Symbolic politics are also used for issues that lack clear solutions, have high costs, involve value conflicts, have an uneven spread of relevant information, and/or that are highly complex (Newig, 2007, p. 291).

Symbolic politics, or as Baker (2007, p. 298) puts it, "empty rhetoric," have been compared to their "genuine and consequential" policy peers, or those that influence human life. Gusfield (1967) contrasted the instrumental and the symbolic functions of political acts. Certain political acts have an instrumental function in that they exert a "direct influence" on human activity (Gusfield, 1967, p. 176). It is through enforcement that these laws or policies come to have an instrumental function. In contrast, symbolic acts are significant because of the meaning people attribute to them. Symbolic acts do not have to be enforced, or perhaps cannot be enforced, but still exert an influence through what they represent. Anderson (2003) adds that policies can be categorized based on the benefits they distribute. On the one hand, material policies confer advantages or disadvantages on people, while on the other hand, symbolic politics do neither, and instead appeal to "cherished values," such as "peace, patriotism, and social justice" (Anderson, 2003, p. 16).

Researchers have come to show, however, that all policies have characteristics of both the symbolic and the material, with some invoking the idea of a continuum of action types, ranging from the symbolic to the substantive (Anderson, 2003; Kim & Lyon, 2013). Newig (2007) agrees, but instead of using a continuum, he proposes a two-axis chart for categorizing policies. Policies vary along two dimensions—their *issue-related substantive effectiveness* and their *political-strategic effectiveness.* The former dimension captures the degree to which a piece of legislation can resolve an issue, while the latter captures a piece of legislation's political consequences. While the stated intention of legislation is often that it is for addressing real-world conditions (issue-related substantive effectiveness) it is also often used for political ends, such as demonstrating leaders' commitments to an issue or meeting the "emotional needs" of a constituency (political-strategic effectiveness) (Newig, 2007, p. 279). Political acts have both dimensions of effectiveness but differ in the degree to which they have more or less of each.

Returning to the case of Costa Rica, this paper investigates whether this nation's pledge has moved beyond a symbolic commitment and, if so, how? In order to do this, the next section presents background information on the circumstances under which Costa Rica's initial pledge was made.

Background information on Costa Rica's pledge

Óscar Arias Sánchez, Nobel Peace Prize Laureate, began his second (non-consecutive) term as President of Costa Rica in May 2006. In a decree released on 7 December 2006, the Office of the President of Costa Rica launched a presidential initiative entitled Peace with Nature (Executive Power, 2006). This document provides an overview of the new government's concern with global environmental issues, stating that the government is broadly pursuing an aim of establishing active and perpetual peace with nature (Executive Power, 2006, p. 2). The decree states that because of Costa Rica's notable work in issues such as health, education, and democracy, the country has the moral authority to assume active leadership at the international level to promote a larger political responsibility oriented toward resolving the problems that affect the planetary ecosystem (Executive Power, 2006, p. 2). This document invokes themes from Arias's first presidency, when he received a Nobel Peace Prize (Fletcher, 2013). By calling the initiative *Peace* with Nature, leaders were trying to "recreate the image of peace" that existed during Arias's first presidency (G3[2]) and help Costa Rica once again receive international recognition for undertaking ambitious, progressive reforms (G5).

The government and an appointed leader assembled a 30-person coalition to advance the Peace with Nature initiative's goals. This coalition included former and current government officials (including the President and both the Minister and Vice Minister of the Environment), leaders from industry, and Costa Rican scientists, including Alvaro Ugalde and Mario Boza, leaders from the development of Costa Rica's national parks (Evans, 1999). The committee also included scientists from the United States with a history of conducting research in Costa Rica (G6; Ponchner & Vargas, 2007). While the specific aims of the Peace with Nature coalition are not articulated in the December 2006 decree, in the months following, the members of the coalition decided to pursue three main objectives: the creation of a fund for the national parks, carbon neutrality, and the greening of the public sector (G6). One interviewee explained that carbon neutrality was a frame within which all of these aims fell, since it encourages lower rates of consumption (C1). Thus, from the start the carbon neutral pledge was embedded in a broader political

2 To cite interview data throughout the text, references to data are tagged with a letter and a numeral. The letter represents the field from which the interviewee was drawn and the numeral represents the interviewee's order in the process of fieldwork. Thus G3 indicates the third interviewee from government. For further explanation, see the "Methods" section.

agenda (Sherwood, 2007). The Minister of the Environment, Dr. Roberto Dobles, announced the Peace with Nature initiative and the carbon neutral pledge at the February 2007 United Nations Environment Programme's (UNEP) governing council meeting in Nairobi, Kenya. Dr. Dobles became the president of the governing council at this meeting. It was a strategic decision to highlight Costa Rica's domestic work on climate change at this international forum (G2; G4). In his opening remarks Dobles (2007, p. 7) said:

> Coming from Costa Rica, a country where the sustainable management of natural resources has been a state policy and where peace has also been part of our way of life (we abolished the armed forces in 1948) I am very honored to serve as President of UNEP's Governing Council and Global Ministerial Environment Forum. We have now declared Peace with Nature in our country and this concept is now at the center of our development and trade policy.

The pledge announcement was an opportunity to highlight that Costa Rica was, once again, leading the way on important social and environmental issues, this time with climate mitigation (Flagg, 2018). A top government official from the Arias administration explained that the adoption of the carbon neutral pledge did not require the approval of the unicameral legislative assembly in Costa Rica because the pledge is a policy, not a law (G4). Therefore, no entity is required to become carbon neutral but every institution has the opportunity to do so. Interviewees explained that there was a general environmental and climate awareness in government, industry, and academia before 2007 and the pledge capitalized on this enthusiasm (G3; G5). There was no external, supranational governing body that oversaw Costa Rica's pledging process or that has enforced the degree to which Costa Rica is on track to meet its voluntary commitment by 2021, so any enforcement of the implementation of carbon neutral pledges would have had to come from the domestic context. The same appears to be true for the other nations that have made identical announcements to become carbon neutral (Flagg, 2015). This feature of carbon neutral pledges has led Kythreotis (2015, p. 807) to state that carbon neutral pledges "only mean something if they are translated into firm political action."

More than 10 years have now passed since the initial pledge announcement. If the pledge was more than a symbolic maneuver, it should be possible to observe some post-pledge shifts in Costa Rica's environment and society. Indicators of these shifts may include changes in 1) carbon emissions, 2) political planning and procedures, and 3) institutional practices. The next section describes the research methods used to investigate whether there is evidence of these changes.

Methods

Data for this case study consist of government documents and fieldnotes from interviews. Data were woven into a narrative to trace the process between the announcement of the pledge and 2015. The point is to analyze data "on the causal mechanisms, or processes, events, actions, expectations, and other intervening variables" during this time period (Bennett & George, 1997, p. 5). Fieldwork in Costa Rica was conducted in August 2013 and July 2015. Conducting fieldwork over time enabled the initial interviews to guide archival research, and then to use that archival research to guide the second, more targeted, set of interviews. A possible drawback of this approach, however, is that it did not enable the deep immersion that would have been possible in one long fieldwork visit. Archival documents were collected before, during, and after fieldwork and include politicians' speeches, newspaper articles, government decrees and laws, and reports from international institutions (i.e., the UNFCCC [United Nations Framework Convention on Climate Change]). Interviews with representatives from government, science, industry, and civil society were designed to fill in the gaps from the archival research, and to explore the process by which the pledge was adopted. During interviews, participants were also eager to speak about what has happened since the pledge was announced. Interviewees in government include government officials and government consultants who worked on carbon neutrality. Given that the respondents of interest were "hard-to-reach," but also "somewhat interconnected," a snowball sample (Schutt, 2009, p. 174) was used to recruit respondents. Each interviewee was asked to recommend additional respondents.

Table 1 provides the date of interviews and interviewees' affiliations. In total, 22 interviews were conducted with 20 respondents. Because the fieldwork was conducted in research trips separated by two years, two key informants were interviewed again during the second trip, to follow up on information gathered in the first interview, inquire about the status of the carbon pledge, and acquire contact information for additional respondents. Interviewees were recruited on the basis that they were involved in the process leading up to the pledge or had worked on carbon neutrality after the pledge. These people were identified from the ongoing analysis of archival documents or from other respondents. On the recommendation of interviewees, the sample includes a representative from AECID (the Spanish Agency for International Development Cooperation), which was involved in the carbon neutrality initiative, several academics (some of whom were involved in the initial work on carbon neutrality, and others who have written about the pledge), and a representative from INTECO (the Costa Rican Institute of Technical Norms). Similar to Speck's (2010) findings, interviewees were knowledgeable and concerned about anthropogenic climate change.

Table 1: Interviewees by date, and primary and additional domains of public life.

Date	Primary domain	Additional domains
Industry		
8/1/2013 (Skype)	I1 (Bananas)	–
7/8/2015	I2 (Bananas)	–
7/20/2015 (Skype)	I3 (Hotel)	–
7/21/2015	I4 (Hotel)	–
7/21/2015	I5 (Coffee)	–
Government		
8/21/2013	G1	–
8/26/2013 & 7/6/2015	G2*	Science
7/8/2015	G3	Academia (Economics)
7/13/2015	G4	Industry
7/14/2015	G5	–
7/16/2015	G6	Science, civil society, academia
Science		
8/22/2013 & 7/10/2015	S1*	Academia
8/28/2013	S2	Academia
7/22/2015	S3	Government
Civil society		
7/13/2015	C1	Science, government
7/20/2015	C2	–
Academia		
8/27/2013	A1	Academia
7/9/2015	A2	Academia
Other		
7/14/2015	AECID-1	–
7/15/2015	INTECO-1	–

Note: *Interviewed twice. Respondents from: I = Industry, G = Government, S = Science, A = Academia, C = Civil society. AECID: the Spanish Agency for International Development Cooperation. INTECO: Costa Rican Institute of Technical Norms.

Source: Author's summary of fieldwork process.

Interviews were conducted in Spanish and/or English, based on each respondent's preference. Notes from each interview were typed into field notes as soon as possible afterward. The author conducted all interviews and completed all translations. When it was not possible to capture direct quotations, the best account possible of interviewees' words is provided and field notes are cited. Table 1 is divided up by the interviewees' domain of public life (industry, government, science, civil society, etc.) from which they were recruited. Many interviewees, especially those in government, science, and civil society have moved among these sectors and academia, reflecting a long-standing pattern in Costa Rica (Hrabanski et al., 2013, p. 130). The second column lists interviewees based on the role that was the most meaningful to them in describing their involvement with work on carbon neutrality. This is how they are referenced throughout the text (i.e., G1 for first government official interviewed). Any additional affiliations are listed in the final column of Table 1.

A general outline of events was constructed, first from an analysis of the archival documents. Then insights from interview fieldnotes were added. This strategy illuminated the process that followed the announcement of the pledge. Process tracing "focuses on the unfolding of events or situations *over time*," and this strategy was used for analyzing the data (Collier, 2011, p. 824, emphasis in original). The following section explains three dimensions of the post-pledge context in Costa Rica that emerged from this analysis.

Results

The findings reveal that three areas of public life began to shift after the pledge was announced: 1) government action and changes in emissions; 2) sub-national action on carbon neutrality; and 3) issues associated with monitoring and verifying emissions.

1. Government action and changes in emissions

Carbon neutrality was a political decision, and thus was made by political leaders and top government advisors. A plan to achieve carbon neutrality was not formalized at the time of the pledge announcement (C1; INTECO-1), but one of the first consequences of the pledge was that it created the political pressure to formulate detailed plans to achieve it. Following the Minister of the Environment's announcement of the pledge at the UNEP meeting, experts from natural science, public policy, and government began to write the national plan on carbon neutrality. This plan, known as "The National Strategy on Climate Change" (Government of Costa Rica, Ministry of the Environment, Energy, and Telecommunications

[MINAET],[3] 2009), was finalized in 2009. The plan includes both national and international agendas for responding to climate change, as well as a strategy for carbon neutrality. This part of the plan explains that as part of the Peace with Nature initiative, Costa Rica has made the following voluntary commitment: by 2021, Costa Rica will contribute nothing to global warming or to the deterioration of the air that we breathe (MINAET, 2009, p. 80). Additional text and figures clarify that the aim is to produce net zero total emissions by 2021.

One former government official stressed the importance of using international standards in this National Strategy because this would enable comparisons between Costa Rica and other countries. To elaborate the high regard to which he held standards (and data more generally), he quoted William Deming, a statistician from the United States, as saying: "In God we trust. Everyone else uses data" (G4). His point was that a carbon neutral national strategy needed to have metrics that people could trust. The data on Costa Rican forests and emissions for the national plan came from several institutions, including FONAFIFO (the National Forestry Financing Fund) and the National Meteorological Institute (MINAET, 2009).

One piece of evidence that would indicate that Costa Rica's pledge has become something more than a purely symbolic commitment would be a decline in the country's carbon emissions since 2007. A decline in emissions would provide some evidence for the pledge's issue-related substantive effectiveness (Newig, 2007). Table 2 displays Costa Rica's absolute and per capita carbon emissions from 2005 to 2014, the most recent year for which data are available (World Bank, 2019). These data show that both absolute and per capita carbon emissions declined between 2008 and 2010, before rebounding slightly in 2011.

Table 2: Carbon dioxide (CO_2) emissions from Costa Rica.

Year	CO_2 emissions (kilotons)	CO_2 emissions (metric tons per capita)
2005	6868.29	1.62
2006	7099.31	1.65
2007	8122.41	1.86
2008	8129.74	1.84
2009	7902.39	1.76
2010	7568.69	1.67
2011	7741.04	1.68
2012	7766.71	1.67
2013	7598.02	1.61
2014	7759.37	1.63

Source: World Bank (2019).

3 Telecommunications left MINAET in 2013.

Though this decline in emissions would seem to suggest that Costa Rica's pledge helped foster emissions reductions, analyzing changes in emissions alone as evidence of the pledge's move from symbolic to substantive should be done with caution. First, the observed dip in emissions is attributable more to the effects of the global recession, rather than to any concerted efforts to reduce emissions. Globally, greenhouse gas emissions and carbon dioxide emissions specifically dropped from 2008 to 2009, before increasing again in 2010 (Climate Watch, 2019). Second, even under ideal conditions, there would be a lag between a policy announcement and changes in national emissions. These two limitations for analyzing changes in emissions means that the analysis of the post-pledge context must examine broader social, political, and institutional changes that can be more directly attributed to the pledge announcement. The next two sub-sections describe some of these changes.

2. Sub-national action

Costa Rica's carbon neutral commitment is a national goal, but work on carbon neutrality has happened in institutions at sub-national scales. When asked what the authors of the national plan had in mind when they envisioned Costa Rica as a carbon neutral country, an official from the Department of Climate Change said they did not think about carbon neutrality at the level of the nation—that would be, as he put it, "too abstract." Rather, they thought about schools, businesses, and institutions becoming carbon neutral, adding that "everyone has homework" when it comes to carbon neutrality (G2).

Unlike New Zealand's carbon neutral public service program (Birchall, 2014), the work on carbon neutrality in Costa Rica has primarily happened in the private sector. Following the carbon neutrality announcement, the Minister of the Environment met with various Costa Rican industries. Government thought carbon neutrality was "good business" since working toward the goal would save businesses money and be attractive to consumers, "especially the Europeans" as one former official explained (G4). In elaborating on this point, he explained that Costa Rica ships many exports to Europe and that if these products could continue to meet high standards but also be certified as carbon neutral, consumers would want to buy them. He used bananas as a specific example. But he also believed that changes could be made to goods sold domestically to tourists in Costa Rica, such as hotel rooms (G4). In short, he assumed consumers would make decisions to buy carbon neutral products once they were available.

There are various chambers of business in Costa Rica that oversee and represent individual businesses in an economic sector and the Minister of the Environment started by visiting several chambers of industry including bananas, hotels, banks, and airlines (I1; G4). The government "invited" industries to join the efforts on carbon neutrality (G1), and interviewees explained that industry, both at large and specific businesses, was receptive to the idea (I2; I3; I4; G5; S1; C1).

Following these meetings, some sub-national constituents began to make their own carbon neutrality pledges. For example, an interviewee from CORBANA (the National Banana Corporation), a public, non-state overseer of Costa Rica's banana industry, explained that by the time the Minister of the Environment arrived to talk with the banana industry, the commission of banana producers and government officials was already discussing carbon neutrality for the industry. One year later, the commission produced and shared with the government a report that outlined their efforts to become carbon neutral. The government then gave this plan to individual banana producers so they knew about strategies and plans to become carbon neutral. Overall, the respondent from CORBANA claimed that industry generally "supported the idea" of carbon neutrality (I2).

Interviewees from hotels and the coffee industry also reported being receptive to carbon neutrality and explained that working toward the goal had multiple benefits. As an employee from Café Britt, a major coffee company, explained, Britt was one of the first Costa Rican companies to become carbon neutral (Department of Climate Change, n.d.) because "we really believe it's something we can work with" (I5). He added that Café Britt sees the environmental benefits from working on carbon neutrality and explained that carbon neutrality might give the company an advantage on the international market by appearing environmentally friendly.

A representative from a luxury hotel near the Arenal volcano explained that carbon neutrality was about doing the right environmental thing and making money (I3). The hotel started working on carbon neutrality right after the government's announcement because the hotel has "a lot of primary forest" around it and it wanted to maintain that. But, she added, it's "a business strategy also." She explained that the hotel is a luxurious one, and that "everything here is green," suggesting that carbon neutrality is also about value. Tourists are "attracted to that idea," and "most people are looking for that" when they book a vacation. She added that the hotel hired an employee to calculate the hotel's emissions and create an inventory of its greenhouse gas emissions. The hotel started this process in 2007, finished its inventory in 2011, and then sent it to the Ministry of the Environment.

The general manager of a hotel in San José who claimed that the hotel was briefly carbon neutral had a similar explanation about the hotel's motivations for carbon neutrality. He said that in 2010, the hotel became carbon neutral, but at the time of the interview (July 2015) the hotel was no longer considered carbon neutral nor was it working to become carbon neutral because it was undergoing significant renovations. The hotel pursued carbon neutrality out of a sense of "social responsibility" (I4). The hotel had previously pursued social programs to benefit children and the environment so the carbon neutral pledge extended this tradition. As he explained, the hotel has to be a "place where people want to come." He added, we "want the [carbon neutral] stamp" (an indicator from the government signifying that the business is carbon neutral) and we want to "be an example for other

companies." For these industry representatives, carbon neutrality was important to each business's identity and good for marketing, since the stamp illustrates its environmental achievements to customers.

3. Issues of monitoring and verification

When the Minister of the Environment met with industry representatives, these representatives asked about the process for becoming carbon neutral (G4). To determine the standards for carbon neutrality, in 2009, the Ministry of the Environment solicited help from INTECO to create a carbon neutral norm. INTECO verifies that Costa Rica is in compliance with norms from international organizations such as the International Organization for Standardization and standardizes voluntary norms that are pursued at the national level (ISO, n.d.). An employee from INTECO explained that INTECO's work on carbon neutrality was different from its usual work because a norm did not exist for how a country could achieve this goal (INTECO-1). There was, however, a norm from the United Kingdom detailing how groups at smaller levels of scale could become carbon neutral. This norm, PAS 2060 (Publicly Available Specification), was developed by the British Standards Institution in 2010 (Ecoact 2019). INTECO used this norm as the basis for its carbon neutrality norm. As a university official put it, "This [carbon neutrality] is something we built," (S1) emphasizing his belief that it was pioneering for Costa Rica to apply PAS 2060 to a nation.

According to INTE.12.016, the norm INTECO developed, organizations must follow three steps to become carbon neutral: calculate, reduce, and compensate (INTECO-1). First, an organization identifies the sources of its emissions, calculates emissions, and develops an inventory of annual tons of carbon dioxide (CO_2) emissions. A business can hire a consultant to do this inventory or enroll an employee in a course that INTECO offers. Second, the organization reduces emissions. The carbon neutrality norm does not specify how or what a company should do; the company must select carbon-reducing actions on its own. But even after taking such actions, an organization will inevitably still release emissions. Thus, third, an organization compensates for its remaining emissions to bring total emissions to net zero. Here, a company pays for its emissions by purchasing carbon offsets through FONAFIFO.

When asked to compare this Costa Rican process of achieving carbon neutrality to the UK norm it was based on (PAS 2060), the respondent from INTECO said it was "similar." The three steps are the same, but in the United Kingdom the norm for sub-national groups to become carbon neutral was not paired with the national objective of becoming carbon neutral (INTECO-1).

After a company completes these steps, INTECO or Earth University verifies that the company emits net zero emissions and is evaluated annually to ensure its continued compliance (G4; S1; INTECO-1). A business can lose the carbon neutral stamp. A third organization, ECA, the Costa Rican Entity of Accreditation (ECA, 2011) accredits INTECO and Earth University (INTECO-1). Upon verification that a product or company has "zero impact" on the climate, the Ministry of the Environment and Energy awards the business a carbon neutral stamp (MINAET, 2009, p. 83).

Discussion

The carbon pledge has undergone changes but remains salient in Costa Rican politics. In 2010, the Peace with Nature coalition disbanded but was replaced with the Department of Climate Change, which is in charge of the carbon neutrality goal (Republic of Costa Rica, 2009, p. 31). As of July 2015, the staff in this department still expressed a commitment to making Costa Rica a carbon neutral country (G2). President Luis Guillermo Solís (2014–2018) first intended to push back the target date of 2021 (Fendt, 2014) but then committed to meet the goal by that date ("Costa Rica pledges," 2017). Recently elected President Carlos Alvarado Quesada almost immediately pledged to discontinue the use of any fossil fuels in transportation, the country's largest contributor to greenhouse gas emissions, by the year 2021 (Embury-Dennis, 2018).

In its Intended Nationally Determined Contribution (INDC), submitted ahead of the 2015 Conference of the Parties (COP) meeting in Paris, the Costa Rican government "reaffirm[ed] its aspiration of becoming a Carbon Neutral economy starting year 2021" (Government of Costa Rica, Ministry of Environment and Energy, 2015, p. 2). The document adds that the aim of carbon neutrality is to make emissions by 2021 "comparable to total emissions in 2005," a notable difference from the 2009 document, where this baseline year was not discussed (Government of Costa Rica, Ministry of Environment and Energy, 2015, p. 3). Later in the INDC, the government describes its ambitious long-term goal to "accomplish zero net emissions by 2085" (Government of Costa Rica, Ministry of Environment and Energy, 2015, p. 10). At this time, it is unclear why 2085 was chosen as the new target date for achieving carbon neutrality, but other sources also affirm the country's commitment to produce net zero carbon emissions by 2085 (Climate Action Tracker, 2015; Replogle, 2015). It seems as though shorter-term emissions goals have been made for 2021, and longer-term goals have been set for 2085. Although the timeline for achieving carbon neutrality appears to have shifted significantly, support for de-carbonization persists.

This analysis of Costa Rica's pledge reveals that the pledge has moved beyond the merely symbolic (Bluhdorn, 2007) and has fostered some shifts in Costa Rican society. However, at this time, there is more evidence of political and institutional changes that are attributable to the pledge, than of changes in carbon emissions. The announcement of Costa Rica's pledge was an almost entirely symbolic act. By the time politicians began to discuss carbon neutrality, 20 years had passed since President Arias had been awarded a Nobel Peace Prize, an action that brought significant global attention and economic advantages to Costa Rica. Initially the goal was to achieve carbon neutrality by 2021, the bicentennial anniversary of Costa Rica's independence from Spain (MINAET, 2009). From the start, the pledge was associated with Costa Rican national identity and highlighted the country's unusual actions to a global audience.

Other research has found that the symbolic characteristics of pro-environmental actions can motivate adoption of these actions. Noppers et al. (2014, p. 60) find that people are more likely to pursue "green" actions when they believe these actions will improve their "self-identity and social status." Though these authors' conclusions are drawn from research conducted on individual people, we see a similar dynamic happening at the national level in Costa Rica. The symbolic pledge of becoming the first nation to become carbon neutral, during a historical moment (2006–2007) of global inaction on climate change (Roberts & Parks, 2007), was a way to shape the global community's ideas about what kind of place Costa Rica is and display elites' own ideas about the nation they inhabit.

The pledge announcement was a highly symbolic event. At the time of the announcement, a clear plan detailing how to become carbon neutral did not yet exist. But the announcement of the pledge was a single moment in time that was followed by an interest in confronting the question of how to reduce emissions. The state led in this effort. The data drawn upon here do not show evidence of a coordinated, government-led effort to overhaul the Costa Rican economy in an ecologically modern way (Buttel, 2000; Mol & Sonnenfeld, 2000). However, elites organized and created a way for institutions to pursue carbon neutrality on their own. The Department of Climate Change (n.d.) reports that 41 companies had been verified as carbon neutral by the end of 2015, and by the end of 2016, this number had climbed to 64. Another four companies have completed their carbon emission inventories and are working toward becoming carbon neutral (Department of Climate Change, n.d.).

The pledge has led to some "green" capacity building, an indicator of issue-related substantive effectiveness (Newig, 2007). There are some similarities here to research done on voluntary agreements or voluntary regulations. The government of Colombia, for example, has pursued voluntary regulation agreements with industry that create incentives for compliance with an environmental initiative rather than penalize for non-compliance (Blackman et al., 2013). While Blackman et al.

(2013, p. 363) find that Colombian industry's compliance with voluntary environmental agreements has been "spotty," they also find that the agreements have fostered "environmental management capacity" in these industry groups.

Costa Rica's carbon pledge has fostered "green" capacity building in higher education, industry, and government. For example, Earth University not only declared itself carbon neutral but also stated its intention to become an entity that certified other organizations' greenhouse gas emissions in 2007 (Vargas, 2007) and formed its carbon neutral program to certify companies as carbon neutral in 2008. The hotels working on carbon neutrality hired personnel to calculate their emissions. Also, while the group known as Peace with Nature disbanded in 2010, the government transformed this committee's work into the Department of Climate Change. And clearly, Costa Rica's work on carbon neutrality from the mid-2000s influenced its INDC ahead of the Paris 2015 COP.

While the pledge has moved beyond entirely symbolic, there was room to make it much more substantive. The act of "inviting," as one interviewee put it (G1), businesses to join the national efforts on carbon neutrality allowed government to tout its mitigation efforts to international audiences, but freed it from having to hold industries accountable to their commitments. In short, the pledge is a win-win scenario for the government. Several interviewees, even those most intimately involved with the work on carbon neutrality, were critical of the government's shortcomings on the pledge (G6; C1).

The findings from this case suggest a new way for researchers to consider symbolic politics. This analysis reveals that research on symbolic politics has thus far paid too little attention to the issue of time, or more specifically, to how political acts can change from symbolic to (more) substantive with the passing of time. Researchers have made helpful strides in thinking about the characteristics of symbolic politics and the circumstances under which they are adopted (Gunnlaugsson & Galliher, 1986; Gusfield, 1967; Matten, 2003; Newig, 2007; Ovink et al., 2016; Wysong et al., 1994). Thinking about how symbolic politics are different, or not so different, from other kinds of politics has evolved from the use of categories (symbolic or not), to continuums (more or less symbolic), to two-axis charts (Newig, 2007). But a consistency throughout this work so far has been that political actions are treated as static over time. Political acts begin and end as either more or less symbolic. Prior work has not paid enough attention to the question of how symbolic political decisions can change when they are placed in a societal context that has to decide whether to grapple with them, and if so, how. This research shows that while Costa Rica's pledge began as symbolic, it has taken on some substance over time. With the use of process tracing, which is especially helpful for analyzing the "unfolding of events or situations *over time*" (Collier, 2011, p. 824, emphasis in original), this research shows that while the initial pledge announcement was highly symbolic, the pledge has, over time, become something different. This means that this pledge merits further study over time.

Conclusion

Though the findings from this work are limited to the case of Costa Rica, it is very possible that the findings have relevance more broadly in the aftermath of the Paris Agreement. The pledge-and-review structure of the Paris Agreement now puts nations' individual pledges front and center in climate politics. Despite the inability of even complete implementation of nations' pledges to limit global temperature rise to 2 degrees Celsius (Rogelj et al., 2016), the findings from this research suggest that national pledges may lead to important "green" capacity building and both institutional and political changes that may, over time, lead to emissions reductions.

Future research could investigate potential parallels between the aftermath of Costa Rica's pledge and the aftermath of other nations' pledges. An important question for the future is whether INDCs started as symbolic, and whether they have become more substantive over time. A related question to investigate is whether certain political contexts are more conducive of helping change symbolic pledges to substantive commitments. Additional research is needed to investigate these and related questions.

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Time, Power and Environmental Impact: A Growth Curve Model of the Relationship Between Temporal Change and CO_2 Emissions Per Capita

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Abstract

In this analysis, I examine the effect of social-structural factors associated with the passage of time on carbon dioxide (CO_2) per capita, while also accounting for global power relations. I use World Development Indicator data on 91 nations over a 60-year period. I control for global power relations using Clark and Beckfield's (2009) trichotomous world-system categories to assign each country to a world-system stratum. I then use a hierarchical linear growth curve model to highlight the extent to which countries belonging to core, semi-periphery, and periphery categories are able to rely upon changes captured by the passage of time, such as improvements in technology, to reduce CO_2 emissions per capita. Key findings indicate that, in nations belonging to the core and semi-periphery, such factors are associated with increases in CO_2 emissions per capita, rather than the decreases that might be expected.

Keywords: carbon dioxide emissions; environmental sociology; structural human ecology

Introduction

It is often implicitly assumed by national governments and international organizations that, over time, there is a linear progression in both technological efficiency and ecological awareness among populations, producers, and policy-makers that leads to a general decline in negative anthropogenic environmental impact (Intergovernmental Panel on Climate Change [IPCC], 2014; United Nations Environment Programme [UNEP], 2012). In many ways, the environmental social sciences have been developed through the findings, debates, and contentions that

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surround the relationship between year-to-year changes in social, economic, and political factors, and such impacts—and are meant to examine whether such trends do indeed exist. The nuances of the relationship between carbon dioxide (CO_2) emissions and a host of other social indicators, such as economic growth, population structures, and technological change, has been the motivating force behind many theoretical and methodological innovations, though such developments have often taken place with the aim of refuting or qualifying the validity of preceding contributions to method or theory. For example, in the field of structural human ecology (SHE), York et al. (2003a) employed cross-national STIRPAT (stochastic impacts by regression on population affluence and technology) analyses to demonstrate the presence of a significant and positive association between economic growth and increases in a nation's environmental footprint. Such findings were built upon and complicated by Liddle (2014) whose work demonstrated the importance of accounting for the demographic age structure of populations in such studies. These contributions continue to be built upon further still, as is well exemplified by recent work that incorporated spatial regression analysis into the traditional STIRPAT formulation in order to illustrate the need to conceptualize the effect of urbanization as a phenomenon that brings about environmental impact in both technological (e.g., spatial) and demographic capacities (McGee et al., 2015).

Interestingly, while the question of how the relationship between human-induced CO_2 emissions and social factors—such as those mentioned above—might vary over time has been central to many of the theoretical debates and developments within the diverse field that constitutes the environmental social sciences, few studies to date have chosen to deal with the effect that the passage of time (and more particularly the changes in cultural, technological, and political/institutional factors that are captured by the passage of time) has on the relationship between environmental impact and human activities directly (Jorgenson, 2014; Jorgenson & Clark, 2012; Jorgenson & Givens, 2015). Those studies which have dealt with time have, thus far, done so by interacting year dummies with a variable of interest, such as gross domestic product per capita (Jorgenson & Clark, 2012). Such an approach offers the benefit of allowing researchers to explore how the relationship between two variables, itself, varies from year to year, but it does not allow for the direct exploration of the relationship between time and emissions. Here, I hope to contribute to the field by using a method that, to my knowledge, is novel within the field of SHE to address the effect of factors captured by year-to-year changes in time, such as technological change, on per capita CO_2 emissions, while also accounting for the modifying effect that geopolitical context has on this relationship.

In order to effectively explore the role that temporal developments play in the achievement of a greater or lesser degree of emissions, I use a hierarchical linear growth curve modeling approach to better understand how the passage of a year of time affects CO_2 emissions per capita on average, while also controlling for the effect

that a host of other theoretically relevant factors have on this important outcome. The use of the hierarchical linear growth curve modeling approach allows for the investigation of the relationship between time and CO_2 emissions per capita, while also allowing other theoretically relevant and empirically measurable factors to be controlled for. The hierarchical structure of the growth curve model also has the benefit of allowing for contemporaneous and extemporaneous factors to be controlled for, making the logic of the hierarchical linear growth curve model similar to that of fixed-effects modeling approaches with fixed-effects estimators for both time and nation-state. However, by using a hierarchical modeling approach, I am also able to control for historical factors, something that presents methodological difficulties in the more traditional fixed-effects modeling approach. Considering the findings of research performed in the unequal ecological exchange and environmental world-systems literatures (Bunker, 1984; Grimes & Kentor, 2003; Jorgenson, 2006; Roberts & Grimes, 1997; Roberts et al., 2003; York et al., 2003b), I account for the effect of historical relations of power over trade networks on the relationship between emissions and temporally variant factors by interacting the temporal variable with the world-systems position (WSP) strata of core, periphery, and semi-periphery. Doing so allows for the development of a more robust understanding of how this relationship varies within the developmental strictures typically placed upon nations belonging to such categories as a result of the contemporary structure of the geopolitical field.

I contextualize the findings of the present research by drawing upon several theoretical traditions within environmental sociology. Specifically, key theories used to understand study findings and to orient the research project are "treadmill of production" (ToP), structural human ecology (SHE), environmental world-systems, and ecological modernization (EM) frameworks. Building upon such scholarship, I employ the methods used here to add greater nuance to the tensions between neo-Marxian understandings of environmental crises and EM perspectives. In doing so, I note that, in many ways, this debate acts as a proxy for the larger debate among policy-makers, activists, and academic experts surrounding the ability of technological progress and potentially growing ecological rationalization to mitigate anthropogenic environmental impact on its own (e.g., absent meaningful structural and policy reform).

Literature review

While scientific knowledge concerning the potentially devastating effects of climate change—and key anthropogenic drivers behind such changes—has grown immensely, several assumptions that are foundational to modernization hypotheses still seem to limit the incorporation of such knowledge into global mitigation strategies in a number of ways. The influence of the modernization school in

this respect is perhaps most readily visible in international policy organizations' emphasis on elaborating mitigation strategies that reduce environmental impact while still maximizing economic growth, despite the fact that economic activity is recognized as a key contributor to climate change by the very same institutions (IPCC, 2014). Such strategies reflect an approach to achieving sustainability that still understands and measures international development in terms of various stages of growth (Rostow, 1959), and that seems to suppose that the most appropriate and effective route to sustainability is likely through the introduction of a technical and consumption-based solution that will "consistently produce such a countervailing effect that [it] neutralizes scale effects" (Rosa & Dietz, 2012, p. 4) of growth in economic activity and population size.

Importantly, the inability to conceptualize a route to global sustainability that incorporates economic stability, as opposed to economic growth, has led to an adoption of mitigation strategies that primarily rely on the ecological rationalization outlined by EM theorists, such as improvements in technological efficiency, the establishment of environmentally conscious political regimes and policies, and a turn toward more environmentally friendly consumption and production patterns (Longo et al., 2016; Sonnenfeld, 2000; York & Rosa, 2003; Mol, 2010). Considering this, it is of the utmost importance that environmental social science research contribute to the development of a more robust understanding of the effectiveness of modernization strategies with respect to reducing environmental impact. To a large extent, much of macro-structural environmental sociology research has been performed with this goal in mind—a point to which I now turn.

EM theorists developed the EM framework in the last decade of the 20th century in order to provide a counterpoint to the neo-Marxian approaches to environmental sociology that understand environmental crises as an inevitable outcome of modernization processes under capitalism. To that end, EM has focused on developing an understanding of emergent processes of institutional environmental reform (Mol et al., 2014). In particular, EM proponents have focused much of their attention on demonstrating that as socioeconomic processes and institutions develop, or modernize, renewed and intensified environmental concerns and improved efficiency and technology can lead to the decoupling of the economy and environmental impact (Mol, 1997; York & Rosa 2003; York et al., 2010). Thus, given sufficient time and economic growth, the introduction of environmentally protective political policies, and popular social movements, as well as more environmentally aware choices among consumers—and subsequently producers—within the marketplace should lead to a relative dematerialization of economic processes and allow for economic growth and environmental mitigation to be compatible (Jorgenson & Clark, 2012; Mol, 2002; Spaargaren & Cohen, 2009).

The process of "ecological rationalization" has been the centerpoint of EM research, which has often relied upon case studies of ecologically reflexive institutions to demonstrate that, even if EM has not spread through our cultural and economic systems wholesale, there are still instances that illustrate the potential, and presence, of such a transition (Mol & Spaargaren, 2000; Mol et al., 2014; York et al., 2010). Or, as Mol et al. note, "structural human ecology/neo-Malthusian perspectives diverge significantly from ecological modernization theory in that the former are highly abstract, rather than richly particular" (Mol et al., 2014, p. 25). Following the logic of modernization theory, EM proposes that the process of ecological rationalization is fundamental to development, and that, though more developed nations will experience such a rationalization first, all nations will ecologically rationalize as a consequence of the economic growth they may experience, as well as through gaining access to global flows of environmental information and goods (Jorgenson & Clark, 2012; Mol, 2010; Spaargaren & Mol, 2008). A central assumption of this approach is that, on the whole, progress under modernization is linear and fairly continuous and will lead to reductions in environmental impact (York, 2004). Yet, despite the centrality of time to the assumption of progress, EM research does not generally deal with, or account for, the potential effects of technological, cultural, or institutional factors associated with time on improvements in ecological outcomes empirically.

Neo-Marxian and SHE perspectives have taken opposing theoretical and methodological approaches to EM in understanding the capacity of institutions and policy-makers to address the environmental crisis through the modernity processes of capitalism. For example, ToP, which was developed by Schnaiberg (1980) to facilitate an understanding of the uptick in pollution and resource extraction following World War II, posits that, due to the Iron Laws of Competition (Marx, 1976), economic processes under capitalism, which also entail economic expansion, will lead to ever-increasing rates of environmental impact. Specifically, theorists in this perspective argue that as more capital is made available to be invested into newer and more efficient technologies, production processes become more and more dependent on these technologies, and capital eventually uses them to replace significant portions of the workforce. The replacement of human labor with new technologies in leading firms has two effects, according to this perspective. First, as new technologies penetrate deeper into the production processes of society, expanded extraction of natural resources would be required in order to provide these new machines with the materials they require to operate properly. The second effect of the growing use of new technology would be that political elites, under pressure from industry to support expansion of production, and from workers to provide a growing job market, enact policies that enable businesses to easily expand into new markets and increase firms' access to natural resources. This expansion, in turn, grows consumption levels, and, as a result, the market for new technologies steadily increases. The end result is a cycle, or "treadmill," that requires ever-greater

quantities of ecological resources, and produces ever-greater quantities of polluting by-products (Gould et al., 2004; Schnaiberg, 1980; Schnaiberg & Gould, 2000). In a fashion similar to EM approaches, ToP has temporal processes at the center of its most foundational hypothesis. However, contrary to EM theories, ToP would suggest that with the passage of time there would be ever-greater rates of financial accumulation and industrial expansion, which would result in more pressure being placed on environmental sinks and resources and, thus, ever-greater environmental impacts. Critics of such theories often point to their apparent economic and technological determinism as weaknesses, arguing that they leave no space for the possibility of reform and rationalization that EM examines (Mol et al., 2014).

In addition to differing from the EM perspective in how it conceptualizes the role of temporality in socioecological processes, neo-Marxian approaches such as ToP understand the role that global power relations play in conditioning such processes in a manner that directly challenges the logic of the modernization theory that EM builds upon. Importantly, EM theorists have taken great care to address concerns of eurocentrism within the framework (Mol et al., 2014). Thus, a greater number of EM studies have begun looking at processes of environmental reform, including the presence of environmental Kuznets curves (EKC), in countries throughout the global North (Roach, 2013; Shahbaz et al., 2013), Asia (Baek & Kim, 2014), and several other nations throughout the global South (Ahmed & Long, 2013; Chandran & Tang, 2013; Tiwari et al., 2013). Other critiques of EM have claimed that the perspective ignores the global context of many economic and environmental processes, and have resulted in the development of a new international understanding of EM, which is well represented by the environmental flows approach Mol and others have developed (Mol & Spaargaren, 2005). However, while EM proponents relying on this approach often posit that global flows of resources, technology, and information will likely lead to a reduction of impacts from social and economic processes across all nations, theorists in environmental world-systems and unequal ecological exchange who draw from, and contribute to, ToP and other neo-Marxian traditions argue instead that global power dynamics, which enable the domination of trade networks and conditions by a few countries, result in less powerful nations being forced into a position where they bear the brunt of the international community's environmental burden (Ergas & York, 2012; Grimes & Kentor, 2003; Jorgenson, 2006; Jorgenson & Clark, 2012; Prell & Sun, 2015; Roberts & Grimes, 1997; Roberts et al., 2003; York et al., 2003a; York & Ergas, 2011). As a result of such a power dynamic, a number of neo-Marxian theorists argue, even if economic growth were to proceed in all nations, many nations would continue to pollute because, in such countries, economic growth is dependent on the establishment and expansion of environmentally intensive economic activities.

As has been noted above, the field of SHE has been deeply involved in the question of how human activities—including the introduction of new technologies, political policies, and cultural changes—impact the environment. One of the most influential strains of scholarship to deal with such questions in this tradition has been STIRPAT. Contemporary STIRPAT literature, and the SHE methodologies and analyses that draw from it, traces its origins to the IPAT (Impacts = population x affluence x technology) formulation (Commoner, 1972; Ehrlich & Holdren, 1972). The development of IPAT—which at its heart is an accounting equation whereby one can determine the value of any particular term so long as the other three are known—centered to a significant degree around debates over the role of technology in how humans impact their environment. Particularly, IPAT developed through a debate between Barry Commoner, who argued that environmental degradation was most appropriately attributed to changes in technology and economic growth (Commoner, 1971), and Paul Ehrlich and John Holdren, who believed that environmental harm was primarily driven by unrestrained population growth (Ehrlich & Holdren, 1971). For Dietz and Rosa (1994, 1997) the debate between Commoner and Ehrlich and Holdren highlighted that, due to its multiplicative nature, IPAT could not be used in order to identify singular causes of anthropogenic impact or to test hypotheses concerned with such matters (Dietz, 2013; Jorgenson, 2013). These realizations led to the elaboration of the IPAT equation into STIRPAT, a tool with which the multiplicative logic of IPAT could be subjected to hypotheses testing in regression analyses. In practice, the difficulty of measuring factors of anthropogenic impact represented by the final T (technology) in the STIRPAT formulation has led to technology being calculated as the exponentiation of the residual in STIRPAT models after accounting for population and affluence (York et al., 2003b). However, a powerful tool in models within, and influenced by, the STRIPAT tradition has been the decomposition of STIRPAT components in order to more closely approximate the effect of technology. As Dietz notes, "it was always clear that unpacking technology would capture a variety of structural effects that vary across contexts" (Dietz, 2013, p. 199), a fact which is well represented by the development of literatures that find their methodological impetus in the STIRPAT tradition.

Despite the importance of the behavior of measures of pollution and sustainability over time to our understanding of the relationship between human activity and environmental impact, and what can be assumed to be a relatively strong relationship between time and changes in factors intended to be captured by the final T of models influenced by STIRPAT, few works in this area have considered the relationship between time and impact in an immediate manner (Jorgenson & Clark, 2012; Jorgenson, 2014; Jorgenson & Givens, 2015). To this end, Jorgenson and Clark (2012) examined the effect of economic growth on CO_2 emissions conditioned by time by interacting GDP per capita with time in five-year increments. They also take global power relations into account by performing the analyses within

the context of less developed and highly developed countries. While their findings indicated a minor decoupling of economic growth and CO_2 emissions per capita in highly developed countries, no such trend was found in less developed countries. These findings lend support to the notion that more powerful nations reduce their environmental impact by exporting environmentally harmful activities to less powerful countries, or the "pollution-haven" hypothesis (Pearson, 1987). Jorgenson (2014) then built upon the previous work by examining the relationship between the carbon intensity of wellbeing (CIWB) and GDP per capita conditional upon time period. Here, time was again integrated into the study by interacting every fifth year with GDP per capita in five different continents, and findings demonstrated that in all continents except Africa economic development increased CIWB. Recently, this work has been furthered still, as researchers have performed a similar analysis on consumption-based CIWB by interacting GDP per capita and time for every year from 1990 to 2008 in the context of both OECD and non-OECD nations (Jorgenson & Givens, 2015). Jorgenson and Givens (2015) suggest that economic growth was associated with declines in sustainability across all countries, with the effect being particularly notable in OECD nations—once again demonstrating that the relationship between economic development and impact must be understood in both a temporal and geopolitical context.

The present study attempts to contribute to this tradition by directly examining the effect of difficult-to-measure factors that change through time on the CO_2 emissions per capita, while also accounting for the position nations hold in the world-system, using a hierarchical linear growth curve modeling approach. In performing such an analysis, the present study makes two important contributions to the literature. First, I argue that by examining the association between time and CO_2 per capita—while also accounting for power, age structure, economic development, levels of urbanization, geographic advantage, and contemporaneous factors—one is able to gain insight into the effect of difficult-to-measure variables that are also associated with time, such as ecological awareness of a population, policy changes, and technological improvements that might affect how social processes relate to environmental impact. Using such a technique allows us to approach the issue of time in the context of sustainable development in a new way, and enables us to think about the debate over the role of technology in environmental mitigation from a different angle. Second, here I argue that, though interacting years with economic activity is a good way to understand how particular years modify the effect that growth has on impact, treating time as a continuous variable allows for the development of a more general understanding of how CO_2 per capita has been impacted by those factors most directly captured by changes in time when all other theoretically relevant drivers of impact are accounted for. In this way, this research grants us insight into how the combined factors of technological change, environmental policy reform, and the development of ecological concern among consumers and producers affect CO_2 emissions per capita in the core, semi-periphery, and periphery of the world-system.

Data and methods

With the exception of world-system position (WSP), all variables were drawn from the World Bank (2013) for the years 1960 to 2011. The dependent variable, CO_2 emissions per capita, measures CO_2 emissions from liquid, gas, and solid fuel consumption in energy production, emissions from main producers of electricity and heat—and emissions from unallocated auto-producers—in million metric tons, divided by the total population within a given nation at a given time.

The independent variable of interest in the present study is time, which is a continuous variable measured in years from 1960 to 2011. Here, I follow previous work in the SHE tradition, and attempt to capture the effect of technology, which is traditionally viewed as being captured in the residual term of models by disaggregating a model component that encompasses many other relevant factors (Dietz, 2013; Jorgenson, 2013; McGee et al., 2015). However, while many researchers have attempted to capture the impact of technology by disaggregating variables that are known to be fundamental drivers of environmental impact—such as population (Liddle, 2014; Roberts, 2011), or affluence (Shi, 2003; Wang et al., 2013)—here I follow McGee et al. (2015) and attempt to capture technology by bringing a new component into such analyses. Yet, the present study also differs significantly from McGee et al. (2015) in that, where they attempt to capture technology by incorporating a measure of impervious surface development in a nation, I capture the effect of technology and ecological rationales among populations and policy-makers by disaggregating the temporal variable. Disaggregating the temporal variable, in this instance, is achieved by controlling for as many temporally variant, theoretically relevant, and empirically robust and consistent variables as possible. Thus, I argue that time is of interest because, when all time-varying covariates that are empirically robust, and theoretically important to understanding the relationship between social activity and emissions, are accounted for, time then represents those theoretically relevant drivers of impact which we are unable to measure, such as technological progress—including those technologies associated with the spread and intensification of impervious surfaces, political regime change, and ecological awareness—albeit in an imperfect manner. To that end, the controls included in the models presented below account for a number of factors that are known to have an effect on CO_2 emissions per capita and to vary significantly over time, and that are commonly used in macro-quantitative SHE analyses. Importantly, here I do not claim to be accounting for all variables that are theoretically relevant. It is my hope, however, that the inclusion of the independent variables included here can help generate the beginnings of a picture that describes the relationship between the various aspects of ecological rationalization and environmental impact. Specifically, here a non-monotonic urbanization, the age structure of the population, and a non-monotonic GDP per capita are included in the models in order to control for factors relevant to CO_2 emissions per capita that are easily measurable and highly time-variant.

GDP per capita, measured in 2005 US dollars, is used as a control variable to measure the effect of national-level affluence on emissions. Research in the fields of SHE, ToP, ecologically unequal exchange, and world-systems theory have all found economic growth to be a key contributor to environmental impact and anthropogenic CO_2 emissions per capita (Dietz & Jorgenson, 2015; York et al., 2003c). A quadratic term for GDP per capita is also included in order to allow the relationship between this variable and emissions to be expressed non-linearly. In particular, the inclusion of a quadratic term for GDP per capita allows for the direct examination of the claim in many EM and EKC hypotheses that at greater levels of economic development the impact of economic processes will begin to be alleviated, and even reversed, for a variety of reasons.

Urbanization, or the proportion of the total population living in urban areas, and the ratio of working-age population are included as a control variables in order to account for the ways in which differing demographic structures can drive impacts. Urbanization can be a driver of environmental impact in multiple dimensions. For example, urbanization is often a driver of concurrent industrialization, and thus CO_2 emissions. At the same time, processes of urbanization often require the development of the built environment and are predictors of access to energy sources, and thus energy use. As a result, urbanization can be conceptualized as an aspect of development which drives an increase in energy use and manufacturing (Liddle, 2014). Previous work has suggested the presence of an EKC with respect to urbanization and environmental impact as well (Erhardt-Martinez et al., 2002). Further, more recent work has identified the presence of an EKC in the relationship between urbanization and emissions in developing nations (Martínez-Zarzoso & Antonello, 2011). In order to control for this possibility in the present study, a quadratic term is included for urbanization. In addition to urbanization, it has been found that the proportion of the population that is of working age is deeply tied to the productive capacity of a nation-state and thus is a significant driver of energy use and emissions (McGee et al., 2017; York & McGee, 2017).

It should be noted that there are other theoretically relevant and empirically robust variables that are not included here, such as foreign direct investment, or the percent of the GDP that is gained from import and export activity. I omit these variables as a result of the fact that they are most typically used in order to capture aspects of ecologically unequal exchange in the international economy. Though these variables work well to capture the effect of such phenomena on GDP per capita, here I am interested in how qualitative, categorical differences in the position of power that a nation-state holds in the global economy modifies the way that aspects of ecological rationality which vary from year to year affect emissions per capita. As a result of this aim, I measure such effects using WSP dummies. Descriptive statistics of key variables according to WSP can be found in Table 1.

Table 1: World-system position descriptive statistics.

Variable	All nations	Core	Semi-periphery	Periphery
Mean GDP per capita	11241.67	18105.05	7507.357	3572.61
Maximum GDP per capita	81947.24	67804.55	81947.24	61662.50
Minimum GDP per capita	113.8766	150.55	408.72	113.87
Mean CO_2 per capita (million metric tons)	1.83×10^{-6}	2.63×10^{-6}	1.73×10^{-6}	7.45×10^{-7}
Maximum CO_2 per capita (million metric tons)	1.97×10^{-5}	1.18×10^{-5}	1.97×10^{-5}	1.1×10^{-5}
Minimum CO_2 per capita (million metric tons)	1.28×10^{-10}	3.49×10^{-8}	9.40×10^{-9}	1.28×10^{-10}
Groups (countries)	91	34	18	39

Source: Author's summary.

I account for power in geopolitical relations by relying upon the WSP measures created by Clark and Beckfield (2009). In order to test for robustness in findings, alternative analyses to those presented here were performed using the more traditional, Snyder and Kick (1979), WSP indicator. The findings reported below were robust across both measures of power. There are 91 nations for which information on environmental indicators and WSP are available that are included in the present study. As a result, I limit my analyses to those 91 nation-states.

Though I use both Snyder and Kick's (1979) and Clark and Beckfield's (2009) measures of WSP in this study, I focus my analysis on those models using Clark and Beckfield's measure because it provides a greater level of parsimony. Specifically, while both measures of WSP are created using network block modeling techniques, the Snyder and Kick (1979) measure performs its block calculations using an index variable that consists of trade flows, treaty participation, occurrence of military intervention, and the presence of diplomatic relations. The Clark and Beckfield (2009) measure only relies on trade network centrality. The result of this is that, though the Snyder and Kick measure acts as an effective gauge of placement in the world-system, the Clark and Beckfield measure is a more easily interpretable measure of power for the purposes of the present study.

Importantly, the models used in this study assume that WSP is relatively fixed in the 51-year period being examined. While the degree of mobility of nations within the world-system is an unsettled issue, there is a precedent of treating the position of nations as fixed over periods of time that may be considered brief relative to the 550-year time span within which the modern world-system has developed (Clark & Beckfield, 2009; Snyder & Kick, 1979). Understanding this, I contend that the position of power held by a nation in the international economy during the early years of the postwar era was one of many key factors that contributed to the adoption of political, social, and economic policy programs that were determinative

with regards to the ways the nation interacted with the environment over the period of time observed in this study. In order to test this assumption, an alternative model was explored where WSP was enabled to be slightly dynamic following the year 1989. The year 1989 was chosen in order to capture potential changes to WSP that occurred during and after the collapse of the Soviet Union. To capture such change, following 1989 WSP was coded according to Clark's (2012) updated, post–Cold War era, WSP indicator. Findings did not differ substantially from those presented below, and, as a result, I focus on the more parsimonious (fixed WSP) model. A list of WSP nations in this study can be found in Table 2.

Table 2: World-system position measure nation classifications.

Core	Semi-periphery	Periphery
Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Iran, Ireland, Italy, Japan, South Korea, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Pakistan, Poland, Portugal, Russian Federation, Saudi Arabia, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States	Chile, Colombia, Cote d'Ivoire, Cyprus, Iraq, Israel, Kenya, Kuwait, Libya, Nigeria, Panama, Peru, Philippines, Sri Lanka, Tunisia, United Arab Emirates, Uruguay, Venezuela	Benin, Bolivia, Cambodia, Cameroon, Congo (Dem. Rep.), Congo (Rep.), Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Haiti, Honduras, Iceland, Jamaica, Jordan, Lebanon, Malta, Mongolia, Nepal, Nicaragua, Paraguay, Senegal, South Africa, Sudan, Syrian Arab Republic, Togo, Trinidad and Tobago, Vietnam, Yemen

Source: Clark and Beckfield (2009).

With the exception of WSP and time, all variables in the study were natural log transformed, making the such variables presented in the models below elasticities. The result of this is that all coefficients below represent the percent change in CO_2 per capita associated with a 1-unit change in the independent variable (York et al., 2003b).

I use a hierarchical linear growth curve model, with years nested within nations, to perform the analyses presented below. Such an approach is beneficial, as hierarchical linear models entail a precise weighting operation that prevent the biasing of coefficients or standard errors by unusual observations or panel sizes. Additionally, the clustering of years within nations serves to control for both contemporaneous and extemporaneous effects. Controlling for these two factors serves to limit the influence of omitted variable bias substantially. Further accounting for contemporaneous factors, or the clustering of years, allows for the effect of changes from one year to another, such as changes in technology, culture, policies, and institutions to be captured within the time variable. Thus, the effect of a one-year

change in time corresponds to the average effect of within-nation changes of such factors. The general structure of the hierarchical linear growth curve model used here is as follows:

$$CO_2PC_{it} = \beta_{0i} + \beta_1(GDPPC_{it}) + \beta_2\left(GDPPC_{it}^2\right) + \beta_3(Urban_{it}) + \beta_4\left(Urban_{it}^2\right) + \beta_5(Productive\ Age_{it}) + \beta_{6i}(time_{it}) + e_{oit}$$

$$\beta_{0i} = \beta_0 + \beta_7(Core_i) + \beta_8(Semi_i) + \beta_9(Peri_i) + \mu_{0i}$$
$$\beta_{6i} = \beta_0 + \beta_{10}(Core_i) + \beta_{11}(Semi_i) + \beta_{12}(Peri_i) + \mu_{1i}$$

Level 2: $\begin{bmatrix} \mu oi \\ \mu 1i \end{bmatrix} \sim N(0, \begin{bmatrix} \sigma_{u0}^2 & \\ & \sigma_{u1}^2 \end{bmatrix}$

Level 1: $e_{0it} \sim N(0, \sigma^2_{e0})$

Where CO_2PC_{it} represents the log of per capita CO_2 emissions of the *i*th nation in year *t*; $GDPPC_{it}$ is the logged value of nation *i*'s GDP per capita in time period *t*; $GDPPC_{it}^2$ is the log of the quadratic term for country *i* in year *t*; $urban_{it}$ is the log of the percent of the population living in urban areas in nation *i* during year *t.* $Urban_{it}^2$ is the quadratic term for the log of urban population percentage; $time_{it}$ is the value of the variable time in country *i* during year *t*; $Peri_i$ is the binary measurement of the periphery status of nation *i*; $Semi_i$ is the binary measurement of the semi-periphery status of nation *i*; $Core_i$ is the binary measurement of the core status of nation *i*; e_{0it} is the residual difference in CO_2 emissions per capita for the *i*th country in year *t*; μ_{0i} is the residual differential CO_2 emissions per capita value for country *i* when all predictor variables are held at 0; μ_{1i} is the residual difference in CO_2 emissions per capita change for nation *i* for every additional 1-unit increase in time. σ_{u0}^2 represents the between-nation variance in CO_2 emissions per capita; σ_{u1}^2 is the between-nation variance in CO_2 emissions per capita change for every 1-unit increase in time.

Results and discussion

The results of the hierarchical linear growth curve model analyses are presented in Table 3 below. Model A demonstrates the effect of time on CO_2 emissions per capita absent of any theoretically relevant time-variant controls. The results indicate that every year of temporal change, on average, results in a 0.025% increase in CO_2 emissions per capita.

Table 3: Hierarchical linear growth curve model of the effect of time on CO_2 emissions per capita.

Variable	Model A	Model B	Model C
Level 1 variables			
GDP per capita	_	2.346*** (0.176)	2.539*** (0.178)
GDP per capita2	_	–0.091*** (0.010)	–0.112*** (0.011)
Urbanization	–	–5.572*** (0.370)	–5.331*** (0.365)
Urbanization2	–	0.901*** (0.053)	0.890*** (0.052)
Ratio of working age population	_	–0.012 (0.047)	–0.019 (0.046)
Time	0.025*** (0.001)	0.002 (0.001)	0.011*** (0.002)
Level 2 variables			
Periphery	_	_	30.676*** (3.340)
Semi-periphery	_	_	16.848*** (3.881)
Core (reference)	–	–	–
Cross-level interactions			
Year x periphery	_	_	–0.0158*** (0.002)
Year x semi-periphery	_	_	–0.009*** (0.002)
Year x core (reference)	–	–	–
Constant	–50.873	–10.346	–27.347
Variance terms			
σ^2_{eo} (Year level)	0.293	0.225	0.219
σ^2_{u0} (Country level)	4.393	1.606	0.278
σ^2_{u1}	–	–	3.03e-7

Notes: All models include 91 nations and 3,556 nation-years. *** p<0.001; standard errors in parentheses.
Source: Author's summary of model.

Model B examines the effect that time has on CO_2 emissions per capita while holding constant theoretically relevant variables, without taking global power structure into consideration. Findings suggest that, outside the effect of changes in population, economic development, and urbanization—which are controlled for in both Model B and Model C—time has no effect on CO_2 emissions per capita when context is not considered.

Model C controls for all theoretically relevant time-variant variables and also examines variation in the effect of time in nations belonging the core, semi-periphery, and periphery. Findings suggest that in the core, a one-year increase in the temporal variable is associated with an increase of 0.01% in CO_2 emissions per capita. The effect of time-variant factors on CO_2 emissions decreases by 0.009% in semi-periphery nations, resulting in an increase of 0.001% in kilograms of CO_2 emissions per capita being associated with a change of one year. Interestingly, periphery nations are found to have an even greater decrease in the effect that time has on CO_2 emissions per capita, 0.0159, suggesting that in such nations the passage of a year of time is associated with a slight decrease of 0.0059% in CO_2 emissions per capita on average. The graphic representation of these relationships can be seen in Figure 1. With the exception of the working age ratio variable, all regression coefficients reported in Model C were found to be statistically significant at the 0.001 alpha level with a two-tailed test. Considering the importance of questions around the impact that economic growth has on environment health, it is important to note that Model C indicates that there is an attenuation in the relationship between GDP per capita and CO_2 emissions per capita, such that as GDP per capita reaches very high levels its effect on emissions decreases substantially. Importantly, this research does not examine if, or how, this relationship is modified by power differentials in the global economy, which is an important consideration in such discussions. Additionally, I note that the relationship between GDP per capita and emissions remains positive throughout the range of observed values. Thus, the model indicates that even when nations achieve what might be seen as unusually high levels of GDP per capita ($81,947.24 in 2005 US dollars), economic growth is still found to result in increases in emissions. Likelihood ratio tests between Models B and C suggest that Model C provides the best fit to the data: as a result of this, I focus the discussion on this model.

Overall, the findings presented here suggest that factors captured by the passage of time that, as of yet, are not able to be directly measured and controlled for on the international scale—such as technological change, changes in policy approaches and political regimes at the national and international level, changes in the level of ecological concern among producers and consumers, and other aspects of ecological rationalization—do have a significant effect on CO_2 emissions per capita. While the association of time and CO_2 is modest in all world-systems categories, it is also found to be highly significant, and, importantly, significantly different in every world-system strata.

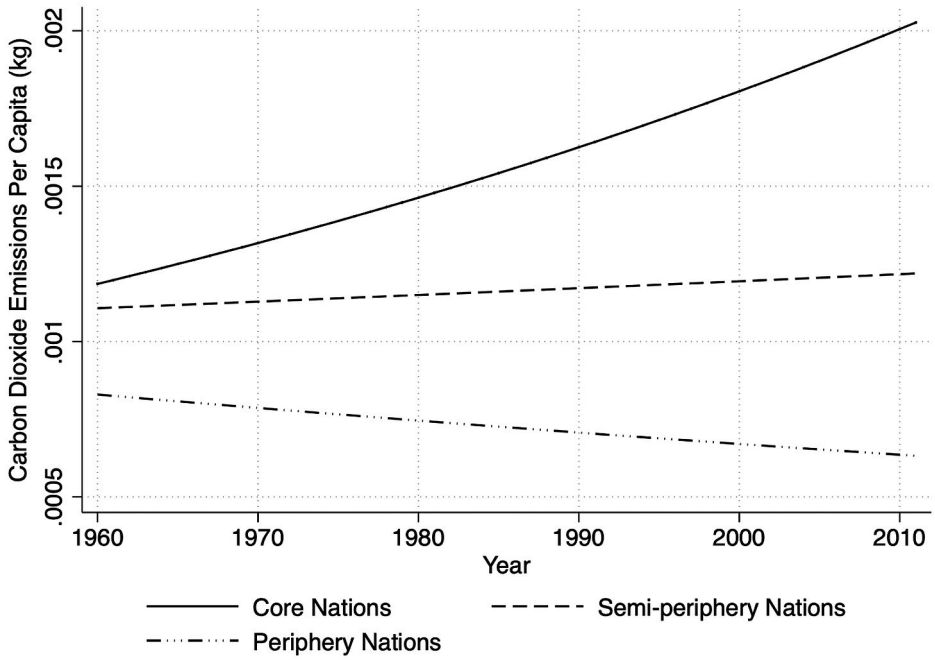

Figure 1: Estimated effects of time-variant factors on CO_2 emissions per capita.

Source: Author's summary of model findings.

The findings of the present research complicate our understanding of the role that social factors that change over time have on CO_2 emissions in interesting ways. For example, the fact that all three world-systems categories have relationships that are significantly different from one another provides support for the supposition of environmental world-systems scholars that, due to the nature of power relations in the international economy, nations holding different positions in the world-system will have notably different social and economic structures which will ultimately lead to notable differences in the impact that such nations' socioeconomic activities have on the environment. Thus, as Figure 1 demonstrates, time is associated with increases in CO_2 emissions per capita to a greater degree in core nations than it is in the semi-periphery, and is associated with decreases in CO_2 emissions per capita in the periphery. However, the specific relationship between time-variant factors of interest and CO_2 emissions per capita do not necessarily support a world-systems understanding of how such a relationship should play out in each world-system category. For example, if this relationship is viewed strictly through the environmental world-systems lens, then it might be considered surprising that all nations in the analysis except for those belonging to the periphery express a positive association between time and emissions. In particular, this finding seems to challenge the well-established "pollution-haven" hypothesis (Pearson, 1987),

where core nations improve socioecological relations by exporting environmentally harmful production processes to nations in the semi-periphery and periphery. Despite this apparent contradiction, if viewed with an eye toward consumption, then these findings do seem to offer support to environmental world-systems hypotheses, which note that labor forces in such nations, "being poorly paid, cannot constitute an important consumer market" (Roberts et al., 2003), and thus cannot account for great increases in consumption of energy. This insight, when taken in conjunction with insights of from the "displacement paradox" and the "Jevon's paradox"—which, respectively, note that new technologies are often used in addition to older technologies, and that increases in technological efficiency often lead to the technology being used by consumers at greater rates (York, 2006; York & McGee, 2016)—provides a plausible explanation of these initially surprising findings. Considering these theoretical contributions, we should not necessarily be surprised to see factors such as technological change, policy change, and increasing ecological concern associated with increases in emissions in the core, as it is possible that 1) new technologies, particularly in the energy sector, are being used in order to expand markets in the core, rather than replacing older technologies (York, 2012), and 2) increases in efficiency are leading to increases in consumption, as has recently been found to be the case in the United States with alternative fuel vehicles (McGee, 2018).

The existence of a positive relationship between time-variant factors and emissions in the semi-periphery indicates that these nations might be experiencing increases in emissions as a result of taking on environmentally harmful production processes in order to provide consumer goods for nations in the core, thereby increasing the use of energy that is required to sustain manufacturing processes. Thus, this finding offers support for environmental world-systems' "pollution-haven" hypothesis (Pearson, 1987; Roberts et al., 2003).

The negative relationship between the temporal variable and emissions in nations in the periphery offers support to both environmental world-systems theory and to Mol's theory of environmental flows. Specifically, we should expect periphery nations to release fewer production- and consumption-related emissions (Smith & White, 1992; Roberts et al., 2003; Van Rossem, 1996) than those belonging to the semi-periphery and core due to the fact that such nations often rely on niche economies (such as tourism) or human and non-human animal labor to grow their GDP. Further, as noted above, in many less powerful nations, large shares of the populations are not necessarily economically empowered enough to increase their rates of consumption or access to infrastructures. In spite of this, such nations often still have access to some of the benefits of technological and cultural change that EM, and environmental flows theory in particular, notes is fundamental to ecological rationalization. For example, it is possible that increases in access to

information technologies in such nations has the effect of raising concern over global environmental issues and leads to effective political mobilization strategies which are aimed at reducing local and national-level environmental impact, though more research should be done to explore the validity of this possibility. Thus, while previous research has suggested that information technologies can, in fact, exacerbate environmental problems (Longo & York, 2015), perhaps in those nations which exert the least power in the international market that is not the case. It should also be noted that, if environmental flows are responsible for the decline in emissions associated with temporal change in the way described above, then this suggests that the beneficial environmental outcomes we see in the periphery are, in large part, the result of severe global inequalities that the global community should seek to correct. Put differently, we cannot rely on such mechanisms to correct the global environmental crisis, as they are deeply tied to the global environmental inequality that most supra-national and national institutions aim to alleviate.

While these findings offer support to the notion that flows of environmental goods and information will benefit less powerful countries in the global economy, they also challenge the hypothesis of EM that all nations will improve in their relationship to the environment, given enough time, as a result of a global process of ecological rationalization. Rather, the findings presented here suggest that, in the majority of nations, time-dependent factors are associated with increases in CO_2 emissions per capita. It is important to note that, as indicated above, the majority of emissions have historically come from nations belonging to the core and the semi-periphery (as can be seen in Table 1), as a result, we should expect that—supposing the trends observed here continue—CO_2 emissions per capita will continue to increase globally. The models presented here focus on changes in per capita emissions, and as a result are subject to being driven by change in the denominator (i.e., change in population). Figure 2 displays the average change in population within each of the world-system categories used in the present study. I note that the general increase in population within each category should lead us to expect a decline in per capita emissions unless total emissions are increasing at a rate that is greater than the rate of increase in population within such nations. These trajectories suggest that the present results are not being driven by a denominator effect.

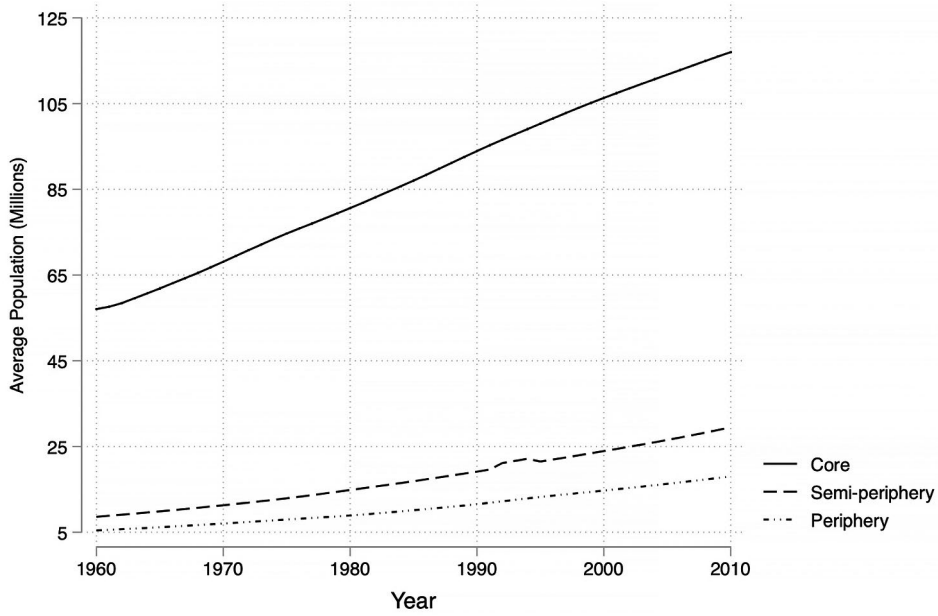

Figure 2: Change in average total population size within world-system strata.

Source: Author's summary of model findings.

Conclusion

This study draws from SHE, neo-Marxian environmental theory, environmental world-systems theory, and EM literature, and uses a hierarchical linear growth curve modeling approach in order to examine the association between social factors associated with environmental impact that change over time, and CO_2 emissions per capita in the world-system. Using such an approach, I examine the debate between EM theorists and environmental world-systems proponents in a novel way. By disaggregating time, and using it as a variable of interest, I gain insight into the contentious issue of the extent to which the aggregate of changes in technological efficiency, policy approaches, and the ecological awareness of producers and consumers, as well as other unmeasured aspects of ecological rationalization, affect emissions at the national level.

Building on work that has found that changes in time modify the relationship between economic activity and emissions, I find that the relationship between time and CO_2 emissions per capita is statistically significant, as well as statistically different across world-systems strata. In particular, the findings here suggest that, in all nations except for those belonging to the periphery, time is positively associated with CO_2 emissions per capita, with the strongest association being in the core of

the world-system. This finding suggests that, outside of the periphery, the process of ecological rationalization is likely not working to reduce the rate of emissions over time, and supports the argument of SHE and environmental world-systems scholars that broader structural changes will likely need to be made to the global economy if we hope to reduce the environmental impact of social processes.

In a broader sense, the findings presented in this study suggest that assumptions that temporal progress in technological change, ecological awareness, and environmentally friendly policies and political regimes, and other aspects of ecological rationality, lead to a gradual decline in the environmental impact of social processes are not necessarily valid, at least insofar as greenhouse gas emissions are concerned. What's more, the findings presented here indicate that the modernist assumption of global economic processes leading to increasing similarities in the way that nations relate to the environment is a questionable one, and that, in fact, nations that belong to different world-systems positions—or have notably different levels of control over their trade network and, thus, their role in the international economy and production chain—have trajectories of growth in CO_2 emissions per capita that are decidedly different from one another. The implication of these findings is that international policy-makers must account for such differences as they attempt to outline pathways to sustainability for all nations. Further, the findings presented above suggest that—at both the national and the international level—policy-makers must take a more active role in ensuring that social structures and processes become more environmentally benign, rather than assuming that socioecologically sustainable societies will roll in on the wheels of inevitability. To that end, the findings of this study point in two broad research directions. First, as mentioned above, disaggregating time allows for the rough approximation of the effect of theoretically relevant, temporally variant social factors on emissions and environmental impact. As a result of this fact, and the approximate nature of the analyses, the findings here should be seen as one part of a larger conversation and not a final word. Further, disaggregation of time will become more effective as a greater number of theoretically relevant variables become more readily available and more reliable. With this fact in mind, it is important that continual efforts are made to more precisely track the effect on CO_2 emissions per capita of those factors that were captured by time in this study. Second, it is important that comparative and qualitative work be done in order to better understand what causes the relationship between time and CO_2 emissions to differ across world-system positions, as well as what interventions might successfully limit these differences.

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Doing Business and Increasing Emissions? An Exploratory Analysis of the Impact of Business Regulation on CO_2 Emissions

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Abstract

Since 2005, the World Bank has released a data set titled *Doing Business: Measuring Business Regulations*. These data have become an important set of indicators of international business climate. However, the impacts of pro-business regulation on the environment have generally been overlooked. To help resolve this problem, I estimate a time-series cross-sectional Prais-Winsten regression model to test the relationship between business climate—represented by the World Bank's *Doing Business* data set—and carbon dioxide (CO_2) emissions in developing nations over 10 years, from 2005 to 2014. The results show that there is a statistically significant and positive association between business climate and CO_2 emissions in developing nations. This shows that pro-business regulations contribute to increasing CO_2 emissions in developing nations, a major driver of global climate change. I suggest that these results are due to business climate encouraging environmental load displacement, which posits that developed nations are partially displacing their environmental impacts onto developing nations.

Keywords: business climate, climate change, environmental load displacement, environmental sociology, political economy

Introduction

Business climate is a term widely employed to denote the economic environment in which businesses operate, predicted by various conditions relevant to the conduct of business, prevailing within a nation, a region, or globally. Business climate is most commonly associated with regulatory or policy conditions, but includes other conditions such as business relationships with labor unions, political attitudes, and

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economic stability. While "business climate" is a popular buzzword, the effects of the application of its principles by the World Bank, governments, and corporations has been under-studied in the social sciences, especially in terms of its environmental impacts. This is surprising, considering how closely tied the concept is to business growth and economic development, as well as the abundance of research detailing how economic growth is a primary human driver of climate change. Despite these connections, the relationship between business climate and the environment is unclear. While some regulations are passed to protect the environment and limit environmentally damaging business practices, others could also make it easier to start and expand businesses by simplifying complex processes. The potential environmental impacts of business climate are important to consider, especially since the creation of a "good business climate" is gaining notice due to the concept's promotion by the World Bank as something that developing nations should prioritize for economic development. The World Bank has encouraged governments to adopt pro-business policies to stimulate economic growth, and this implementation has led to business-friendly practices being codified into law.

In this study, I examine the association between pro-business climate and anthropogenic carbon dioxide (CO_2) emissions, as well as exploring some possible explanations about the nature of this association. I suggest that "good business climate" is one way to facilitate the displacement of the developed world's environmental harms—which stem from production and material consumption—onto the developing world, where the materials for production are extracted, and now increasingly the goods for consumption themselves are produced.

Global governance institutions, such as the World Bank, are changing the way they disseminate normative models of development: no longer through conditions attached to loans, but diffused through economic policy (Babb, 2009; Kentikelenis et al., 2016). Encouraging a pro-business climate is one way to frame the opening-up of countries to international economic markets in the name of economic development. While developing nations who make an effort to create such a business climate are often rewarded with an influx of industry and foreign direct investment, these industries and investments are often those with the most detrimental environmental effects (Jorgenson et al., 2007). Building on the academic literature, I have two broad research questions: given the ways in which regulation has been tied to business interests, what is the relationship between CO_2 emissions and business climate? And how much does an international regulatory environment that is "good for business" influence CO_2 emissions?

To examine these questions, I use the World Bank's *Doing Business* data set—specifically the "Distance to Frontier" measure—which assigns nations a score out of 100 on 10 regulatory attributes that together create a so-called good business climate. I use this score to examine the impact of business climate on CO_2 in developing nations that are classified as middle-income and low-income. I find

that the Distance to Frontier scores are positively associated with CO_2 emissions in the sample of developing nations. This relationship holds, even when controlling for variables such as foreign direct investment and GDP, both of which have been previously established as factors associated with environmental load displacement in general, and growth in carbon emissions in particular. One possible explanation is that the creation of a good business climate is a pathway through which environmental load displacement is occurring; that is, high-income nations are offshoring carbon-intensive industries to those developing nations that are more pro-business.

Literature review

A well-established and growing body of social science literature focuses on the human drivers of climate change (for recent overviews, see Jorgenson et al., 2015; Rosa et al., 2015). In particular, scholars have linked certain types of economic policies, such as deregulation and neoliberalism, to environmental degradation because they contribute to the cycles of resource extraction, production, and consumption (Rudel et al., 2011). Higher levels of economic inequality and unequal distribution of economic power within nations are associated with higher levels of pollution and environmental degradation (Jorgenson et al., 2015). Within this system of inequality, the globalized economy has externalized costs to developing nations, allowing for artificially low prices on consumer goods and material resources in developed nations (Schor, 2005). Developing nations are also under the purview of global institutions such as the World Bank, which have fashioned development into a "project," aiming to integrate all countries into the world economy (McMichael, 2012).

Within this context, business climate is often codified into economic policies (Steinnes, 1984) with the purpose of promoting economic growth (Djankov et al., 2006; Neumark & Muz, 2016). Business climate has also become a matter of interest for the World Bank as a global development institution: it produces annually a measure of business regulatory climate titled *Doing Business*[2] (2017b). This combination of factors suggests that business climate has the potential to act as a pathway for environmental load displacement.

International business climate

In exploring the relationship between businesses, regulation, and the environment, it is essential to distinguish between two different types of regulation: environmental and pro-business policy. Past scholarly research has focused on how explicitly environmental regulation has had impacts on business; either by encouraging innovation, stifling growth, or something in between (for an overview see Ambec

2 This dataset, created in 2005 and published annually, uses 10 subscales, each measuring a different area integral to the creation of a "good business climate," in order to rank 186 nations from best to worst (World Bank 2017b).

et al., 2013). Companies often focus on the costs associated with regulation and make efforts to avoid it. However, some companies view a lack of engagement with environmental concerns as a risk and have instead used climate change or other sustainability concerns as a business opportunity (Tsalis & Nikolaou, 2017).

Environmental protection could arise endogenously from within the business community due to external, non-governmental pressures, which could be adopted into a global business climate. For instance, a study of the effects of globalization on environmental self-regulation in China shows that multinational firms are more likely than domestic firms to self-regulate by adhering to international standards; though this is partially due to the higher regulatory standards in the developed nations where the multinational firms are usually based (Christmann & Taylor, 2001). Markets within a nation or region that are early adopters of innovations, often in the form of technology or practice, are known as "lead markets." These markets have the potential to act as an avenue for environmental protections when the new technologies or practices adopted are eco-friendly and sustainable: examples include companies that transition to wind energy use or produce eco-friendly technologies such as fuel-efficient vehicles (Beise & Rennings, 2005). However, the diffusion of environmental protections through lead markets often depends on government interventions and regulations to protect the markets themselves (Beise & Rennings, 2005). These aspects of business climate have the potential to help protect rather than harm the environment.

Indicators of good business climate are often focused on low tax rates and reduced business costs, with the expectation that an influx of businesses drawn by favorable indicators will lead to economic growth (Steinnes, 1984; Neumark & Muz, 2016). However, a study in the United States indicates that business climate measures focused on low costs and taxes are positively associated with inequality (Neumark & Muz, 2016). This suggests that, despite the potential for economic growth, pro-business climate can have unintended, negative consequences for social and ecological sustainability.

The role of the World Bank

As a development agency, the World Bank has the ability to influence global norms: environmental policy reforms are often diffused from global institutions who exert top-down pressure on nations to adopt legislation (Longhofer et al., 2016). Traditionally, the World Bank has used its ability to limit access to promised resources, in the form of loans, to force countries to adopt specified policies (Babb & Chorev, 2016). However, the use of conditionalities has been critiqued, causing international financial institutions to find new methods of encouraging the adoption of such policies (Kentikelenis et al., 2016).

The creation of the *Doing Business* data set is one such way to create knowledge that is viewed as credible by policy-makers, and then used to inform policy decisions (Broome et al., 2017). Through the *Doing Business* data set, the World Bank is attempting to measure a part of the policy climate that is theorized to be essential for economic progress: business regulation (Besley, 2015). This provides incentives for countries to establish policies that align with the specified practices and accept the resulting data sets, such as *Doing Business*, as measures of their success. Furthermore, the World Bank has published studies which boast that the economies of those countries with "better" business regulations (as defined in the *Doing Business* data set) have faster economic growth (Djankov et al., 2006). The connections made between business climate and economic growth suggest possible mechanisms by which business climate could impact the environment.

Environmental load displacement

The ecological unequal exchange perspective emphasizes that inequality among nations engaging in the global economy results in the offshoring of environmental damages from wealthier to poorer countries (Bunker, 1984; Hornborg, 2009). The impacts of industrialization are not spread evenly across developed and developing nations relative to their use of resources (Jorgenson, 2004). Wealthier nations are able to outsource the environmental impacts of their consumption levels to poorer nations, where the extraction of resources for and minor production of consumer goods takes place (Jorgenson, 2006). Wealthier nations are also offshoring hazardous waste from domestic industries, as well as the hazardous industries themselves (Frey, 1994). Environmental load displacement is a core concept within ecologically unequal exchange theory. It describes a process by which pollution and other human-driven forms of environmental degradation are outsourced from developed nations to less developed nations (Jorgenson, 2016). There are multiple pathways through which environmental load displacement can occur: the literature addressing ecological unequal exchange has primarily focused on foreign direct investment and trade networks as facilitators of this sort of outsourcing of environmental harms (e.g., Grimes & Kentor, 2003; Muradian et al., 2002; Jorgenson, 2006; Rice, 2007; Hornborg, 2009; Bonds & Downey, 2012; Huang, 2018).

Even green initiatives, such as environmentally beneficial technologies, can act as a pathway through which environmental load displacement occurs: the resources needed to produce these technologies involve destructive extraction practices, subsidizing the lifestyles of the developed world with environmental degradation in the developing world (Bonds & Downey, 2012). However, nations pursuing the improvement of their business climate often end up experiencing environmental degradation with limited evidence to show that any economic development has occurred as a result of improved business climate. The studies that show that there is a positive relationship between business climate and economic growth often come from the creators of the *Doing Business* data set themselves (e.g., Djankov et al., 2006).

However, given that environmental load displacement not only paints a false picture of "sustainability" in developed nations but also adds to the many issues facing developing nations as they try to improve quality of life (Muradian et al., 2002; Muradian & Martinez-Alier, 2001), it is important to consider additional ways in which the displacement of carbon emissions and other forms of pollution and degradation are occurring. Business climate has been discussed within the literature on ecological unequal exchange as a facilitator of foreign direct investment, which has a positive association with carbon emissions and deforestation (Shandra, 2007; Jorgenson, 2007, 2009). Foreign direct investment channeled into manufacturing sectors in developing nations has resulted in inefficient production due to older machinery and lack of protective regulations, leading to higher levels of pollution, and contributes to the outsourcing of emissions from production (Jorgenson, 2009). Deforestation rates often increase in repressive nations, for whom it is relatively easy to enact the kinds of sweeping regulatory reforms—such as deregulation (or non-regulation) of land use—necessary to create a "good" business climate and attract foreign investment (Shandra, 2007).

Environmental load displacement allows developed nations to artificially reduce the full impact of their consumption levels by outsourcing production to developing nations. As a signifier that a nation is "open for business," I propose that business climate is acting as a pathway encouraging environmental load displacement, leading to increased emissions in developing nations. To explore this, in the analysis below I test the hypothesis that production-based anthropogenic CO_2 emissions and business climate are positively associated in developing nations.

Methods

I estimate a time-series cross-sectional Prais-Winsten regression model with panel-corrected standard errors (PCSE), a correction for AR(1) disturbances, and two-way fixed effects to test my hypotheses. PCSE allow for disturbances that are heteroskedastic and contemporaneously correlated across panels, which corrects for understating the actual variability of coefficients. I have included country- and year-specific intercepts to control for country- and year-specific effects, which corresponds to a two-way fixed-effects model. All of the variables are logged using log base 10 in order to correct for skewness and to allow the results to be interpreted as elasticity coefficients, where the coefficient for the independent variable is interpreted as the percentage change in the dependent variable associated with a 1% increase in the independent variable.

Data

All data were collected from the World Bank, both from the World Development Indicators and *Doing Business* data sets, and span the period of 10 years from 2005 to 2014. I restricted my sample to developing nations by using data on national income level from the World Bank. I excluded those nations categorized as high-income; those with a 2016 gross national income per capita above $12,235 in current US dollars (World Bank, 2017c). Studying developing nations is a common restriction for researchers when focusing on the impacts of the World Bank's activities, as most of the Bank's efforts are geared toward these nations (e.g., Grimes & Kentor, 2003; Jorgenson, 2007, 2009; Shandra, 2007). The resulting sample includes 104 nations. All nations included in the sample are listed in Table 1.

Table 1: Nations in analysis.

Afghanistan	Costa Rica	Lesotho	Senegal
Albania	Dominican Rep.	Liberia	Serbia
Argentina	Ecuador	Macedonia, FYR	Seychelles
Armenia	Egypt, Arab Rep.	Malawi	Sierra Leone
Azerbaijan	El Salvador	Malaysia	South Africa
Bangladesh	Ethiopia	Mauritania	Sri Lanka
Belarus	Fiji	Mauritius	Suriname
Belize	Gabon	Mexico	Swaziland
Benin	The Gambia	Moldova	Tajikistan
Bhutan	Georgia	Mongolia	Tanzania
Bolivia	Ghana	Montenegro	Thailand
Bosnia & Herzegovina	Guatemala	Morocco	Timor-Leste
Botswana	Guinea	Mozambique	Togo
Brazil	Guyana	Namibia	Tonga
Bulgaria	Honduras	Nepal	Tunisia
Burkina Faso	India	Nicaragua	Turkey
Burundi	Indonesia	Nigeria	Uganda
Cambodia	Iran, Islamic Rep.	Pakistan	Ukraine
Cameroon	Jamaica	Palau	Uruguay
Central African Republic	Jordan	Panama	Vanuatu
Chad	Kazakhstan	Paraguay	Venezuela, RB
Chile	Kenya	Peru	Vietnam
China	Kyrgyz Rep.	Philippines	West Bank and Gaza
Colombia	Lao, PDR	Romania	Yemen, Rep.
Congo, Dem. Rep.	Latvia	Russian Federation	Zambia
Congo, Rep.	Lebanon	Rwanda	Zimbabwe

Notes: PDR = People's Democratic Republic; FYR = Former Yugoslav Republic; RB = Bolivian Republic.
Source: Author's selection of countries from *Doing Business* data set (World Bank, 2017b).

Independent variable

My independent variable, "Distance to Frontier," is an index compiled by the World Bank in their data set *Doing Business*. The World Bank describes this variable as "scoring economies based on how business-friendly their regulatory systems are" (2017b). The variable name refers to the scale used: a score of 100 on a particular subscale represents the "frontier" (of the Distance to Frontier index), defined by the best performance by a country on that particular subscale since the start of data collection (World Bank, 2017b). The Distance to Frontier index is compiled using scores on 10 subscales: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency. In order to assign scores, the World Bank surveys business owners and related experts in the largest city of each country included in the sample to ascertain the regulatory ease (or difficulty) of starting a business, focusing on the domestic and formal sectors (2017b). Other kinds of regulations that could impact businesses—such as environmental regulations—were not included in the World Bank's measure.

While the World Bank focuses on regulations, these are not measured in terms of a lack or overabundance, but rather in terms of their perceived efficiency. The World Bank maintains that "rules" that enhance the protection of businesses as well as clarify and increase "the predictability of economic interactions" are essential to promoting economic activity (2017b, p. 13). Thus, the resulting Distance to Frontier index is designed to measure a distinctly pro-business regulatory climate, rather than equating a lack of regulatory oversight of the economy with pro-business policy. To this end, these data are gathered using surveys given to business experts in the largest city of each nation included in the sample. The surveys are constructed using case studies involving hypothetical businesses. For example, one of the measures used to compile the "starting a business" variable is how many days it would take to obtain the necessary permits to start a business (World Bank, 2017b).

The *Doing Business* data set was first released in 2005, but the World Bank did not begin creating a compiled score until 2010. In order for my analysis to cover the longest period possible, I created an indexed score based on the five subscales for which data are available starting in 2005: starting a business, registering property, getting credit, enforcing contracts, and resolving insolvency. To create my compiled Distance to Frontier score, I weighted each of the five subscales equally by dividing each score by 0.2 before adding them together. This resulted in a compiled score out of 100 for each of the 10 years. This score is highly correlated (0.912) with the World Bank's indexed score for 2010–17, and has a Cronbach's Alpha of 0.77, which is above the cutoff of 0.7 for indicating a good fit. The high correlation of

the World Bank's index and my calculated index further suggests that the additional measures included in recent years have not substantively changed the overall business climate scores of each country. Because this increased time frame allows me to use longitudinal fixed-effects modeling techniques, this final indexed score for 2005–14 serves as the primary independent variable. The map in Figure 1 gives a general sense of which countries experienced the greatest change in their Distance to Frontier score over time.[3]

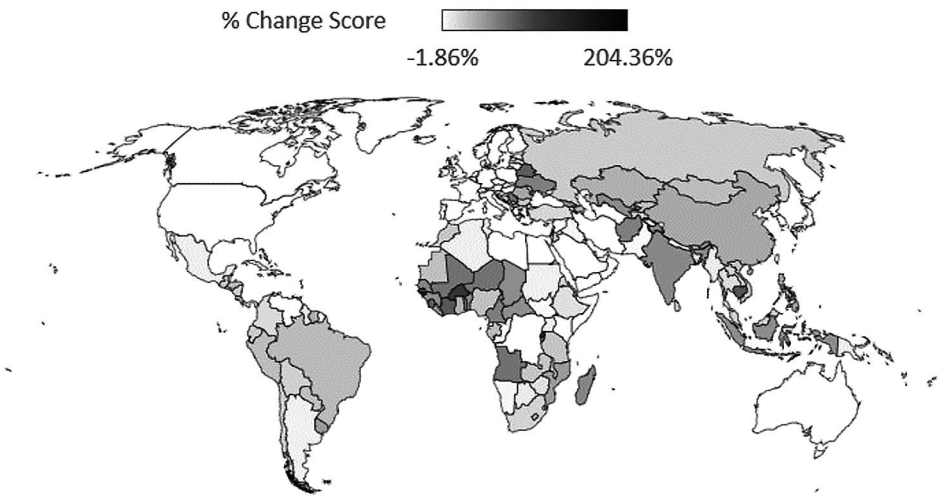

Figure 1: Distance to Frontier percent changes scores, 2005–14.

* all countries: countries without data are in white.

Source: Author's representation, derived from *Doing Business* data set (World Bank, 2017b).

Timor-Leste has the lowest Distance to Frontier score overall, but it is also the nation which experienced the greatest increase in its score over 10 years, with a 204% increase from a score of 6 to 18. The average increase is 31%, exemplified by Bosnia and Herzegovina, whose score was raised about 15 points over the 10 years, from 47 to 62. While the majority of nations in the sample increased their scores over the decade in question, some nations experienced a decrease—although the changes were minimal. For example, Kenya's score dropped from 55 to 54, a 1.86% decrease.

3 A complete list of the Distance to Frontier and change scores for each of the 104 nations in the sample is available from the author upon request.

Dependent variable

The dependent variable is total annual CO_2 emissions from the burning of fossil fuels and the production of cement in kilotons, and was collected from the World Bank's World Development Indicators. The measure does not include CO_2 emissions from land use changes and industrial processes other than those already mentioned (World Bank, 2017a). CO_2 emissions are often used as a proxy for overall environmental emissions, as they are among the worst offenders in contributing to climate change because they account for the largest share of greenhouse gases (World Bank, 2017a). CO_2 is also emitted as a byproduct of material production from a variety of economic sectors, making it a more comprehensive indicator of overall environmental impact than other types of emissions. Therefore, it is a popular choice for a dependent variable in cross-national studies of emissions (e.g., Grimes & Kentor, 2003; Jorgenson et al., 2015; Jorgenson & Clark, 2012; Longhofer & Jorgenson, 2017; Huang, 2018). Additionally, CO_2 emissions impact a global commons; the effects are not localized, as could be the case with other environmental indicators.

Control variables

The control variables include GDP per capita, manufacturing and exports as a percentage of GDP, population total, capital formation, and urban percentage of the population—all collected from the World Bank's Development Indicators data set, as well as foreign direct investment which was collected from the United Nations Conference on Trade and Development database (UNCTAD, 2017). GDP per capita is in constant 2010 US dollars and is used to control for economic development. Studies have shown that GDP has a strong positive association with CO_2 emissions. Manufacturing (value added) as a percentage of GDP is used to control for differences in economic structure. Exports of goods and services as a percentage of GDP is included to control for integration into the international economy. Population growth has consistently been found to be an important driver of environmental stress. Foreign direct investment is measured in terms of inward stocks as a percentage of GDP and is used to control a well-researched pathway for environmental load displacement. Capital formation is measured as a percentage of GDP and is used to control for domestic investment. Finally, the urban percentage of the total population is used to control for urbanization. These variables are all standard controls used in cross-national research on environmental outcomes (e.g., Shandra, 2007; Jorgenson, 2007; Jorgenson & Clark, 2012; Shandra et al., 2011; Huang, 2018). Table 2 provides descriptive statistics and correlations for all variables in the model.

Table 2: Descriptive statistics and correlations.

Variables	Mean	Std. Dev.	1	2	3	4	5	6	7	8
1. Population	16.08	1.87	1	–	–	–	–	–	–	–
2. GDP per capita	7.79	1.09	–0.16	1	–	–	–	–	–	–
3. Urban population	3.81	0.48	–0.04	0.74	1	–	–	–	–	–
4. Exports % of GDP	3.47	0.53	–0.33	0.42	0.36	1	–	–	–	–
5. Manufacturing % of GDP	2.41	0.67	0.40	0.22	0.16	0.06	1	–	–	–
6. Distance to Frontier	3.91	0.30	0.02	0.55	0.33	0.31	0.31	1	–	–
7. FDI stocks, inflows	3.27	0.98	–0.35	0.33	0.41	0.55	–0.08	0.35	1	–
8. Capital formation	3.19	0.44	–0.07	0.26	0.17	0.22	0.13	0.28	0.11	1
9. CO_2 (kt)	9.25	2.28	0.77	0.44	0.42	0.02	0.52	0.38	-0.07	0.12

Notes: 977 observations. All variables have been logged. FDI = Foreign direct investment.
Source: Author's summary.

Results

Table 3 reports the findings. The results of the analysis for the independent variable, Distance to Frontier, indicates that CO_2 emissions and business regulation have a statistically significant ($p<0.001$) and positive relationship. For a 1% increase in a nation's Distance to Frontier score, there is a 0.151% increase in CO_2 emissions, net of all other factors in the model. These results suggest that over the 10 years from 2005 to 2014, higher Distance to Frontier scores are associated with increasing CO_2 emissions. The effects of population, GDP per capita, urbanization, and foreign direct investment are all positive and statistically significant, which is expected given the findings of previous research. However, the effects of exports, manufacturing, and capital formation are not statistically significant. Overall, the results support my hypothesis: CO_2 emissions and business climate are positively correlated.[4]

4 Unreported analysis of high-income nations had null results: the results did not indicate a statistically significant relationship between business climate and CO_2 emissions in high-income nations.

Table 3: Elasticity coefficients for the regression of CO_2 emissions, 2005–14: Prais-Winsten regression with panel-corrected standard errors (PCSE) and AR(1) correction.

	Model 1 logged coefficient (PCSE)
Distance to Frontier	0.15 (0.04)***
Population	1.97 (0.15)***
GDP per capita	0.74 (0.11)***
Urbanization	0.58 (0.04)***
Exports	–0.02 (0.03)
Manufacturing	–0.01 (0.02)
Foreign direct investment	0.06 (0.01)***
Capital formation	0.01 (0.03)
R-square	0.996
n (observations)	977
# of nations	103
Observations per nation (min/avg/max)	3/9.5/10
Rho	0.412

Note: * p<0.05 ** p<0.01 *** p<0.001. Variable names are italicized.

Source: Author's summary of analysis findings.

Discussion and conclusion

The simplified regulations promoted by the *Doing Business* version of "good business climate" (Dixit, 2009) have made it easier for many environmentally damaging industries to move to developing nations. Ecological unequal exchange theory emphasizes that this inequality is inherent in the relationship between developed and developing nations. The relationship between business climate and CO_2 emissions in developing nations exists because environmentally damaging industries have mostly been outsourced from developed nations—thus resulting in the observed positive relationship between business climate and CO_2 emissions in developing countries.

Low wages and cheap materials are two incentives for outsourcing (Grimes & Kentor, 2003; Muradian et al., 2002), but business climate has added regulatory incentives as well. The 10 subscales[5] all focus on regulatory aspects of starting and running a business and those who rank well often have simplified processes

5 As a reminder: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency.

allowing for quick turnaround through a streamlined bureaucracy. Simplified and standardized business practices are the frontier against which the *Doing Business* data set is measuring nations. The ease of starting a business, however, also applies to the ease of outsourcing one. Additionally, it is possible that developing nations with "good" business climates also lack environmental regulations: this possible relationship merits further study.

World Bank data sets have international influence, often dictating norms and standards; whatever standard the World Bank uses to measure business climate is codified as "good" or "bad" business climate. This influence is seen in nations' responses to the rankings: leaders in nations such as Russia and India have made it a matter of economic policy to try and improve their nations' rankings (World Bank, 2017b). Measuring business climate is intended to measure economic progress by putting a spotlight on specific policies (Besley, 2015), but rather than creating an impartial variable, this measurement of business climate becomes part of an ideological debate itself. The World Bank has tried to greenwash its image after many critiques of its disregard for the environment (Babb, 2009), such as the relationship between its lending programs and multiple forms of ecological degradation (Shandra et al., 2011). However, there is little evidence that the World Bank has considered the environmental impacts of the regulations supported by its data sets; the *Doing Business* report does not mention the natural environment, though it does mention the inauguration or dissolution of environmental laws (often in the form of taxes) in a section detailing changes in business climate since the 2017 report.

Underlying the World Bank's construction of "ease of doing business" are assumptions about development that have potentially damaging repercussions for the environment. Ideally, economic growth could be accompanied by environmental protections and incentives for "green" innovation, but in reality it is often accompanied by carbon-intensive industrialization. Not only are developing nations the ones that are most encouraged to pursue economic growth as a path to development, but they are also the nations that usually experience the most harmful effects of environmental degradation, including climate change (Roberts & Parks, 2007). This is especially problematic for the future development of these nations: the standard of living achieved by high-income nations has been subsidized by outsourcing ecologically harmful industries (Schor, 2015).

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Creating "People's Park": Toward a Redefinition of Urban Space

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Abstract

This study examines the development of an urban space, from a vacant lot to a usable public space as a public park, in order to analyze how the transformation of space affects meaning for the surrounding community. I ask: In what ways does this transformation empower individuals to take advantage of subsequent reuse opportunities? Does the process by which the change takes place influence subsequent community engagement opportunities? I argue that *how* the spatial transformation is organized influences the potential environmental and social justice opportunities that can be created for community members, and thus its impact on the community dynamic of the defined space. For this analysis, I examine how the transformation of space affects human social interaction in a community which, historically, has been racially and economically marginalized. The development of the space was spurred by organizers who felt a public "pocket park" would add value to the community, as well as provide a space for social interaction to take place between community residents. Implemented with little engagement from community residents, I document the transformation of this space—and the positive and negative consequences of the transformation for residents—using participant observation, in-depth interviewing, and content analysis.

Keywords: community gardens, qualitative methods, semiotics, urban space

Introduction

> Change life! Change society! These ideas lose completely their meaning without producing an appropriate space. (Lefebvre, 1991, p. 54)

This research explores the transformation of an urban space from an unused public parcel to a usable community park and garden, adding to a growing literature on community gardens and transformative urban spaces. I explore how the process of transforming a vacant urban lot to a community garden impacts the use and the

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meaning of space for the surrounding neighborhood and its residents. Exploring the model of social change developed here, I ask: Does the mechanism for change impact the subsequent use of the space? Does how the spatial transformation occurred impact whether gardens become tools for social change in urban communities?

Methodologically, I reference Buffalo specifically as the place of study, for its patterns of racial and economic division that have led to current social and environmental justice concerns (Berube, 2016; Rey & Lakamp, 2011). Through qualitative analyses documenting the transformation of a public space in Buffalo, New York, I argue that once an urban space has transformed, opportunities for cultural and environmental empowerment become available to community members that alter their relationship with that environment. This is evident in other studies of gardens developed with grassroots principles guiding the change process. However, if these grassroots principles are not employed, can the same results be achieved? Employing an environmental justice framework, I suggest that by interacting in the transformed space, individuals can empower community action. Applying an environmental justice perspective in this case is particularly relevant for understanding how sociocultural conditions such as food security are influenced by the lack of accessible fresh produce which are characteristic of cities such as Buffalo.

In order to address this and other issues that arise with lack of accessible green space in urban communities, the park was conceived and developed, but was missing key components usually necessary for successful community spaces. Without a grassroots initiative from the community, park organizers created the park and implemented programs without being mindful of community sentiment. The original top-down approach was met with suspicion, lack of understanding, and confusion over park access. Organizers sought to correct this by becoming mindful of the necessity of community engagement, and with this engagement, met with success over time. By employing a grassroots model of public engagement, organizers collaborated with community residents to support the park in the ways that community members wanted, such as reading circles and accessible garden growing beds. The success of these was due to a specific intent to engage community participants that was not present at the development and inception of the park.

First, I will address the theoretical background and existing literature surrounding the phenomenon of community-driven urban greening transformations. Following this, I include a discussion of political economy of such spatial transformation and connections to the environmental justice framework. I then address the methodology and study background, followed by discussion and conclusions.

Community gardens and social benefit

Human ecological perspectives focus on the relationships between social structures, human agency, and the natural environment. Traditionally, the human exceptionalist paradigm (HEP) and contrasting new environmental paradigm (NEP) offer the development of these conflicting perspectives as a defining moment in the development of environmental sociology; as environmental sociologists call for a shift from a relationship over nature to one within nature—or away from the HEP and toward the NEP (Catton & Dunlap, 1978). Within this shift, research has shown that community gardens offer positive additions to the urban landscape (Beilin & Hunter, 2011; Eizenberg, 2012; Shinew et al., 2004). For instance, community gardens offer individuals places to interact and engage with nature and each other. Yet urban environments, which by their nature are built spaces, often have few authentic green spaces available for relationships and exploration such as engagement with nature, environmental education and recreation, and social gatherings. However, "pocket parks" (sometimes called "vestibule parks") and gardens, defined as small green spaces embedded in, but not separate from, the urban landscape, offer small spaces of solace amidst the busy city streets with profound impact, although these are not always considered community gardens (Shinew et al., 2004). In fact, researchers have demonstrated the positive impact of community gardening on several quality-of-life variables. For instance, collaborative gardening has been found, at an interpersonal level, to increase positivity in race relations and promote greater cultural diversity understanding among community members (Firth et al., 2011). Drawing again on human ecology, Rishbeth (2004) notes that the visual design of spaces changed by community gardens is very important in fostering (or, where poorly executed, limiting) interpersonal relationships between ethnically diverse groups who use community gardens. She finds that these spaces, when well-designed, support social interaction between those who may not otherwise have opportunities to interact with each other. Rishbeth concludes that the biological and physical structure of the natural world does affect our responses and ability to make social decisions about a space.

Moreover, the addition of pocket gardens in city spaces is found to increase levels of food knowledge and education among community residents, as well as to increase community efforts toward sustainable and local food production systems. Empowering individuals to grow their own food becomes a vital and beneficial outcome of gardening efforts where access to healthy, seasonal produce is limited.

Furthermore, community gardens are focal points for collective action of social activists; they have been identified as political spaces for empowerment. Infamous battles over the use of public space for gardening in Berkeley, Los Angeles, and in New York City have shown how public space comes to represent a larger political meaning that includes eminent domain and the right to use public space for the

greater good (Eizenberg, 2012; Rosenthal, 2002). Images of bulldozers destroying gardens unite prospective activists to come together for a common cause. Taken together, much literature has focused on community gardening as a way to increase social capital, a space for researchers to study and locate effects of leisure activity in a community, and as an incentive to attract economic investment in the community which may increase economic gains in areas such as real estate and decrease poverty (Hanna & Oh, 2000; Holland, 2004; Moore, 2005; Putnam, 2000). However, less research has been conducted to examine efforts of residents to construct meaning about the process of transforming space when incorporating community gardens in their urban neighborhoods. The scholarship of semiotics lends itself to understanding how space is constructed, and how this approach is useful for analyzing meaning-making among community members.

Constructing the meaning of urban space

Semiotics allows us to understand that space symbolizes meaning for people. It does so by providing the tools to analyze how we recognize images as meaningful in our daily lives. Transformation of urban space is interesting at many levels. When considering how meaning is embedded in images of physical space, community space is redefined. This can entail defining a community as a place where individuals interact, as well as an idea of togetherness shared among individuals occupying a shared space. Sociologists have long been interested in this process as developed within the symbolic interactionist perspective and the work of cultural theorists. Gottdiener (1994) recalls the importance of Lefebvre's initial conception of "social space," in which everyday activities take place and meanings are socially produced.

It is this sphere of social space, constrained by realities of the natural world, in which I locate this analysis. The acknowledgment that social space is a powerful variable, which can influence how everyday activities take place, is vital for understanding both the importance of the social construction of space and how individuals attribute meaning to different spaces. Lefebvre (1991) used the notion of social uses of space to direct the development of exchange value based on market relations over a given space. In addition, the social construction of spatial meaning flows from how a space is used and whether it has a collective meaning. In community development, the space assumes a new meaning with each different use, as does the exchange value for those who engage in it. This is evident when analyzing why the transformation is taking place and whether new meanings can be derived from the space. Thus, if claims are made about the social meaning of a space, but the space fails to meet that expectation, the space cannot succeed in meeting the needs of its supposed role (Lefebvre, 1991) as defined by those actors engaging in the transformative process.

Communities, then, are constructions that create meaning for individuals who participate within these social structures. Spaces, then, can be transformed to meet community needs. Suttles (1972) argues that urban models become self-fulfilling prophecies for urban distributions of opportunities. Groups become structures within an urban context, whose existence and character depend on their relationship to a wider society (Suttles, 1972). Tranel and Handlin (2006) offer evidence that community gardens address specific structural problems of urban revitalization. For example, gardening efforts produce positive, long-lasting, structural improvements for the local community, from crime reduction to increased occupancy rates.

Political economy of urban space

Castells (1983), Harvey (1989), Gottdiener (1994), and other urbanists have argued that political, economic, and structural considerations of space become vitally important to consider when analyzing social identity struggles. How the meaning of space is contested and framed by different groups often determines how a space will be used and what type of interactions will take place in a given area; whether reinforcing or resisting its existing social characteristics. Current political and economic realities consequently affect the defined usefulness of a space both by and for those engaging in and defining it. Abu-Lughod (1994) details these political economic considerations in her work documenting the battle for the New York's Lower East Side. She analyzes the residents' claims to their land, their space, and the identity of their neighborhoods and community. This redefinition of space is evident in the struggle that residents and developers engaged in—each staking claim to the space, but in different ways. The meaning of urban space was hence transformed by adjusting the emphasis on social capital as the Lower East Side became redefined for its current and future residents.

Schmelzkopf (1995) documents that New York's Lower East Side provided a site of contestation as residents fought city government for the right to garden versus the city's plan to build more housing units. After the city initially encouraged and supported the rise of community gardens in the area, the city reneged on its agreement when it became more economically advantageous to replace gardens with high-rise, luxury housing stock. The argument was framed as either houses or gardens, but activists were able to reframe the controversy to argue that gardens and housing could coexist. Smith and Kurtz (2003) draw on Cox's (1998) argument that spaces of engagement provide a context in which to examine urban political struggles. In this context, they argue that community garden contests in New York City become political struggles that extend beyond the physical gardening space and come to represent struggles over personal and property rights.

Subsequently, Mele (2000) argues that individuals create their own territories within public spaces. Following Habermas (1984), these democratic spheres shape one's norms of the social lifeworld (theoretical space in which Habermas argues social interaction occurs) and the form of discourse that transpires. These spaces become useful to those individuals in ways that others may not recognize. In essence, individuals will create their own meaning about a given space.

As Rosenthal (2002) explains, New York University students expanded on this controversy dramaturgically by creating a play portraying the events. Theater was used to interpret the urban landscape in a culturally new way. For community garden organizers, these spaces were created to foster community relations, beautify the urban landscape, and create a sustainable environment full of food and botanicals. These spaces continue to dot the urban landscape. Community gardens located in areas of abandoned and derelict industrial land offer a sense of hope and growth for a community located in these neglected urban landscapes.

Community gardens as environmental justice initiatives

Gardens offer opportunities to interact, learn, and understand the natural environment, while offering a space to gather and socialize with others. Traditionally, environmental justice frameworks have been applied to communities battling contamination, workplace hazards, and battles for open green space (Bullard, 1993). Capek (1993) broadens the understanding of environmental justice frames by offering a way to apply them to different situations. In doing so, she argues that "the environmental justice frame is built around a concept of rights constructed in part by the actions and rhetoric of previous social movements" (Capek, 1993, p. 8). Central to this argument is the idea that every individual, regardless of race or class, deserves a clean and healthy environment in which to live. The environmental justice framework has been extended to include groups who advocate for health care and healthy environments, including increasing available green space and recreational opportunities. Community gardens offer a component of a "healthy space" framework.

The transformative potential that community gardens have is a powerful benefit for communities. Grassroots initiatives that flow from these experiences are often likely to address environmental justice and other areas of inequality (Bowen et al., 1995; Ferris et al., 2001). Community gardens have also been used as spaces to encourage environmental justice practices that demonstrate food sovereignty (Alkon & Mares, 2012). Empowerment activities such as community ownership of garden plots and growing and harvesting one's own food are both opportunities to engage in alternative forms of political economy for individuals traditionally marginalized

from such practices. Both symbolically and practically, gardens provide community space for individuals to interact and work together where they otherwise might not. Engaging in community gardening activity is often an indicator of civic engagement in the community at large. This is a supported context for social and political engagement (Glover et al., 2005). Hence, community gardens are "wedges" into the neighborhood (Knack, 1994) for such engagement, and can function as a way to foster empowerment and social action among individuals.

Often when a space is framed within an environmental justice initiative, the neighborhood assumes that identity. As Martin (2003, p. 731) asserts, "[such] framings empower a neighborhood-based political community" within the physical landscape. The environmental justice framework ties individual and community identity to a claim over usable space—trying to reclaim identity with space and the area in which individuals live.

Research design

This analysis examines the transformation of an urban space to a community garden and the construction of meaning of space among community residents in Buffalo, New York, from 2005 until 2011. Initial exploration for this research project began in January 2005 (although early inception of the park began in 2004), stemming from my intrigue over a billboard advertising urban space as the "Future Site of People's Park," to the park grand opening in 2008, and subsequent seasons and summers of various community activities hosted at the park (see Figure 1 and Figure 2). Through conversations with local community members and environmental activists in the area, I came in contact with park organizers and was able to witness this transformation. These interactions facilitated my data collection in the urban neighborhood experiencing this transformation of space.

Figure 1: People's Park future site.
Source: Author's photographs.

The community in which "People's Park" was developed has about 3,000 residents, of which 87% are African-American. At the time of the first ideas of park inception (2004), drawing on Census 2000 data, the average annual income was US$23,000. Of the total families living in this immediate community, 24% were considered to be living below the poverty line in 2000, with a 31.2% poverty rate in 2010. Of these residents, 49% owned and 51% rented their residences (US Census Bureau, 2000, 2010). This neighborhood is still zoned for mixed use, including residential, light industry, and commercial uses. It is notable to mention that there has been no notable change in Census figures from 2005 to the time of this publication.

People's Park received a celebratory grand opening in May 2008, yet as park development began in 2005, I was able to document the transformation of this urban space firsthand from its beginnings. Initially, I documented formal and informal conversations and committee meetings, and conducted interviews with community residents and those involved in the steering committee overseeing park programming, fundraising, and development. Individuals comprising the steering committee for the park were involved with community life in block clubs,[2] crime prevention groups, and/or simply living in the neighborhood. Convenience sampling of individuals yielded 25 participants. Specifically, formal interview participants were recruited from the steering committee (n=6), convenience sampling from those who use the park (n=15), and convenience sampling from members of local block clubs who were not active park users (n=4). Of these respondents, 8 identified as Caucasian and 17 identified as African-American; 19 were from the immediate geographic area, and 6 were not, but lived within 10 miles of the park. Interviews were then transcribed and analyzed. I conducted participant observation by being present in the park for everyday use, as well as attending special events in the park. These observations. as well as the informal conversations with park users, conducted through ongoing participant observations, were part of the data collection and thematic analysis as well.

As part of data collection efforts, two undergraduate students, trained in qualitative methods, assisted with observations. The two students also carried out participant observation methods as participant observers (in-depth field notes, informal interviews, and observation) throughout the summers of 2008 and 2009. They observed the park throughout the daytime hours (from 9:00 a.m. to early evening) for an average of 15 to 20 hours per week. The detailed notes of these observations, as well as my own observations (ongoing through 2018), in-depth interviews, photographs, and architectural plans of People's Park provided the context for the thematic analysis of the park.

2 Block clubs are popular neighborhood organizations in the United States. Such organizations include officers, such as president, vice president, treasurer, and secretary, and generally focus on neighborhood crime prevention (i.e., neighborhood watch), as well as beautification projects. In Buffalo, block clubs must formally register with the Board of Block Clubs of Buffalo and Erie County.

Through this thematic and document analysis, I highlight the importance of the space's original context, its size and location, and the work to transform the space through park programming for community members. Additionally, I include a historical analysis to frame the foundation of the space's transformative process. These components of the space and efforts to transform the space empowered local residents to act as agents of social change through this form of building community.

The making of People's Park

Members of local community groups, led by a local businessman, began discussions to create a park in Buffalo in late 2004. The proposed space for the park was a former gas station connected to an automobile parts store located in Buffalo's Masten District. Historically, this district has been and still is was one of the most impoverished neighborhoods in the city. In 2004, 36% of the population was earning an income beneath the poverty line, and the area hosted a 21% housing vacancy rate (Buffalo Urban Renewal Agency, 2004). Although usually referred to as the East Side of Buffalo, or "east of Main Street," the Masten District actually encompasses the central portion of the city. Colloquially, East Side continues to refer to communities characterized by high rates of crime and poverty (McNeil, 2009, 2018).

Revitalization of this area has been evident in recent years in the numerous endeavors that serve to support small businesses, repair roads, and invest in community infrastructure in parks and schools. The location for People's Park was intended to extend these efforts by providing much-needed green space—current census maps reveal that less than 1% of Buffalo's land use is dedicated green space. Gardens have played an important role in communities, whether addressing food scarcity or neighborhood beautification. Introduced as models for growing sustainable sources of produce and food, community gardens provide nourishment in times of need, such as with "victory gardens" following World War I (Hanna & Oh, 2000). More recently, community gardens have been growing in popularity in urban areas as a way to reclaim vacant urban space. The construction of these spaces as viable gardens offers a sense of revitalization for areas that have been virtually ignored as locally unwanted land use, as was the case with the gas station set to be transformed into People's Park. Moreover, community gardens offer a sense of pride in one's community space as well as an incentive to invest in one's local space. The community garden efforts in many rust belt cities, such as Buffalo and Detroit, have expanded, reclaiming community space from vacant, polluted, crime-ridden lots as spaces that offer a sense of empowerment, hope, and redevelopment for local residents (White, 2011). People's Park is an example of one such community revitalization project.

Early conversations to develop the park involved a local architect specializing in green design techniques who would eventually be responsible for the design and architecture of the park. The People's Park Steering Committee was formed as the group of individuals responsible for fundraising, publicity, and landscape design. The funds for this project came from a local business owner who created the nonprofit organization, MAKEDA Inc., to oversee the park's development. MAKEDA become the organization of ownership on record, receiving further support for brownfield remediation of the former gas station from New York State's Brownfield Cleanup and Reclamation program and maintaining liability for injury as the property owner. And, even with the private funding support of MAKEDA, steering committee members were responsible for raising matching funds to support the park project. With three years of effort and community support, People's Park was born.

The naming of the Park was intentional and significant for shaping meaning for the space and initially created controversy among organizers. Although People's Park in Buffalo was formed free from struggle with local political entities, historically, the name "People's Park" refers to the Berkeley, California, park and gardens created in 1969, as an initiative of the New Left and Free Speech Movement to beautify a neighborhood after the removal of low-income housing projects. Individuals came together to clean, plant, and beautify the now vacant space, transforming it from an unused and abandoned space to a community park. The University of California at Berkeley, with backing from Governor Ronald Reagan and the Board of Regents, subsequently blocked access to the park by installing a chain link fence. Protests followed, resulting in numerous arrests, injuries, and one death. The university bulldozed the remaining gardens, but the community eventually reclaimed the space in the years to follow, and today it is signified as a space on the urban landscape where freedom of expression and transformative power reside.

Drawing on this historical significance, organizers chose the name "People's Park" to evoke a sense of ownership to the people of the surrounding community. They felt that this park would come to represent a sense of freedom and openness that community residents could experience as part of their daily lives. However, at a planning meeting before the park opened, some questioned the name as referring to what they saw as "communist ideology, seemingly 'off-putting' to the larger community and potential financial supporters" (Researcher's field notes, fall 2007). A few organizers present were concerned about potential political ramifications of the name's "association with communism," as was offered at the meeting, given that their primary objective was simply to provide a community green space, free from restriction for residents. In the end, group consensus was that the naming would not deter potential donors and would best convey the intended meaning of the space.

The space for People's Park

An analysis of blueprints and notes from meetings reveals that park architects and organizers took much into consideration in its design for public use. The design of People's Park is one that displays characteristics of pocket parks of other urban areas, such as New York City. The design is functional as an open space, providing picnic tables, gradation in the landscape offering dimension, a retaining wall that doubles as seating, a separate fenced raised bed area for flowers and vegetable growing, and many garden beds full of annuals and native perennial plants. The space is aesthetically pleasing and offers a sense of solace from the bustling activity of the city.

Designed intentionally for social gatherings and outdoor entertainment, the park's amphitheater and stadium rows built of brick facilitate easy communication between people in the park. The park offers plenty of space for planting and growing, educational exhibits for teaching composting and other environmental practices, and social interaction.

However, from interviews and observations, major concerns about the limitations to public use were noted among residents. The narratives include a wide range of concerns, including the lack of shade and the physical inaccessibility of the garden behind the protective wrought iron fence and the gate, which is locked overnight.

The lack of shade in the park is a serious concern for most visitors. Visitors complained about the lack of sun protection, especially for young children. In addition, lack of facilities such as a drinking fountain or restroom also emerged as limitations. Two picnic tables with removable umbrellas were usable at times, but were usually kept locked in the facilities building, leaving everyday visitors no access to shade for sun protection. Park users commented that the environment does not lend itself to a relaxing atmosphere for networking and meeting—core aims of the project—when physically uncomfortable. Residents have stated numerous times since the park's opening (in 2008) that they would use the space more if shade was present. Organizers appreciated the full sun exposure as helpful for the limited growing season that a Northeast city has, and capitalized on this by planting native trees and perennials. However, the trees would not provide shade for some years, until the trees mature. Residents convinced organizers to draw up modifications, including building a shade structure that would block direct exposure from the sun, allowing more social activities to take place in the heat of the day. It has been noted in interviews that if the shade structure had been built into the original plans, the use of space would have been very different.

A second concern exists in the wrought iron fence that limits public entrance. The presence of the fence creates a literal and symbolic boundary limiting public participation. Some organizers felt the fence was needed to protect and maintain the

space. The conflict over the fencing was warranted; to some, the park would be more inviting without the symbolic meaning the fence brings, but, to others it was socially constructed, as a barrier to unwanted behavior, such as graffiti which was defined as art to some and vandalism to others. Moreover, because the city public works department does not maintain the park, insurance liability for the space became a very real concern for park organizers. Mishaps that occurred at the park were the responsibility of MAKEDA, the property owners. Their rationale was that keeping the fence locked from 8:00 p.m. to 8:00 a.m. reduced the likelihood of mischievous activity, including acts of vandalism, during the overnight hours.

The neighborhood itself was another barrier to access. The stretch of Main Street where the park is located has very little foot traffic and the neighborhood itself is dotted with industrial and residential properties. It is not a cohesive residential community. Main Street symbolically represents the racial divide between the East and West Sides of Buffalo, based on race and income, and Buffalo has historically been ranked as one of the most racially divided cities in the United States. According to the Brookings Institute, in an article entitled, "Region's Segregated Living Cited in New Data," the Buffalo–Niagara Falls Metropolitan Area ranks sixth in the nation for most segregated metropolitan area, and third most impoverished. Commenting on previous Brookings Institute's findings, Rey and Lakamp (2011) explain:

> The index is based on a percentage and what it would take to achieve an even residential pattern between blacks and whites, using scores ranging from 0 to 100. Anything above 60 is considered a very high level of segregation. Buffalo Niagara scored 74.4. That's actually a slight decline in segregation from a decade ago, when the region scored 78 on the index. "It's moving in the right direction. Certainly, it means there's something going on," Frey said. "But you know, in some ways, the die is cast in these older metro areas." (Rey & Lakamp, 2011)

These concerns among residents and their contrast with park organizers' intentions for the space's use affected how residents viewed and accessed the space. Additionally, the residents' lack of perceived ownership over the space ultimately described and shaped what the space meant to them. This top-down model that MAKEDA embraced—if we build it, they will come—did not come to fruition as they had hoped; the lack of community engagement in the planning process was reflected in the numerous complaints and lack of use of the park area.

Community use of People's Parks

Organizers sought to make the park an enjoyable space for residents by developing a myriad of different park activities. These included informal uses of the park for nature exploration to more formally organized programs such as farm market days and gardening activities to morning reading circles and evening concerts.

While opening celebrations took place in May 2008, the park began providing opportunities for social interaction much earlier than the official opening. For instance, Science Firsthand[3] used the space as an outdoor natural science laboratory where youth, especially those from the surrounding neighborhoods, could engage in hands-on activities. In this program, youth were able to investigate the natural environment with their adult mentors, taking note of plant species and other evidence of the natural world. As the director of this program shared, for most children in this community, this was the first exposure to "the environment" as a place to begin to understand ecology—life in an ecosystem. As Louv (2005) points out, involving children in nature and spending time outdoors is vital for childhood emotional and physical health. In another example, children from the parochial school across the street used the park for their butterfly release that year. They celebrated with songs and a ceremony to commemorate their role in raising the butterflies from caterpillar pupae to adult insects. As with many environmental activities, this began with having access to a space for exploratory science (Hoffner, 2006).

Researchers are increasingly aware that the local urban food environment influences one's access to food (Alkon & Mares, 2012; Raja et al., 2008; Walker et al., 2010). Organizers heard these concerns from residents as well and developed another popular programming use for the park as a space for access to fresh local produce. Food deserts, according the United States Department of Agriculture (USDA), are low-income areas (as defined by census where 20% or more of population is below the poverty line) in which 33% of the given census tract live further than a mile from a large supermarket or grocery store. The USDA further explains that under these income and food access criteria, about 10% of the 65,000 census tracts in the United States meet the definition of a food desert. These food desert tracts contain 13.5 million people with low access to sources of healthy food, especially fresh produce. The majority of this population—82%—live in urban areas (USDA, 2017).

Raja et al.'s 2008 study reveals this pattern in Buffalo, especially for East Side communities. Similarly, for this specific East Side population, grocery store options were limited to corner markets with little, if any, fresh produce, usually at prices 50% higher than larger grocery stores. Factors limiting access to fresh produce are linked to legacy pollution from previous industrial land use in residential neighborhoods. Because of this, community members were hesitant to create gardens in their own backyards without the means to perform necessary soil testing. Unfortunately, because of Western New York's heavy industrial past, issues of legacy pollution have historically plagued Buffalo and the surrounding cities and towns. At People's Park, programs such as a weekday mobile farmer's market and educational opportunities for how to grow food led by local residents were introduced.

3 Science Firsthand is a National Science Foundation federally funded program that connects youth to teen and adult science mentors in urban communities.

Local residents, including families recently arriving to the United States through a local refugee resettlement agency, who struggled to find safe spaces to garden—free from soil and water contaminants that may have been lurking in their own backyards—began to frequent garden programs and began adopting growing beds at People's Park. To date (as of summer 2018), given the continued global refugee crisis and Buffalo's commitment to supporting this population, refugee agencies continue to provide food security and gardening opportunities at the park for their clients. Garden beds, both those containing vegetables and perennials, are maintained by refugee populations and clients from adult rehabilitation agencies. While this involvement gives individuals a space to relax and enjoy the outdoors as part of their therapy, community gardening has also become a form of respite for these individuals seeking some semblance of agency over their lives.

Studies reveal that a key element for success is strong local leadership developing staff and volunteers who work with community partners, as well as provide ongoing skills-building workshops (Twiss et al., 2003). Still, despite the investment in community-building activities and opportunities for social engagement, evidence of continued community support was scarce; few people were attending park activities or using the park outside of organized events. The short history of People's Park left organizers struggling with how to increase neighborhood involvement in order to maintain a meaningful park experience for the surrounding community. Ironically, residents we spoke with were not without enthusiasm. Many echoed the overwhelming support for a neighborhood park, stating "A park is exactly what we need around here. Something to make the neighborhood look nice" (Researcher's notes: field interview with park user, summer 2008). Yet few actually made use of this particular park. In part, residents identified an ambivalence in access to the space for residents that shaped their low levels of involvement, which originated with the top-down bureaucratic approach that emerged with the park's origin story.

For instance, many respondents noted that the space appeared closed to the public for enjoyment. One resident notes, "I am never really sure if the park is open. I like the idea of visiting, but I feel as though I may be intruding on something" (Researcher's notes: field interview with park user, summer 2008). Many respondents referred to the issue of whether they were able to just enter the park and take respite, or would doing so intrude on another purpose or use of the space. This is particularly heightened by the use of a locked fence. A common survey response to using the space read like this: "Not sure whether the park is public or private. I want to come in, but I am not sure I am allowed" (Researcher's notes). Questions arose about availability: was something planned, would the gate be locked, would they be expected to weed or maintain some part of the garden? Moreover, there were issues with governance. Organizers were intent on having community members as the main caretakers of the park. However, as revealed through interview data, while most community residents appreciated the space, they neither had time for the responsibility of a community garden, nor did they know they were expected to do so. The lack of shared governance over the park resulted in confusion over the park's role for the community and expectations of how it would continue as a viable open space for the community. Similarly, this post and comment in an online newspaper blog addresses these concerns:

> Not just a park where lawnmowers show up and the gates open, People's Park has become a destination of sorts for the surrounding community. That means there are bigger plans that are needed despite the park's understated size. (Queenseyes, 2008)

> So, I'm confused. Where does the money for the upkeep of this place come from? Is this now a Buffalo public park? Does the city (or county) do the upkeep? (Anonymous, 2008)

In conversations with organizers, they acknowledge that there had been very few efforts to work with community individuals to determine what programming they would like to see occur in the park and the maintenance of the park; but, in fact, initially there was no effort at all to involve the community in the creation of a space intended for their use. About a year into park development and programming (2009), as part of our ongoing research, we offered to administer feedback surveys that could offer some indication of what the community wanted to see in from this space. After community feedback through our surveys and meetings with vested neighborhood organizations, organizers were better able to understand why the park had as little community involvement as it did. Thus, they began working toward a more collaborative approach to the park's use by involving block clubs and neighborhood groups in programming and planning for the next gardening season. Without community input, assumptions of space use and design were made by organizers. Determined uses and availability of the park may not have been in line with the community's wishes; however, through communication with organizers, community members sought a balance between formal and informal uses of

the space. The most successful formal programming initiatives introduced were a summer concert series, a children's reading circle, and youth nature programming such as building bird houses and the basics of composting.

Of these, the weekly reading circle was the most successful. This program was supported by a local group called Fathers Armed Together to Help Educate, Restore, and Save (FATHERS), whose mission was to engage youth who had had brushes with juvenile detention at a young age. FATHERS volunteers provided mentorship and leadership to these disenfranchised teens, and supported them in turn with opportunities to themselves become leaders and mentors in their own volunteering. The reading circle met these goals: youth volunteers from the FATHERS reading circle program distributed books and engaged in one-on-one reading time with younger neighborhood children. The park served as a nice setting for this event due to its amphitheater-style stone seating. Organizers collaborated with local social service organizations, such as The Salvation Army, in the neighborhood to best serve children directly in the surrounding neighborhoods. In an effort to create a sense of lasting change, organizers wanted children to own the books they were reading. The children attending this reading program were at or below their age-standard reading levels and few had books of their own at home. So that book ownership could be a reality, they held a book drive prior to the event and gave away nearly 600 books each season.[4]

This program led to families returning to the park to engage in reading; and even the teens who were volunteer readers returned on a regular basis. As one resident stated, "My children love the reading program and I love that they can read in a relaxed atmosphere surrounded by the park." Another woman who regularly brought her grandchildren to the park for the reading circle stated, "You know, these kids don't really have much at home and they feel so good about being able to come here, use the books, and take one home each week" (Researcher's notes: field interview with park user, summer 2009).

This was evidence that the park was becoming more than simply a green space, but a space where children felt comfortable and relaxed outside of their homes. Another respondent stated that her grandson needed to come to the park in order to be safe, after a violent incident he had suffered while playing in a vacant house (such houses were attractive as play spaces for children, but were unfortunately also attractive to older youths and adults engaged in criminal activity, such that it was not uncommon for children to be exposed to violence as a result of this overlap in use).

4 The book drive was supported by a local organization, Project Flight, which for 25 years has been collecting and distributing books to low-income children and families in the city of Buffalo.

A sense of empowerment was also visible in the teen volunteers of the reading circle, who benefited from the strong father-like influence from the men organizing as FATHERS, and, as one-time disenfranchised youth, became an important liaison for education in this space. Many went on to volunteer in more diverse ways, joining the Mayor's Summer Youth program, assigned to a variety of outreach programs across Buffalo similar to the reading program at People's Park. The park, though initiated as an environmental project, became a space for furthering education, both for those who were just starting to learn to read and those offering their services to read to groups of children.

Members of FATHERS became further involved by using the park as an informal meeting space to engage youth in crime prevention education and awareness. The park became a safe space for youth to discuss their concerns and fears with neighborhood mentors; and, in turn, mentors became more aware of the challenges youth were facing in their everyday lived experiences.

The FATHERS reading circle was an outstanding example of the potential for community transformation that was made possible by the creation of People's Park. It is a "close the loop" approach which proved a successful model for youth engagement.

However, while the park offered a physical space where individuals could engage in activities, it was ultimately the park organizers' pursuit of conversations and continuous engagement with individuals and organizations in the community which has begun to endow the space with the potential to support the overall transformative goals of the community at large.

Figure 2: People's Park in use.
Source: Author's photographs.

Exploring meaning of People's Park

Even with the improved programming at the park, overall, questions of the community's sense of park "ownership" continued to surface. Community members did not feel as though they owned the park, let alone had the right to pursue their recreation there. Nor did they feel they should be left with the responsibility for its maintenance, despite the responsibility as assigned when determined by organizers that the park would be a "community-maintained garden." Additionally, they did not feel as though they had authority to direct the programming decisions, or even a voice in the decision-making process. As Lefebvre (1991) recalls, social space cannot succeed in its intention if the needs of the agents within the space are not met. Ironically, while organizers felt that the park was community-owned, they expressed frustration with the lack of community participation toward the park. Overall sentiment was that there still needed to be a distinct effort to provide an opportunity for the community to take ownership of this park. Without that, community members would not take ownership, even if the opportunity for involvement is present.

Despite the lack of initial overall community investment, the park offers respite and opportunity for those who access it. Transforming a vacant lot to a vibrant community garden involved the cooperation and collaboration of many individuals on many levels. Individuals ranging from community organizers to successful businessmen brought a variety of assets to this process. While the creation of a community garden is most often considered a grassroots initiative, in this case support came from a top-down structure—decision-makers were those with vested financial capital and social interests in changing this space. Although many steering committee members considered themselves local community members, at first, they implemented change with little input from the community at large.

While the park offered a physical space where individuals could engage in activities, it was only conversations and continued engagement that supported continual interaction for groups of individuals. The physical transformation of the space began to support the transformative goals of the community at large. Overall, data from formal and informal surveys with park users support evidence of more facilitated, direct communication over park usage. Data reveal that individuals enjoy using the park (90% of respondents), disclose sentiments in favor of returning (75%), although seldom share specifics of these plans, such as a date or time. The park, therefore has improved its potential to serve as a community space and become an accessible space for social interaction as well as environmental education, recreation, and of course, relaxation.

On the other hand, another narrative of the park simultaneously emerged. Organizers struggled with vandalism to vegetables and other plants in the first summer of planting. Organizers would enter the park only to find that tomatoes had been picked and used in fights; seeds and juice splattered over fences and neighboring

walls. Planted beds would have had the freshly planted seedlings pulled out of the soil, unable to be restored. Gardeners were disappointed and expressed their concerns to organizers. As one organizer conveyed, "it is frustrating to do all of this work and have our work ruined. But the fence just seems so unwelcoming." Others saw this in a different light, stating "if kids are going to use the tomatoes this way, and it is their park, why not let them? It's better than rocks or bullets" (Researcher's field notes). However, the following growing season, fewer tomatoes were planted.

Other forms of vandalism arose visibly as well. Graffiti tags became a regular occurrence, costing organizers time and money in removal. Again, it was suggested, that if the park is owned by the community and it can be used as a safe place to graffiti tag, maybe the graffiti artists could be invited to create a mural of their choosing. The idea was immediately dismissed and the quest for graffiti removal techniques endured. This conflict illustrates the tension around what community-owned meant. Organizers still had an idea of how the park should be used and these community-initiated suggestions were seen by organizers as inappropriate uses of the space.

Although organizers have begun to increase their collaborative efforts—to draw on a network of individuals with neighborhood affiliations to promote park activity, respond to vandalism and negative uses of the park, and increase park foot traffic—the community residents were not those making decisions regarding the park. This called into question the meaning of space influenced by a philanthropic act of doing something for a community, without consulting the community for which the gift is intended. Though residents note the role of the space as primarily positive, especially through the social interactions that take place through activities such as the reading circle and environmental education workshops, there is also a recognition that the park symbolizes do-gooder, top-down organizing. The struggle to symbolize change for the community, and how or if the park will continue to transform while meeting the needs of the surrounding community is yet to be seen.

Conclusion

Involvement in gardening activities often opens opportunities for networking and skill-building that may not have been immediately obvious. Studies on youth involvement show that participants were able to benefit by developing skills such as interpersonal communication, mapping, planning, and following directions through their involvement in gardening activities (Doyle & Krasny, 2003). While People's Park has offered social spaces for engagement and empowerment, it is the steering committee, not the community members, who were dominant as the primary organizers. They have begun to understand that their role as sole organizers is limiting to the park's success and have shifted their strategies in order to foster community ownership of the park.

The goal of People's Park was to provide a transformative space for members of a community in an urban space dense with industrial and residential properties, but very little green space. Community garden literature provides a backdrop for understanding the impacts of gardens on communities. Evidence shows that community gardens foster socialization among individuals, enhance the basic quality of life in a neighborhood, and offer basic avenues for enhancing community relations and empowerment. I examined how the meaning of this urban space has been transformed by the development of People's Park. However, the transformation is ongoing. Continued community engagement through park programming offers the best chance for long-term success for the park. Successful programming encourages participation that in turn encourages ownership and responsibility to be taken for the park. It also encourages socialization among community members at events. The spatial determinants of the park tend to be the physical and geographical realities of the park space; yet these have become less of a barrier to community use since community members have been engaged in a more grassroots approach to organizing.

In my study, I share a story of a social space that became actively challenged—from one of a vacant used space, to one that provides environmental justice opportunity and transformative potential for a community. Organizers hoped to address issues such as nature deficit disorder and other social conditions that can be resolved by offering a connection to nature for a youth and adult urban population; however, until they engaged the community, these ideas were not successfully realized. Today the park enjoys much more use than in the past, especially evident in the current uses of the park by refugees and the adult rehabilitation population. In essence, the role of a community garden and park signifies a space where one can engage in kinds of social interaction that differ from those inherent in a concrete, urban setting. People's Park has been successful in that goal—the transformations did influence the conceptual meaning of the space. However, the extent to which community empowerment was established is less certain. Arguably, initially, community members felt further burdened rather than empowered by this neighborhood transformation. In many ways, though, meaning is constantly evolving to meet the needs of park users at any particular time and space. By providing educational opportunities, offering sustainability initiatives, and enhancing community-building, and above all active engagement with community members, this site holds grand transformative potential for this community.

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Making Sense of Hydrosocial Patterns in Academic Papers on Extreme Freshwater Events

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Abstract

This paper will communicate the outcomes of a systematic quantitative literature review that investigated how extreme freshwater events (EFWE) such as floods, droughts, and heavy rainfall are framed in peer-reviewed academic literature focusing on Queensland, Australia, and Saskatchewan, Canada. From this exercise, patterns emerge revealing a predominately science-based hydrological cycle perspective of EFWE with little recognition of societal influences. We advocate for a reframing of EFWE research in these areas to acknowledge how human practices are interconnected with the intensity and frequency of EFWE. We offer this study to encourage others to explore the contemporary narratives around EFWE emerging from research within their own locations.

Keywords: drought, extreme freshwater events, flood, heavy rainfall, hydrosocial cycle

Introduction

Extreme freshwater events (EFWE) include heavy rainfalls, floods and droughts. Even though EFWE occur naturally within global ecosystems, there is broad scientific consensus that with climate change, EFWE will intensify and become more frequent across the planet (Houngbo, 2018; Intergovernmental Panel on Climate Change [IPCC], 2014; Narula, 2018; World Water Assessment Programme [WWAP], 2012, 2014), influencing natural, non-human, and human systems

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(IPCC, 2001, 2007). The consequences of EFWE, both positive and negative, vary greatly depending on the event location and duration, and vulnerability of the environment (IPCC, 2001; Panero, et al., 2018). From a human perspective, EFWE can result in loss of life (human and non-human), cause damage to property (flooding and heavy rainfall), destroy crops (threatening food security), contribute to health deterioration owing to waterborne diseases, and disrupt communication links and infrastructure such as electricity, transport, communication, education, and health care (IPCC, 2014). They can also disturb water catchments, affect storage reservoirs, affect the integrity of water treatment processes and distribution systems, and negatively impact regional water quality (Musavi et al., 2018; Strang, 2015; Wheater & Gober, 2015). Additionally, loss of livelihoods and land values can leave individuals and communities economically vulnerable (Middelmann-Fernandes, 2009). Changes to precipitation patterns can also increase the potential of wildfires, increase forest mortality, affect endemic species, and encourage invasive species (Goodess, 2013).

EFWE can also present beneficial consequences (Middelmann-Fernandes, 2009). Floodwaters soak into soils and replenish underground water stores, providing water supplies for agricultural crops and native plants (WWAP, 2014). Floodwaters can eliminate excess salts from soils, and excess waters can cause rivers to swell, removing debris and other pollution (WWAP, 2012). Further, many flora and fauna depend on EFWE cycles to connect habitats, offer alternative food sources, and trigger breeding, pollination, and seed dispersal (Apan et al., 2010). From a human perspective, this revitalization of ecosystems benefits tourism, the maintenance of recreational environments, and the subsequent economic benefits of increased flora or fauna production (Apan et al., 2010).

The factors, causes, and influences of EFWE are complex: probably more complex than we can currently imagine. Understanding the intricacies of EFWE will be influenced by how social systems investigate and make sense of these events. In this way, research plays a role in shaping how societies understand and respond to EFWE. This paper defines research as "any form of discipline inquiry that aims to contribute to a body of knowledge" (Economic and Social Research Council, 2005, p. 7). Academic research, more specifically, speaks to the construction of knowledge that emerges from verifiable, evidence-based research articles published in credible, academic, peer-reviewed journals. Globally, there has been an increase in the publication of academic articles offering research-based evidence on nearly every concept imaginable, including EFWE (Krause & Strang, 2016). Indeed, as freshwater is essential to all life on this planet, nearly every academic discipline area investigates water in one way or another (Krause & Strang, 2016; Strang, 2004). These individual academic articles offer specific knowledge around defined situations that add to our understandings of EFWE. By investigating this emerging knowledge base as a collective, it is possible to identify the contemporary narratives and patterns

that derive from the accumulation of this knowledge. As such, this paper presents the findings of a systematic analysis of academic, peer-reviewed journal articles published between 2013 and 2015 about EFWE in two geographical locations.

The timeframe and geographical location were chosen to coincide with the publication of academic articles stemming from significant EFWE that occurred in 2011 in both Queensland and Saskatchewan. These locations were chosen as they are familiar to the authors, as they have lived in one or both places and witnessed the varying freshwater patterns. More specifically, both locations experienced devastating EFWE within months of each other in 2011, providing a chance to compare how emerging academic articles explored these events and what narratives they offered. Therefore, this study is time and location specific. This paper does not propose that the analyzed documents are reflective of all academic articles about EFWE. Rather, this paper draws attention to patterns and trends emerging from this particular body of academic research, allowing for the identification of how EFWE are framed, discussed, and understood within published peer-reviewed academic articles found within these specific locations and timeframes. This identification gives rise to the possibilities and limitations of how this knowledge frames academic literature in order to encourage metanarrative reflections of how freshwater might be framed in the future. We hope that by offering this small case study, we might encourage others to explore contemporary narratives around EFWE emerging from research within their own locations.

Framing of extreme freshwater events

Historically, EFWE were conceptualized as natural hazards, with Mother Nature or God unleashing pain and suffering on humans (Mustafa, 2009). Mustafa (2009) suggests that with the advent of science, Western societies have predominantly come to understand EFWE as *natural hazards* that may be solved through the application of scientific knowledge and engineering solutions. Within this scientific framing, EFWE are predominantly understood by a hydrological cycle description: the shortages or excesses of groundwater, atmospheric, or surface water resulting from precipitation levels within specific regions (Global Water Partnership, 2000; Krause, 2014, 2016). A hydrological cycle perspective focuses on the chemical properties of water, the interaction of water with Earth's ecological systems, and how it moves on, through, and around the Earth (Linton, 2008, 2010; Linton & Budds, 2014). Sivapalan et al. (2012) suggest this understanding implies that water is an abstract concept, independent of history or society, while Strang (2004, 2014) suggests this perspective invites an understanding that water can be owned, controlled, and managed. Schmidt (2013, 2014) suggests the hydrological cycle perspective reflects a common way people, governments, and businesses make sense of freshwater. Linton and Budds (2014) advocate that politically understanding water via the hydrological

cycle is convenient for economic purposes as it allows water to be viewed as a discrete resource, one that can be "exploited and manipulated without explicit regard for the complexity of relations between water and ecosystem functions" (p. 113).

A purely hydrological cycle understanding of EFWE is being challenged by a hydrosocial cycle understanding (Linton, 2010; Sammel, 2014, 2016; Sammel & McMartin, 2014; Sammel et al., 2018; Sivapalan et al., 2012). A hydrosocial cycle understanding encourages EFWE to be understood as dynamic fluctuations in the quantity and flow of water, where water movement aligns with larger natural and socially constructed rhythms that have different temporal beats (Krause, 2013; Linton, 2008, 2014; Linton & Budds, 2014; Tortajada & Biswas, 2018). This perspective recognizes the complex, long-term coevolution of human systems with freshwater systems, where humans have interacted with and changed the natural environment, thereby directly influencing EFWE, just as EFWE also influence social systems (Bates et al., 2008; McMartin et al., 2018; Sivapalan et al., 2012). It seeks to make sense of the interplay between natural and social systems, including economics and political priorities (Di Baldassarre et al., 2013; Schmidt, 2013). Krause and Strang (2016) provide insight by suggesting a hydrosocial perspective illustrates how "water flows are fashioned by a combination of topography, power relations, built infrastructure, institutional arrangements, property relations, money and market forces, ideologies, social networks and the properties of water itself" (p. 635). Bijker (2012) claims, "we live in water cultures," where water is "a crucial constituent of any society, including cases of excess, as in flooding, or drought, as in deserts; and cases of infrastructure, as in canals and cases of expertise, as in hydroimperialism, societies will be better understood when the role of water is the focus of analysis" (p. 626). This emphasizes Bakker's (2012) position that water is inherently political.

Interpretations or understandings of EFWE are indicative of social process, policies, and discourses, which can be understood along a continuum that is reflective of different ideologies. From one standpoint, EFWE can be viewed as disturbing what is assumed to be the normalcy of natural systems upon which social systems have been built (Strang, 2004). From another, EFWE may be viewed as an inevitable part of the circulation of freshwater within living, fluctuating systems which are deeply interconnected and influenced by human existence and practices (Christian & Wong, 2017; Harvey & Stocker, 2015; Krause, 2014, 2016; Krause & Strang, 2016; Likens et al., 2009; McMartin et al., 2018; Sivapalan et al., 2012; Tortajada & Biswas, 2018). This continuum highlights theoretical positions underpinning these standpoints, but to what degree are these standpoints represented in peer-reviewed journal articles written about the 2011 Queensland or Saskatchewan EFWE? What assumptions, expectations and recommendations are held within academic publications around these specific EFWE? The aim of this paper is to investigate these questions by identifying patterns and trends that emerge about the

2011 Queensland or Saskatchewan EFWE from academic papers across disciplines. Being clear about these patterns may allow for greater reflection on how these societies make sense of EFWE.

Methods

The methodology of this study was an instrumental case study that recognizes the complexity within the wholeness and utility of the case (Punch, 2005). A case can be defined as a phenomenon within a bounded context and, in this study, was defined as peer-reviewed academic literature, across multiple disciplines, that discuss EFWE in the context of Queensland, Australia, and Saskatchewan, Canada, published from 2013 to 2015, inclusive. These two regions were chosen because both experienced record-breaking flooding in 2011; Queensland faced one of the most devastating floods in Australian history, with 78% of the state declared a natural disaster zone (Wright et al., 2013) while Saskatchewan (and Manitoba) endured a massive flooding event described as one of the five worst floods in Canadian history (CBC News, 2011). Both areas host over a million residents with similarities in governance, investment in science and technology, systems of weather forecasting, emergency warnings, and response measures. Similarities also extend to education systems, including university publication expectations (Sammel et al., 2018).

To identify recent scholarly literature that focused on EFWE in Queensland or Saskatchewan, we employed Pickering and Byrne's (2014) systematic quantitative literature review method. We systematically searched for peer-reviewed papers that (1) focused on EFWE situated within Queensland, Australia or Saskatchewan, Canada, and (2) were published in English. To identify relevant studies, we searched the titles, abstracts, and keywords of papers in three electronic databases (ProQuest—All Databases, Scopus, and Web of Science—Core Collection) using the following strategy:

> (flood* OR drought* OR "extreme water event" OR "heavy rainfall" OR "extreme rainfall" OR "water disaster") AND (Saskatchewan OR Queensland OR Brisbane)

Types of EFWE were used as search terms because "EFWE" is not an established concept in the literature. "Brisbane" was included as a search term in addition to "Queensland," given that the 2011 flooding event is sometimes referred to as the "Brisbane floods." Our search parameters limited retrieved papers to those published between 2013 and 2015 to collect recent literature and to coincide with the publication of academic articles stemming from significant 2011 EFWE in both Queensland and Saskatchewan. See Table 1 for a breakdown of search results.

Table 1: Breakdown of search results.

Detail	n
Number of records identified through database searching	555
Number of records after duplicates removed	388
Number of records after full-text articles assessed for eligibility, and included in quantitative synthesis	193

Source: Authors' summary of research process.

As we were interested in characterizing how EFWE are framed and discussed in academic literature, it was essential that all papers focusing on such events, regardless of the research angle or approach, were retained. Some papers examined specific EFWE in Queensland and Saskatchewan, while others were concerned with possible EFWE in the future, taking a modeling or prediction-based approach.

Search results were screened to ensure each paper met this priority. The following criteria were used to determine if each should be included or excluded for analysis. Articles were excluded where the events or conditions examined were described as seasonal or regular, and therefore of minor significance (i.e., not considered extreme). For papers concerned with EFWE in multiple locations, a significant portion of the paper (which we determined to be at least one third) must have concerned Queensland or Saskatchewan to be included. Papers that discussed drought or flood as a *characteristic* of fauna or flora species were excluded. Finally, any results that focused mostly on marine-based events, such as flood tides, were excluded as our investigation concerned freshwater events only. Papers that examined impacts to marine systems as a result of EFWE, however, such as flood plumes in coastal marine ecosystems, were included.

The final set of papers (n=193) was coded for journal discipline, location of research, and type of EFWE discussed. Journal disciplines were determined using information retrieved from individual journal websites, including where journals self-identified as multidisciplinary. This was used to gain an indication only of likely discipline(s) for each paper. Two coding exercises were developed to facilitate characterizing how EFWE were framed within the reviewed literature. The first exercise recorded the dominant negative and positive EFWE-related concepts discussed in each paper. Table 2 presents the negative and positive coding categories and subcategories we developed based on recurring themes in the literature. As some of the reviewed papers examined more than one of these categories, where necessary we coded for the most focused-upon concepts across positive and negative concepts (up to five subcategories were observed). Where papers did not discuss any explicitly positive or negative concepts, these were coded as "neutral."

Table 2: Coding categories and subcategories for negative and positive concepts discussed in the analyzed papers.

Coding category	Coding subcategory
Negative concepts	
Economic concepts	A—Financial costs to individuals, families, communities, businesses, industries or sectors, organizations, and/or governments associated with EFWE B—Costs to businesses, industries, sectors, or economies due to EFWE-associated impacts to infrastructure C—Engineering and technology costs and damages associated with EFWE
Societal or community concepts	D—Socio-emotional distress at a community level E—Damage to or inefficacy of relations between individuals, families, and/or communities during or after EFWE F—Social infrastructure and services impacted or altered by EFWE G—Unequal experiences of EFWE by different social groups (e.g., vulnerable or marginalized communities) H—Poor, low, or ineffective risk perception and behavioral responses associated with EFWE
Planning, preparedness, and response-based concepts	I—Overreliance on one component of planning or protection from EFWE J—Issues with planning for, management, response, and communication of information before, during, or after EFWE K—Focus on developing or evaluating specific measures to predict, plan for, or monitor EFWE L—Governance issues (e.g., law, land-use planning provisions, government responsibilities, leadership) associated with planning for or responding to EFWE
Health and wellbeing concepts	M—Physical human health matters in relation to EFWE N—Emotional or psychological human health matters in relation to EFWE
Ecosystem or natural environment concepts	O—Temporary or permanent impacts or changes to species or ecosystem function associated with EFWE P—Focus concerns climatic attributes and weather patterns associated with EFWE (e.g., El Niño, La Niña) Q—Significant changes to the landscape associated with EFWE
Positive concepts	
Societal or community concepts	R—Community growth or cohesion enhanced by EFWE S—Support offered by stakeholders (including governments, organizations, or individuals) in relation to EFWE T—New social development opportunities arisen due to EFWE
Ecosystem or natural environment concepts	U—Benefits to ecosystems, environmental processes, or individual species due to EFWE V—EFWE offset or reduced significance of environmental impacts
Other	Any other positive concepts discussed, with details noted

Note: EFWE = extreme freshwater events.

Source: Authors' summary of research process.

The second coding exercise was designed to characterize how EFWE were framed within the collected literature, underpinned by the framing of EFWE discussion earlier in this paper. We established a four-point scale for this coding exercise. Papers that framed EFWE as exclusively natural events were categorized as Level 1, while papers that consistently framed EFWE as an inseparable component of society were categorized as Level 4. Table 3 presents a summary of characteristics for each scale point used to guide paper categorization. For this coding exercise, papers were coded into only one of the four categories, based on their dominant framing and depiction of EFWE.

Table 3: Scale levels developed to characterize the framing of EFWE within literature as part of nature or society.

Scale level	Description and characteristics
Level 1	**Science-constructed framing or understanding of EFWE completely separate from nature and society:** • Underpinning ideology views water as purely scientific, where water can be understood as being limited or in excess as it moves on, through, and around the Earth; • Water and EFWE are understood as a "natural force" and "natural events" that cannot be managed or controlled (separate and distinct from human systems); • Water is framed as a resource, independent of social interactions that can be owned, controlled and managed.
Level 2	**Predominantly science-constructed framing of EFWE as physical or natural processes with minimal acknowledgment of connection to society:** • Underpinning ideology aligns with the hegemonic view that EFWE disturb what is assumed to be the normalcy of natural systems upon which social systems have been built; • Focuses on the scientific occurrences of EFWE and their interactions with other "natural" or environmental-based processes (separate and distinct from human systems); • Where societal aspect(s) are discussed, these tend to concern the impact or aftermath of EFWE to society. Accordingly, EFWE are framed as "disasters" and "crises" that cause major disruption and negative consequences for social and economic systems and priorities, reflective of an anthropocentric perspective; • Does not recognize many historical or complex underlying human societal attributes that may have contributed to or influenced EFWE. Include minimal discussion of management or preparedness.
Level 3	**Acknowledges the interconnection of hydrological and societal factors in EFWE, though often with an emphasis on controlling and predicting EFWE through engineering-based management "solutions":** • Underpinning ideology the same as Level 2, but has an added focus on management, planning, and preparedness for EFWE. EFWE are discussed in terms of avoidance, reduction, or mitigation of negative EFWE consequences to human societies; • Focuses on the occurrences of EFWE and their interactions and interplay with human societies, as well as natural or environmental-based systems; • Recognizes EFWE impact societies, and societies may have contributed to EFWE. While there may be a reflection that societies and EFWE are in some ways interdependent, there are still instances of dualistic and separate understandings; • May include some discussion that water shapes the landscape but no depth of discussion that it also shapes human evolution—may include some minimal theoretical links to this understanding but it is not the main message of the text.

Scale level	Description and characteristics
Level 4	**Completely integrated understanding of EFWE as complexly interconnected with society, coevolving together through time:** • Underpinning ideology focuses on EFWE as an inevitable part of the circulation of fresh water within living, fluctuating systems which are deeply interconnected and influenced by human existence and practices; • Does not offer purely scientific explanations of EFWE, and does not identify a natural/social dualism; • EFWE are viewed as active agents of human evolution, and humans are not viewed as passive actors, but as contributing to and influencing EFWE; • Include very specific examples of the political, economic, social or cultural elements of EFWE; • Alludes to, or directly includes, other species when discussing EFWE.

Note: EFWE = extreme freshwater events.

Source: Authors' summary of research process.

Results

In total, we reviewed 193 recently published papers of which 174 (90% of total papers) concerned EFWE in Queensland, Australia and 19 (10% of total papers) concerned Saskatchewan EFWE (see Table 4). Many publications discussed more than one type of EFWE. The most commonly discussed EFWE across all papers was flood (82% of total papers), followed by extreme rainfall (35% of total papers) and drought (24% of total papers). Within Queensland literature, discussion of EFWE reflected a similar distribution with flood EFWE discussed most (85% of Queensland papers) followed by rainfall (37% of Queensland papers) and drought (18% of Queensland papers). Saskatchewan literature, however, revealed a greater emphasis on drought, discussed in 84% of Saskatchewan papers, followed by flood (in 58% of Saskatchewan papers) and extreme rainfall (in 21% of Saskatchewan papers).

All 193 reviewed papers were published across a wide range of journal disciplines with hydrology and water engineering (51 papers, 26%), ecology and conservation (45 papers, 23%), and policy and government (43 papers, 22%) the most common. Forty-six percent of papers (90 papers total) were retrieved from journals that self-identified as multidisciplinary. Queensland-based papers presented a similar distribution, while Saskatchewan-based literature was more dominated by hydrology and water engineering influences (42%), and included fewer papers from multidisciplinary journals (32%).

Table 4: Summary of reviewed paper information and coded characteristics.

Categories	Total (% of total papers)	Queensland (% of total Qld papers)	Saskatchewan (% of total SK papers)
Total papers	193	174 (90% of all papers)	19 (10% of all papers)
EFWE examined*			
Drought	47 (24%)	31 (18%)	16 (84%)
Flood	159 (82%)	148 (85%)	11 (58%)
Extreme rainfall	68 (35%)	64 (37%)	4 (21%)
Other (cyclone rain, snow melt)	27 (14%)	25 (14%)	2 (11%)
Journal disciplines*			
Multidisciplinary	90 (46%)	84 (48%)	6 (32%)
Hydrology, oceanography, and water engineering	51 (26%)	43 (25%)	8 (42%)
Ecology and conservation	45 (23%)	41 (23%)	4 (21%)
Other	Policy and government: 43 (22%)	Policy and government: 42 (24%)	Geography: 4 (21%)
Negative and positive EFWE-related concepts discussed*			
Address negative EFWE concepts	174 (90%)	158 (91%)	18 (95%)
Address positive EFWE concepts	34 (18%)	34 (20%)	0 (0%)
Address negative and positive EFWE concepts	29 (15%)	29 (17%)	0 (0%)
Neutral (neither negative nor positive)	14 (7%)	13 (7%)	1 (5%)
Framing of EFWE within literature as part of nature or society			
Level 1	15 (8%)	13 (7%)	2 (11%)
Level 2	123 (64%)	113 (65%)	10 (53%)
Level 3	51 (26%)	47 (27%)	4 (21%)
Level 4	4 (2%)	1 (1%)	3 (16%)

Note: * May exceed 100% as papers could be coded more than once for these categories.
EFWE = extreme freshwater events.

Source: Authors' summary of research.

As outlined, we used two coding exercises to characterize how papers framed EFWE. Figures 1 and 2 graphically present the outcomes of the first coding exercise, which captured the negative and positive EFWE concepts (defined in Table 2) emphasized in the reviewed papers. The darkest shaded rows in Figure 1 reveal that negative EFWE concepts were emphasized in nearly all reviewed papers (90%) compared to positive EFWE concepts which were discussed in less than one fifth of total papers. Of the total 34 papers that addressed positive EFWE concepts, 29 also

focused on negative EFWE concepts, meaning only 5 papers focused exclusively on positive EFWE concepts. About 14 papers (or 7% of total papers) were considered neutral as they emphasized neither negative nor positive concepts. Interestingly, positive EFWE-related concepts were not emphasized in any Saskatchewan papers (see Table 4).

Among the overarching concepts coded, Figure 1 reveals that negative economic concepts the most emphasized among the reviewed papers (in 89 papers), followed by negative societal and community concepts (in 65 papers), and ecosystem and negative environment concepts (in 59 papers). Interestingly, the least discussed negative concept (negative health and wellbeing concepts in 38 papers) was discussed in more papers than all of the accumulated positive EFWE concepts (in 34 papers). The most prevalent positive EFWE concept category within the literature was societal and community concepts (in 20 papers).

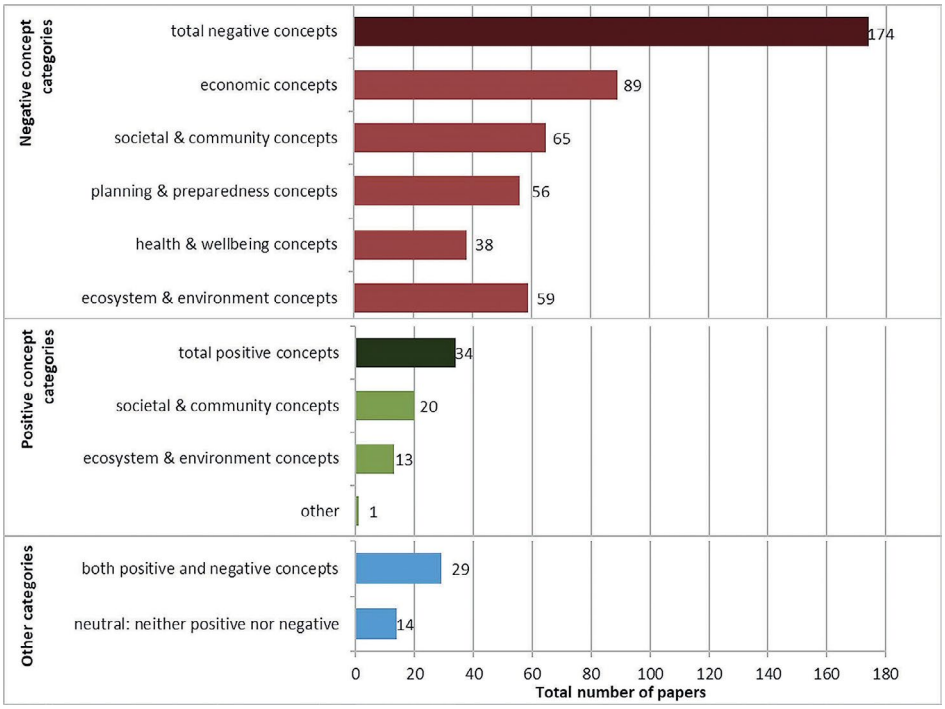

Figure 1: Breakdown of articles discussing negative and positive EFWE concepts.

Note: Total negative and total positive rows (shown by darkest shading) were calculated by totaling the number of papers coded as one or more of the constituting categories (shown in lighter shading).

Source: Authors' summary of research.

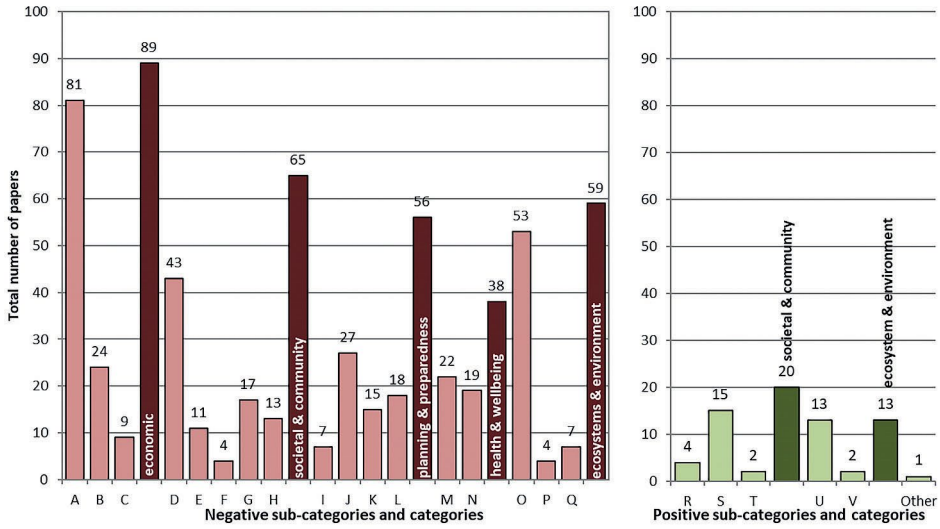

Figure 2: Breakdown of overarching negative and positive EFWE concepts.

Note: See Table 2 for descriptions of each coding subcategory.

Source: Authors' summary of research.

Figure 2 provides further breakdown of the negative and positive EFWE concepts, presenting the number of papers that focused on each coding subcategory defined earlier in Table 2. For example, the total number of papers that emphasize negative economic concepts as shown in the fourth column of Figure 2 is the total number of papers that were coded for emphasizing one or more of the economic subcategories A, B, and/or C. Figure 2 shows that the most emphasized coding subcategory was A, which reflects an emphasis on the "discussion of financial costs to individuals, families, communities, businesses, industries, or sectors, organizations, and/or governments associated with EFWE" (from Table 2) in 81 total papers. The most prevalent positive subcategory was S, reflecting discussion about "support offered by stakeholders (including governments, organizations, or individuals) in relation to EFWE," coded in 15 papers.

The second coding exercise characterized how EFWE were framed in the papers using a four-point scale system from Levels 1 to 4. Figure 3 demonstrates the overwhelming majority of papers (64%) were categorized as Level 2. EFWE are predominantly understood, or portrayed, as science-constructed, physical, or natural processes with minimal acknowledgment of connection to society (as per Table 3). Papers coded as Level 3 comprised 26% of reviewed articles, while 8% were coded as Level 1. Only 4 of the total 193 papers (2%) were coded as Level 4 because they appeared to consistently frame EFWE as intricately, complexly, and inseparably interconnected with and to societies. Of these four publications, three are from Saskatchewan and one is from Queensland.

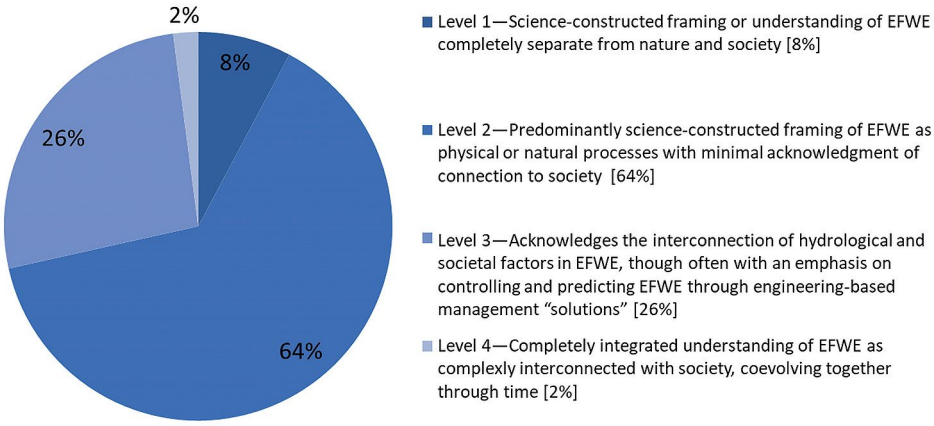

Figure 3: Distribution of papers using scale levels developed to characterize the framing of EFWE within literature.
Source: Authors' summary of research.

Discussion

With the global freshwater landscape changing due to climate change (IPCC, 2014; WWAP, 2012, 2014), it becomes necessary to view the human–water relationship differently and investigate widely accepted paradigms and assumptions (Tortajada & Biswas, 2018). Understanding the multiple geneses of emerging issues, identifying new and innovative approaches, and determining medium- and long-term implications is needed in order to reflect on present-day agendas. By investigating a contemporary narrative around EFWE in these specific academic articles, this paper adds to the growing conversation about EFWE by highlighting the need for academic papers to offer a balance of both hydrological and hydrosocial cycle perspectives within contemporary conversations. The results of this study show that 90% of all reviewed publications were classified as Level 2 (64%) and 3 (26%), as depicted by our developed four-point scale. This implies that the vast majority of academic articles frame EFWE within the hydrological cycle ideology which commonly views EFWE as natural disturbances in perceived normal quantities of water, viewing them as natural disasters or crises. This perspective is consistent with research advocating that water is dominantly interpreted as a natural resource, separate and distinct from human systems (Linton, 2008, 2010; Linton & Budds, 2014; McMartin et al., 2018; Sammel et al., 2018; Schmidt, 2013, 2014; Sivapalan et al., 2012; Takao, 2016; Tortajada & Biswas, 2018). Discussions of social aspects within Level 2 refer only to the impact or aftermath of EFWE to society, with little recognition of complex historical societal processes influencing EFWE. Papers within Level 2 focused on an anthropocentric agenda emphasizing negative aspects of EFWE with minimal discussion of management or preparedness.

Interestingly, 90% is the same percentage of papers that also commented on the negative attributes of EFWE for humans. The most emphasized negative attributes were the consequences and disruptions for humans and societal infrastructure (financial costs to individuals, families, communities, businesses, etc.) and issues of socio-emotional distress at the community level. This is consistent with the assumption made by Di Baldassarre et al. (2013) that human civilizations have always settled near water in order to meet their basic needs (drinking water, agriculture, trade, and economic development) and as such, the occurrence of an EFWE can cause profound negative consequences for these societies. Understanding EFWE as negative, coupled with the need to mitigate against consequences, explains why papers classified as Level 3 were the second-most documented category. Level 3 papers focused on management, planning, or preparedness for EFWE as a means to avoid, reduce, or mitigate negative EFWE consequences to human societies. Krause (2016) suggests that in research and policy development there has been a shift from reacting to managing EFWE. Linton and Budds (2014) perceive the *management of water* to be a core component of the hydrological cycle. They believe it legitimizes the technical authority over water, where experts with scientific and technical knowledge can modify the movement of water for the benefit of human systems without acknowledging the wider relationship between humanity and the environment. A few Level 3 papers reflected on specific human-made changes to landscapes, commenting that these changes many have worsened the impacts from EFWE, but the impact of other human policies or actions were not acknowledged. Our results highlighted that EFWE were mostly commonly understood as "catastrophic natural process," as found in Smith et al. (2013, p. 416). This aligns with Mustafa's (2009) suggestion that Western societies predominantly understand EFWE as "natural" hazards to be solved through the application of scientific knowledge and engineering solutions. Papers categorized as Level 2 or 3 inherently understand humans as being *at the mercy* of EFWE, underpinned by a dualistic theme within the hydrological cycle perspective where nature and society are viewed separately.

Of the remaining papers, 8% were considered to be Level 1. Papers within this category emphasize a purely science-constructed framing of EFWE, with a focus on how water moves on, through, and around the Earth. They suggest EFWE are "of nature" and so cannot be controlled, as they exist outside of, and independent to, society. This position completely separates water from social relationships.

This perspective is contrary to the 2% of papers that were coded as Level 4. The hydrosocial ideology underpinning papers classified as Level 4 views EFWE as an inevitable part of the circulation of freshwater within living, fluctuating systems which are deeply interconnected with and influenced by human existence and practices. For example, one of the four papers in this category (Gober & Wheater, 2014) discussed the pressures on the Saskatchewan River Basin, based upon Sivapalan et al. (2012) belief of the coupled coevolution of water and humans, where "it is not

possible to predict water cycle dynamics over decadal or longer time periods without considering interactions and feedbacks among natural and human components of the water system" (Gober & Wheater, 2014, p. 1419). Laforge and McLeman (2013), another of these four papers, discussed the coevolution of Saskatchewan and freshwater, through the role drought played in shaping and limiting the migration of people, and the impact of freshwater at the household level. Publications in this level offered a framing of EFWE where natural systems and societal systems—including politics, economics, spirituality, and power relations—were recognized as deeply interdependent and inseparable.

This Level 4 perspective aligns with Krause's (2016) argument that hydrosocial cycle perspectives invite us to view the circulation of water as an aspect of everyday social relations so we can understand how the temporal and spatial dynamics of water contribute to, and participate in, shaping social relations. In other words, the hydrosocial cycle perspective invites us to consider how over time, human processes influence our relationship with water, which in turn changes water's relationship with us through the simple expansion of water onto dry land, or the movement of water away from dry land. This perspective recognizes the limits of a hydrological cycle frame and asks societies to adopt an integrated perspective of water–human relationships so we can see the influence of human assumptions, values, understandings, and practices on how we frame our relationships with EFWE (Bakker, 2012; Bates et al., 2008; Gober & Wheater, 2014; Krause, 2014, 2016; Krause & Strang, 2016; Sammel, 2016; Sammel et al., 2018; McMartin et al., 2018; Sivapalan et al., 2012). Lindon and Budds (2014) warn of privileging the hydrological cycle perspective:

> [it] is not merely a neutral scientific concept, but can be regarded as a social construct with political consequences … that it emerged in a specific historical context in pursuit of particular objectives and interests, and that it was constructed according to a vision of nature that authorizes the realization of these objectives and interests by deploying a particular form of expertise. (p. 171)

Yet, our research reveals that in this reviewed collective body of academic work, this Level 4 perspective was rare, despite the United Nations' repeated calls for a more integrated approach to understand water–social relationships (Swyngedouw, 2006).

The privileging of the hydrological cycle within the reviewed academic papers presents opportunities to observe and reflect on Foucault's (1983) concept of *regimes of truth.* This concept suggests that within all societies, historical evolving patterns of thought, classifications, and forms of knowledge, have become so normalized that they structure society's perceptions of self and the world around them. This perceived *legitimate* knowledge holds so much power that it functions as the truth in that social system. And like any other concept, the "truth" about EFWE becomes so entrenched in social systems that it has the potential for controlling conversations.

Even though our findings, based on literature pertaining to specific geographical areas, may not be representative of research literature from other geographical areas, they still do offer one conceptualization of a grand narrative of how multidisciplinary research frames understandings of EFWE. With this as a starting point, we ask, to what degree has the hydrological cycle perspective influenced what people believe to be "true" about EFWE? To what degree does this understanding limit or close down conversations about EFWE? How might a hydrological-focused perspective disable hydrosocial considerations, or other perspectives, such as considerations of EFWE from the perspectives of the more-than-human world? In asking these questions, we can't help but reflect upon the patterns and trends emerging from these specific peer-reviewed academic papers, and how they may exclude a wide net of perspectives, from many unique angles, or how they may limit our understanding of synergies between freshwater and the Earth itself.

Conclusions

Globally, humans (as well as the non-humans with whom we share this planet) face a future of unsustainable freshwater use and increased exposure to EFWE (Wheater & Gober, 2015). Undeniably, there is urgent need to improve our understandings of natural and social systems that influence freshwater and EFWE. This study contributes to the literature by illustrating how recent academic research articles, in two geographical areas, dramatically privilege a hydrological cycle understanding of EFWE. Inherent within our findings is a negative, anthropocentric bias, where EFWE are assumed to be only *natural* events (separate and distinct from human systems) that can, and should, be managed to decrease disruptions to social systems and infrastructure. There is little acknowledging of historical, complex, coevolving relationships that humans have with freshwater. Based on our findings, we advocate for these geographical locations to employ more research from a hydrosocial cycle perspective—where EFWE are understood as an integrated and inevitable part of the circulation of freshwater, critical for all life, and deeply interconnected and influenced by human existence and practices.

Although this case study is small in scope, the pattern it identifies might be reflective of other research in other locations. As such, we strongly encourage researchers, in many geographical regions, to investigate what knowledge predominates (or has become normalized or legitimized) within broader EFWE narratives. We encourage this analysis to ensure balanced representations of hydrological and hydrosocial perspectives within academic research. This recommendation is made with the aim of generating greater depth and breadth of knowledge to assist people, including policy-makers, to more holistically recognize and address changing water conditions that will likely affect all life on our planet.

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Ecology in Context: A New Conceptual Frame

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Abstract

This paper reports on a developing theoretical frame for human ecology. It is based on the archetypal conceptual frames or contexts that underpin all scientific endeavors and draws on the new powerful techniques of semantic analysis. There are three archetypal scientific frames that have emerged since the Enlightenment, referred to here as the *mechanistic*, *systemic*, and *interactive* frames respectively. These three frames are conceptually distinct and each involves different levels of analysis. Each also operates with its own fundamental units: *things* (substantives or nouns) in the case of the mechanistic frame, *processes* (actions through time or verbs) in the case of the systemic frame, and *events* (experienced qualitatively) in the case of the interactive frame. All three frames are equally important for developing scientific understanding, but they are often confused in the scientific literature. Semantic analysis enables human ecologists to unscramble such confusion by drawing on the concept of archetypal meaning (sometimes referred to as the *core* or *invariant meaning*) and by defining and elaborating variations in meaning rigorously through the use of a natural semantic metalanguage (NSM). In addition, semantic analysis enables researchers to analyze the way motile organisms internalize their experiences by mapping the conceptual frame that they have internalized and use to make sense of those experiences. Traditionally, ecology and especially human ecology has been concerned with the interactions of organisms with each other and with their environment or context. It is argued that the interactive frame offers better explanations for evolution, creativity, and the experience of properties than the other two frames and provides a powerful explanatory frame for human ecology.

Keywords: agency, context, ecological interaction, interactivity, mechanism, quality, semantic analysis, system

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Introduction

Ecology has long been thought of as the science of interactions between organisms and their environment. But what exactly is an *interaction*? Is it an *entity* or a *process*? This paper argues that an interaction is neither thing-like nor process-like: rather, an interaction is an *event*. Examples of events include claps of thunder, a river bursting its banks, and the conception, birth, or death of a living organism. A human decision is an event that takes place in the mind. Decisions are fully embodied events, both emotionally and cognitively. More generally, events involve numerous processes interacting together that can be thought of abstractly as a point in time where interacting things and processes create new contexts. The claim here is that an event orientation for ecology, and especially for human ecology, provides a unique frame for dealing with discontinuous change. It is argued that events resulting from an interaction create change. Neither organisms nor processes are creative in themselves. In other words, through the process of interacting with its environment, an organism triggers events of different sorts, some intended and some unintended. These events create new contexts. All organism–environment interactions are context-creating in this way and cannot be explained in terms of mechanism or process as traditionally understood.

In addition to dealing with interactivity, it will be argued that an event orientation provides a gateway for dealing with the human experience of quality including features, properties, characteristics, and evaluative experiences of all sorts. These include the experiences of color, dimension, shape, texture, and, of course, quality. If we think of physics and chemistry as the science of *things* (substantives or nouns), and thermodynamics and general systems theory as the science of *processes* (actions through time or verbs), then ecology is the science of *properties* (adjectives and adverbs in natural languages). Properties are the units of experience not only for humans but for all motile organisms. Even motile bacteria move toward things they find good and away from things they find bad on the basis of their subjective judgment. Judgments, like decisions, are events that involve interacting processes. They are neither mechanisms nor systems.

Properties have both a subjective and objective component: subjective when experienced directly as a participant within a contextual situation and objective when seen from the outside as an observer. A decision made by a motile organism is an event involving internal biochemical interactions. When acted out, that decision creates a new context. In the approach reported here, the evolution of language and the evolution of technology, like biological evolution, are the result of context-creating events. As argued here, contexts are critical in making sense of creativity, emergent properties, and, as Darwin discovered a century and a half ago, evolution.

Finally, it will be argued that an event orientation gives us a way into the subjective experience of organisms which is much richer than traditional push/pull, stimulus/response, or action/reaction dynamics. It strongly suggests that organisms develop their action potential in terms of generalizations or rules in the form "if X, then Y," where X is an internalized contextual feature of a conceptual frame and Y a specific behavior.

Why context?

Whatever exists must exist somewhere, in some kind of place or context. As the philosopher Edward Casey (1997, p. ix) points out:

> Place is as requisite as the air we breathe, the ground on which we stand, the bodies we have. We are surrounded by places. We walk over and through them. Nothing we do is unplaced.

This is a primal fact that calls out for recognition, not only in the case of physical places (such as the surface of a leaf, a pond, or a town) but also their metaphoric extension as conceptual (or internalized) contexts (such as a home territory or nation-state). Contexts are a property of mind. They do not exist independently of the experiencing organism. They have the very useful property of being able to be mapped on the basis of abstracted hypothetical meanings empirically ascribable to the individual or species of organism concerned. Traditional scientific measurement techniques are a special case of such mappings (discussed further below).

We humans recognize the importance of context when we are quoted out of context, when we misread a situation or observe others behaving inappropriately in one or another context. We spend a great deal of our waking lives observing, interpreting, and discussing contexts; whether we are dressed appropriately for the occasion, whether the organizational arrangements are suitable, and importantly, whether our reading of a situation is good enough to assess risks, identify options, and make sound decisions.

At the core of these internal deliberations (*discussions* when more than one individual is involved) is an exploration of whether our understanding of a situational context matches other understandings. Deliberative processes through dialog with others (or within ourselves) enable shared understandings to be developed—or at least an understanding of points of difference. Interpreting contexts correctly not only avoids what Goffman (1959) called situational improprieties; it generates good policies, produces innovative technologies, creates livable habitats, and aims at least to maintain and preferably improve the quality of life.

Contextual thinking then is essential not only for interpreting the meaning or significance of foregrounded foci, it actually creates new contexts as they are acted out. Traditionally the humanities put a great deal of effort into describing relevant contextual factors, but they are largely assumed in the sciences. However, both fail to recognize that the act of setting down or documenting a context creates a new context. We already know this and experience it acutely when a child is born or a loved one dies—the world is no longer the same. But this is true for every action by every living organism. Their actions change contexts and thus are the creative events that really change the world. As we will see, context-changing events increase exponentially and offer a potential explanation for the increasing speed of biological, technical, linguistic, and, especially, cultural evolution.

At present, each academic discipline has its own conceptual frames, working methods, area of specialization, and widely accepted findings that are assumed valid, reliable, and useful for the discipline concerned. But these specializations result in an increasing fragmentation of knowledge. Context analysis offers a tool to translate across disciplines, and, where possible, to integrate findings. The development of the objective metalanguage needed for this task is a job for specialist linguists, just as the development of logic and mathematics (including statistics) are jobs for specialists. But the application of these powerful tools is a matter for all researchers.

First we need to recognize that contexts are important for all scientific disciplines. This is already recognized in evolutionary biology, which seeks to identify selection pressures as contextual features driving evolution and ecology. This includes describing ecological niches and biomes as the defining environmental features that each species of organism needs in order to live well. Some ecologists also illustrate the environmental features impacting on an organism diagrammatically as an *envirogram* (Andrewartha & Birch, 1984), but these involve physical contexts only. Ecologists and evolutionary theorists lack the tools for analyzing conceptual (or subjective) contexts which motile organisms (including humans) draw on to make their judgments and decisions.

Subjective and objective contexts

Here it is claimed that there are two ways of thinking about contexts: objectively (seen from the outside) or subjectively (experienced from within). The outside view turns a context into an object, process, or event. From the inside, it is experienced as an *affordance*: a term invented by the psychologist James J. Gibson (1986). The outside view has describable properties that can be measured in some way (discussed further below). An objective context can even be thought of metaphorically, as though it is itself an agent. For example, we can think of the market as being jittery, a nation-state waging war, an idea going sour, and the gods being angry. The personification

of contexts is metaphoric: markets, nation-states, ideas, and gods do not exist in fact, nor can they do anything. Rather, people do things in the context of markets and so on.

The core methods described here involve analyzing, testing and mapping internalized contexts objectively. Organisms do not interact with the world directly; they act out their internalized generalizations about their world and how they should act in it. These generalizations, as we will see, are internalized as rules and algorithms for living well and for avoiding the opposite.

Young children are brilliant at making sense of contexts. They learn the rules governing their native language and the social dynamics of their culture by interacting with it and internalizing its contextual features. Exactly how they do this remains deeply puzzling, but as child psychologist Vasudevi Reddy (2010) points out, it is not through some sort of conditioning processes, but rather children *engage* with the world from birth. They are active agents, experimenting, playing, and testing limits as they internalize the rules, roles, and the conceptual frames (or internalized contexts) that they need to interact with others and live their lives. Before they start kindergarten, children have learned their language, formed their personalities, and acquired the social skills that they will need to function successfully (or otherwise) for the rest of their lives.

As is well documented, when children play they set up imaginary contexts and make up the rules of the game as part of their socialization. Educators set up contextual situations in the classroom or in the field to adapt their material to the readiness of their students. Students are not empty vessels. Learning comes through the experience of interacting with and engaging with the contextual frame presented by the teacher. Environmental educators are particularly interested in making sense of contexts (Fisher & Hoverman, 1989).

In addition to educators, creative artists set up contexts, for example, as a background to a painting or a theatrical stage, a movie set, or a descriptive passage in prose and poetry. Contexts can be physical, like road networks and urban infrastructure (bridges, buildings, water supplies, sewage treatment plants, and so on), or conceptual, like a set of religious beliefs, a legal or disciplinary framework, a scientific model, a theory, or even an idea.

It is important to stress that a context cannot be seen from the inside, it can only be experienced subjectively as an affordance. Gibson made up the term *affordance* to describe those features of the environment that are useful for an organism: a functional definition of what is experienced subjectively. For example, a bird might perceive a branch, not as a branch, but as functional action-oriented, *sit-on-able*. A small moving animal might be thought of as *chase-able* to a dog. These are pragmatic functional realities: part of an organism's action potential. Seen this way,

the world is experienced subjectively and is very different to the world described by physics and chemistry. The basic idea reported on here can be traced back to Jacob von Uexküll's (1957) idea of *umwelt*, which is sometimes translated as a *perceptual world view* (of an organism) or *frame of mind*, but such phrases are too broad for the specific contextual features that function as an affordance for an organism in any given situation.

It is important here not to confuse the subjective experience of an affordance with its mapping: an abstract conceptual frame that can be illustrated objectively as a diagram or a verbal description. This distinction is further elaborated below when the conventions of scientific measurement are discussed. First, a further psychological distinction needs to be drawn between the ways we experience the world intuitively and deliberatively.

Thinking fast and slow

The behavioral economist Daniel Kahneman (2011) distinguishes between *fast thinking* and *slow thinking*, a distinction that has been long recognized by psychologists in one form or another. Fast thinking, he argues, is subjective, intuitive, and based on the contextual frame *what you see is all there is*. He contrasts this with slow thinking, which is based on externalizing our experiences and objectifying them. The objective view enables us to analyze contexts in great detail, assess risks, develop options, design modifications, and act on them. Fast thinking can also lead to action, but such actions, according to Kahneman, are based on our animal instincts such as food preferences, fight/flight responses, and sexual attractiveness. They served our ancestors well long ago, he argues, but are less likely to do so in the context of our complex societal and institutional arrangements. The reference to *animal instincts* is far too vague for scientific purposes. Tools are emerging to enable us to map the frame *what you see is all there is* for specific organisms, as well as to analytically (and critically) examine the contextual frames that govern deliberative, slow, thinking.

In addition to the two ways of thinking, Kahneman and his colleagues have shown that there are two different selves within us: the experiencing self and the narrating self. The experiencing self involves our moment-to-moment conscious awareness that operates in the context *what you see is all there is*. It remembers nothing and is rarely consulted when making decisions. The narrating self is the brain's interpreter, spinning yarns about what is happening now and what happened in the past, as well as making plans for the future. Only the highlights are woven into the story that the self uses to orient the individual in the world and create the internalized contexts we draw on in making sense of our experiencing self.

There is nothing new here. Broadly speaking, the humanities have always sought to describe the subjective experience of contexts, while the sciences (both physical and social) have focused on making sense of their objective features. However, as

the phenomenologists remind us, our subjective experiences are real, immediate, and constantly evolving. The objective view is artificially constructed through observation and experiment. While artificial, it is rigorous, and, like the built environment, has proven itself far more reliable and useful than the subjective. But this is only true if what economists call *externalities* are ignored. Highlighting unintended consequences of the application of discipline-based decision-making, exposing externalities and dealing with them are at the heart of human ecology.

In summary so far, humans (and all motile organisms) live in physical contexts and act out their internalized conceptualizations of these contexts. In the process, organisms create new contexts. The human species is superb at this, turning dangerous and threatening spaces into familiar and safe places, empty houses into homes, and a pile of clothes into a social statement about ourselves. Local communities and in-groups of various sorts form different types of context created by and existing primarily in the human mind. Lines on maps and fenced or walled borders are physical artifacts and secondary to the conceptual reality. Contexts are far more important than the activities that created them because the activities are short lived, but the contexts themselves are socially constructed and can survive for hundreds and sometimes thousands of years. For example, consider the persistence of territorial disputes, or religious beliefs and associated cultural practices. The contextual circumstances of organisms' experience drive evolution.

Analyzing contexts

As contexts are essential for making sense of what is under consideration in the foreground, a technique is needed for analyzing them. Here it is argued the emerging technique of semantic analysis is best suited for this purpose and offers a conceptual tool to add to our scientific tool box. Just as logic and mathematics are useful tools, semantic analysis offers a formal method for describing and defining meanings explicitly. It uses the techniques developed by cognitive scientists such as George Lakoff and Mark Johnson (Lakoff & Johnson, 1980, 1999, on analyzing metaphor), Cliff Goddard (2011, on cultural scripts), and especially, Anna Wierzbicka (1985, 1988, 1996, 2003, 2014, on semantic primes and their application). While analyzing meaning is also of great interest to philosophers, they do it horizontally, by analyzing the meaning of words largely in terms of other words. Semantic analysis is an empirical science. Like linguistics and cognitive science, it analyzes meanings vertically by examining the interactions of real events, processes, and things with our conceptual or contextual understanding of them. It draws on the universal features of language as benchmarks and has both a subjective and an objective dimension.

To illustrate the technique, we next consider the three archetypal scientific frames that have emerged since the Enlightenment in some detail. These are the mechanistic, systemic, and interactive frames or contexts that scientific disciplines draw on in developing their theories and models about the world.

To understand a context, we need to step outside it, as it were, and examine it objectively. This is difficult for people who have never experienced another culture, or who have been trained in a single discipline or raised in a single belief system. They lack a contextual frame outside their familiar one to step into. As Wierzbicka (2014) pointed out, they are trapped in their ethnocentric and narrow conceptual worldview. Fortunately, as more and more people are exposed to other cultures, different belief systems, or other disciplines, they are able to draw comparisons and escape their parochial cells.

One way to avoid entrapment in one's own mindset is to think about others not in relation to one's own contextual frame, but in relation to the archetypal thinking frames used by people for millennia: what Mary Midgley (2003) calls *myths we live by* or Carl Jung's primordial images and ideas he later called *archetypes*—core ideas that are universal to all humans. Archetypes can also be thought of as benchmarks or anchor points that have become empirically distilled over many generations through the medium of story-telling (Peterson, 1999). They are not simple metaphors but represent the fundamental empirical units of the human experience which, according to George Lakoff and Mark Johnson (1999), are embodied in the human psyche. They are the source of all metaphor. They also include the semantic primes that Wierzbicka and her colleagues have identified as universal to all human languages. The simplest way to think about semantic primes is to think of them as similar to the chemical elements that can be combined in various ways to create more complex molecules and substances of all sorts. In the same way, semantic primes can be combined to define meanings precisely using the natural semantic metalanguage (NSM) developed by these linguists. Again, this is not a new idea. It was first proposed by Leibniz over three centuries ago when he thought of it as an "alphabet of the mind" (Leibniz, [1704] 1903, p. 160–161; Wierzbicka, 1996, p. 13).

The mechanistic frame

This refers to the idea that the universe and everything in it operates mechanistically. People who hold this view are operating in a mechanistic frame or context. For them nothing is real until it can be explained in terms of specific push/pull, action/reaction, or stimulus/response mechanisms. An extreme version of the mechanistic frame considers direct experience, especially the experience of free will, as delusional, and the experience of consciousness as the most difficult problem faced by science.

The mechanistic frame emerged during the Enlightenment period. It came at a time when Europeans were fascinated by automata of all sorts. Examples include mechanical clocks, mechanized scenes from history, and amusement pieces such as toy music boxes and fantastic garden displays of animals and mythological creatures in motion. The historian Jessica Riskin (2016) in *The Restless Clock* traced the history of the idea of mechanism as it came to inform philosophical and scientific thinking over the last 400 years. At the core of Riskin's history are two competing

ideas of mechanism: the idea that mechanisms consist of mindless interacting parts (a view espoused by Descartes, Newton, and modern thinkers such as Dennett and Dawkins), and the idea that mechanisms are not made up of mindless bits and pieces but also involve some sort of agency or purpose (a view espoused by Leibniz, Lamarck, Whitehead, Charles Birch, and process philosophers generally). Darwin was puzzled not only between these two different mechanistic views, but puzzled over the very idea that life, and especially the experience of emotion and value, was mechanistic.

What is common to mainstream mechanistic thinkers, however, is the idea that the world and everything in it consists of things, items, objects, and entities that linguists describe as *nouns* in natural languages. Things in this view range in size from subatomic particles to galaxies. They include photons, atoms, complex molecules, living organisms (plants and animals), and large objects such as planets and stars. They also include conceptual things like minds, motives, and beliefs. The whole universe in this view is thing-like and everything is either a part of one thing or a collection of things.

In this dominant frame, things are in fully determined synchronic relationship with other things. They are either mindless entities governed by immutable physical laws in the Newtonian tradition or have some sort of emergent consciousness associated in the (minority) Whiteheadian and pan-psychic traditions, but they are things nevertheless.

The systemic frame

Some 200 years after the emergence of mechanistic thinking, a new archetypal frame emerged that can be described as the systemic frame. The fundamental units of this frame are not things but processes, actions, and behaviors that linguists describe as *verbs* in natural languages. In all languages, process words (verbs) carry tense markers. The idea that reality consists only of processes is also old, going back to the early Greeks in the West and the Buddhist tradition in the East, but it came into scientific orthodoxy through the work of the mathematician Jean Baptiste Fourier who studied the transfer of heat in solids. In 1811 he was awarded the prize of the French Academy of Science for showing that heat flow is proportional to the gradient of temperature (Prigogine & Stengers, 1984, p. 104). This was the start of what is now known as thermodynamics. In this view, heat is not some sort of thing, but is a process involving energy transfer. Later this frame came to include the physical flows of liquids and gases and the feedback processes that regulate them. More recently the flow of information is being seen in systemic terms as part of general system theory.

In the systemic frame, things are real enough, but they are temporary states in interacting processes. Their existence is temporary: they are always either coming into or going out of being through a specific set of processes including feedback processes. The process philosophy of Whitehead, Hartshorne, and Birch provides further elaborations of this tradition, as does the systems work of Jay Forester and many others.

Like the mechanistic frame, the archetypal systemic frame is fully deterministic, but causation does not involve simple push/pull interactions. Rather, causation is more nuanced as flows interact by merging, separating, and cycling as materials, energy, and information are transferred and transformed. Regulation is not through some sort of immutable physical laws, but through subtle feedback processes. While reversibility is theoretically possible in the mechanistic frame, it is not possible in the systemic frame. Time cannot flow backward.

The systemic frame does not replace the mechanistic frame but offers an alternative conceptual model based on the universal distinction between things (nouns) and processes (verbs). It provides a different level of analysis. One is not better or worse than the other. Both are necessary and both have considerable explanatory power: mechanisms best describe synchronic relationships between things while processes involve diachronic interactions and feedbacks. Some mechanistic thinkers have tried to explain change by positing a fourth dimension—time—which seems unnecessary and artificial as the systemic frame deals with time and change-over-time par excellence. A great deal of highly specialized work has been done to explain how biological phenomena might be explained in these two frames that will not be reviewed here. Rather, we leap over that history to report on a new frame that is claimed to better explain the evolution of living organisms.

The interactive frame

While the systemic frame is excellent for describing continuous change, it does not explain the stochastic, unpredictable, and increasingly complex changes associated with the evolution of life. The idea that species of organisms evolved can be traced back to the work of a number of French naturalists, especially Jean Baptiste Lamarck and his often maligned 1809 classic *Philosophie Zoologique*. But it came into scientific orthodoxy some 50 years later (at least among biologists) with the work of Alfred Russell Wallace and especially Charles Darwin. Nowadays Darwinian evolution is central to all biological understanding, not only among evolutionary biologists but also among geneticists, embryologists, physiologists, endocrinologists, virologists, botanists, ethologists, neuroscientists, and many other disciplines.

The evidence for evolution is overwhelming and often regarded as the best supported of all scientific theories, but how exactly does it work? At its core is the idea that living organisms interact with each other and their environment. Those that do so successfully and reproduce pass on their successful characteristics to the next generation. Over long periods of time successful characteristics tend to survive and unsuccessful ones die out: what Darwin called *natural selection*. Since Darwin, some biologists have seen natural selection as a mechanism (e.g., de Beer, 1968) and others have seen it as a process. Here we reject both these ideas. Evolution is non-deterministic and unlike mechanisms and systems (as defined above). Individual organisms come into being as newly created forms that interact with their environment to create new contexts. The new contexts create new opportunities and pressures for other organisms to interact with. Evolution then is a sequence of context-creating events. It is not individual organisms, species, genes, or populations that evolve: it is the context that evolves. Living entities are part of a series of complex events going back to the beginning of life on Earth. Being alive is totally dependent on the life that has gone before and created the contextual conditions that enables the current generation of organisms to thrive. These organisms are mutually dependent on each other for food and the environmental conditions that enable the whole to thrive. Each is unique (even when closely related) as a result of a unique series of experiences or events. These events are discontinuous (stochastic) and largely unpredictable. In Dawkins' (1991) famous phrase, "evolution is blind," but unlike mechanisms and systems, evolution is also creative, and, as argued here, the context is what is created and selects.

This distinction is fundamental. If we take the archetypal mechanistic frame as involving fully determined bits and pieces in specific functional relationships with each other, creativity is impossible. Likewise, if we take the archetypal systemic frame as involving interacting processes that are also fully determined (in accordance with the laws of thermodynamics) creativity is also impossible. But an interactive approach that recognizes the role of context in the behavior of living organisms offers a frame for thinking about the creativity of life in general. The power of this interactivity cannot be doubted. The free oxygen in the atmosphere is created and maintained by living organisms; the oil, coal, and natural gas we now consume as energy sources were put there by living organisms, as are the limestone and cementiferous materials we use in construction. As Lovelock has pointed out as early as the 1960s, the whole biosphere is self-regulating through the interaction of living organisms. Finally, human activities are now so powerful that they are damaging the conditions under which humans themselves evolved and need for their continued survival. Even more significant is the speed at which contexts are changing. It took millions of years for living systems to deposit the fossil fuels and create the atmospheric conditions and biodiversity on which we depend. Humans are rapidly changing these conditions to a noticeable (and measurable) extent over mere decades.

There is a huge and growing literature that attempts to build creativity into the basic systems frame, including, for example, adaptive systems, soft systems, evolving mechanisms, and emerging properties. Like positing a fourth (time) dimension to account for change in the mechanistic frame, such strategies seem somewhat artificial and arbitrary. Better to accept that mechanistic thinking cannot account elegantly for change and use the much more coherent and well-developed systemic frame for continuous action over time. So too, it is better to accept that systemic thinking cannot account elegantly for creativity involved in the way living organisms develop, adapt, and evolve. As will be argued below, these phenomena are context-dependent and do not readily fit the systemic frame. Rather, creativity can better be explained by recognizing a third archetypal frame, the interactive frame, to account for evolution.

Not only is evolution interactive, so are all biological processes including gene expression, neural transmission, learning, and all behavior. And not only organisms but all living cells interact with their environment, internalize their experiences, and act out their inner states in context, but not any context; only the context that is relevant and meaningful to them. This is not the context that is described by physics and chemistry (important though such explanations are for other purposes)—it is the context that living organisms internalize through experiencing the world in which they find themselves. It is through mapping these subjective internalized contexts that gives science a new methodology to advance our scientific understanding of the behavior of living organisms as they live out their lives. In the case of the human organism, it offers an explanatory frame for dealing with the way humans increasingly impact on the world in which they find themselves. The psychologist Jordan Peterson (1999) in his *Maps of Meaning: The Architecture of Belief* attempts to map archetypal meanings of human narratives in terms of Jungian archetypes. Peterson is not a linguist and does not have the sophisticated tools of semantic analysis available to him, but his technique is fully consistent with the approach adopted here.

Jonathan Kingdon (1993) referred to the human species as "Self-Made," and, more recently Yuval Noah Harari (2015) called the species "Homo Deus," but such phrases are misguided. It is the whole of life that is evolving. Humans are a part of this evolutionary dynamic—an increasingly important part, but not independent of it and certainly not in control of it. Simplistic mechanistic and systemic thinking has unintended consequences. It destroys much of the natural world that we value through the incorrect application of these frames. An interactive frame facilitates holistic thinking as humans plan for an unknown future and build resilience to deal with the unforeseen and unintended consequences of past actions.

Properties

Properties are the units of experience. They describe an interaction between an individual and an aspect of context (including a thing, process, or event) that is in focus. They have both a subjective emotional or value-oriented dimension and a physical dimension at the same time. In natural languages, property words include words denoting features, characteristics, traits, aspects, and qualities. Such words are traditionally classed as *qualifiers*. Indo-European languages typically have several classes of qualifiers known as *adjectives* when they refer to things (nouns) and *adverbs* when they refer to processes (verbs). As pointed out by Dixon (1982), while most languages have rich and open classes of qualifiers, there are a few languages that do not have specific words that might be classed as adjectives or adverbs (notably Chinese), but all languages have specialized syntactic structures that are used to convey property-like meanings or qualities. Just as linguistic categories such as noun and verb are universal to all human languages, so too is the idea of qualifier. These linguistic categories are fundamental features of the experience of being human, like being bipedal and having large brains. They are also fundamental for scientific understanding.

In addition to making use of syntactic features to account for meaning, languages also make use of semantic roles to signify the relationship a word has with the main verb—for example, the roles of agent, beneficiary, causer, and experiencer. Languages are complex, involving not only physical entities such as words and other syntactic structures, but also subjective features such as semantic roles and property-like descriptors. Language itself is a bipolar phenomenon having both sense and reference.

Property-like concepts include references to color, size, texture, weight, number, gender, and evaluative concepts such as good/bad, many/few, true/false, and so on. They differ from nouns and verbs, which operate under the primary assumption of reference. As pointed out above, property-like concepts can be analyzed into two components: one referring to an object, process, or event, and the other referring to a speaker's subjective experience of it. The dual nature of sense and reference inherent in property words and other qualitative expressions has given philosophers much to argue about over the last 2,500 years, some claiming that properties are real and part of the world (philosophical realists) and others arguing that properties exist only in the mind (philosophical idealists). Here it is argued that they are both at the same time.

The human ability to switch contexts from subjective to objective and back gives us a new way of dealing with the conflicted views on properties. This involves a shift from a mechanistic (push/pull, action/reaction, stimulus/response) thinking style to the more complex idea of *engagement* where an organism is constantly interacting

with its environment. Engagement in the case of humans involves interaction through all sense modalities at the same time. Rather than assuming that organisms are activated by drives, needs, and motives of various sorts, this perspective assumes organisms are basically active and not inert entities that need some sort of activating mechanism. There is a vast psychological literature dealing with needs, motives, and drives that seek to measure these hypothesized mechanisms and identify their underlying neural patterns, but such approaches become largely vacuous in an interactive contextual approach. If we do away with activating drives, needs, and motives we can ask new questions and test new ideas about the internal state of organisms as they act out their internalized understanding of their world. The task of science, in this view, is to map out the mental models organisms use in orienting themselves and acting out their goals.

Illustrating the technique

Formal research involves a conceptual framework and then uses (1) rigorous methodologies, (2) the application of standardized measurement conventions, and (3) the creation of robust models and theories within the conceptual frame or disciplinary standards. Research that does not meet these standards is rejected, but where the findings, theories, and models meet disciplinary standards they may be published to encourage critical review and replication.

Consider the following thought experiment. Imagine two points in space, A and B, and yourself as an external observer O as in Diagram 1.

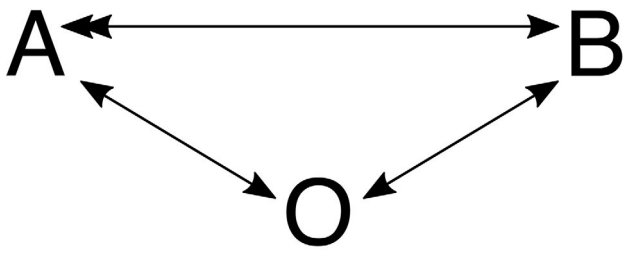

Diagram 1: Observation external to relationship.
Source: Author's depiction.

Observing both A and B from this vantage point, you can say that the relationship between A and B is the distance between them. You can measure this relationship objectively in terms of some standard unit (from millimeters to light-years as appropriate).

Now imagine yourself as being in between A and B as in Diagram 2. Now you are part of the relationship and unable to observe it from the outside, as it were.

Diagram 2: Observation internal to relationship.
Source: Author's depiction.

You can walk to A then turn around and walk to B counting steps, breaths, heartbeats along the way, or use some other strategy relative to yourself. Thus you cannot experience the relationship objectively, but only subjectively in relation to how long it takes you to go from A to B. In this situation the relationship between A and B is exactly the same: they both have the same reference, but are experienced differently. The first is experienced objectively (as distance) and the other subjectively (as time). All human languages mark for tense, providing strong evidence of the universality of time. People often also think of distance subjectively in terms of the time it takes to go from A to B in objective units (hours, days, etc.), and science has combined the two, as in miles per hour, light-years, and of course in their integration as space-time. In physics both space-time and electromagnetic fields are contexts.

Time is not the only aspect of the experience of being alive that can be objectified: so too can Gibson's affordances and all qualitative experiences. More generally, the scientific method has adopted specific measurement conventions for turning subjective experiential properties into objective measurable variables. Such properties as dimensions, duration, mass, capacity, and force are well known. People are so familiar with them that they assume measurement is a simple process. But as the philosopher J. R. Lucas (1984) makes clear, measurement is theory-loaded and far from simple. Measurement conventions include the assignment of a rational number to a distance (length), angle, or mass, but sometimes integers are used, for example in assigning atomic numbers to the chemical elements or in Möhr's scale of hardness. Sometimes a polarity (+ or -) or (N or S) is assigned. Sometimes a logarithmic scale is used, for example in measuring hydrogen ions in soil (soil acidity), while fields can be described not in terms of scalar numbers, but vectors and tensors. Angles can be defined in terms of radians and so on. Potentially all subjective properties can be objectified using some standardized technique.

Measurement, then, is the process of turning a subjective property into an objective one. In more formal terms, a measurement is an interactive event that maps a subjective property onto an abstract category, thereby objectifying it. The objective categories are benchmarks or anchor points for rendering a subjective property objective and permitting precise comparisons.

The conventions associated with measurement and benchmarking are central to all scientific endeavor and go further than the simple allocation of numbers. Categorization is a process of grouping things on the basis of shared features. For example, most scientific disciplines have developed complex taxonomic systems to classify the things and processes they are interested in—the Linnaean classificatory system for naming plants and animals, for example, or the periodic table of elements, or the linguistic conventions for classifying human language families. These are contextual structures (conceptual artifacts) for turning subjective properties or features into objective entities. Instead of being a thing with feathers and webbed toes that goes quack (called *duck* in English), an animal with those features and behavioral traits becomes standardized as *Anas platyrhynchos domesticus*. Classification in itself does not enhance understanding, but it provides an agreed contextual frame within which comparisons can be rigorously evaluated, and on the basis of which new understandings can emerge.

Human ecology

Many ecologists have chosen to focus on natural phenomena as external observers. Others, particularly human ecologists, have chosen to include the human species. They see humans not just as another (albeit special) organism, but as a creative change agent that has created a scientific understanding of the world and the built environment in which most humans live. In addition, human ecologists are interested in both the objective external view of contexts (biomes, niches, bioregions, and so forth) and the subjective experience of being inside a context. It is in the inside (subjective) domain that intuitive, fast thinking, decisions are made. Contrast this with collective and deliberative decision-making where the context is objectified, scenarios proposed, options weighed up, and conclusions drawn: interactive events create new ideas and new courses of action. A decision is an event; and crucially, slow thinking is not a process, but a complex sequence of neurological events. Thinking is not a process because each component of the neurological event is dependent on a wide range of interacting factors. The number of neurons involved, the length of time since each neuron has fired, the presence of suitable neural transmitters, and so on. The pattern of firing, like the interacting patterns organisms which forms the web of life, is a dynamic event, not a simple or even a complex of processes.

Wider applications

It is common to all living organisms (including humans) that they constantly interact with their world and change as they develop, adapt, and learn. At some point in evolutionary history some organisms evolved a capacity to change location (from one physical context to another). In short, they evolved a capacity to move. Motility enabled these organisms to choose between moving up, down, left, or right as well as not moving at all. Changing position gave motile organisms options that were not available for sessile organisms. It also provided selective pressures for evolving better perceptual strategies to find food, and better camouflage and defensive strategies to avoid being eaten. Later a new capacity emerged enabling some motile organisms to predict the movement of their prey. For a predator to secure a meal, it must aim at where it predicts its fast-moving prey will be at some future time, before it strikes. To counter this predatory advantage, prey organisms evolved a whole raft of strategies including ducking and weaving, or playing dead, and most importantly, many evolved cooperative arrangements of various sorts. Many eyes and ears are better than one, and by acting together prey animals evolved defensive strategies giving new survival options that necessitated cooperation. Finally, some organisms evolved a capacity to not only anticipate but to separate their evolved anticipatory capacity from the immediate present. They can imagine alternatives and plan.

At what point in our evolutionary history the human capacity to imagine and plan emerged is controversial. It seems likely that other primates do not have this capability, although they have some of the basic moral precepts such as a sense of fairness, empathy, reciprocity, and theory of mind, as Frans de Waal (2007) and other primatologists have demonstrated. These moral precepts can be thought of as internalized rules of the general form in context "A do B." But there can be no doubt that the capacity to imagine and share our imagined realities through language did evolve progressively along with our bipedalism and bigger brains. What distinguishes humans today from our non-human ancestors is that humans are born into an increasingly human-made world, and are in danger of forgetting that we are just another organism in the constantly evolving web of life.

The three qualitatively different evolutionary steps (to move, anticipate, and imagine) assume organisms are essentially active agents interacting with a world that each conceives differently. It is vacuous, as we have seen above, to explain patterns of behavior in terms of some underlying motive, need, or drive. The experience of pain, hunger, and all of Maslow's famous hierarchy of needs are real enough, but they have no explanatory power. It is like saying behavior X is the result of a drive (need, motive, or other pre-disposition) to do X, or Kipling's famous, fantastic, *just so stories*, which need to be told in a certain way to account for such a natural phenomenon as "How a Leopard Got its Spots."

This is not a small point. The current work in neuroscience seeks to identify shared biochemical processes across the animal kingdom: for example, similar neurotransmitters underpinning similar functions. The existence of shared biochemical processes across species provides powerful evidence of the unity of the whole of life, but it does not account for the actions and choices of individual organisms. Hence the argument in this paper that they can best be analyzed in terms of the internalized contexts and situational factors that demonstrate what is going on.

So too with the important work on the surviving fossils and artifacts our ancestors have left behind. We are totally dependent on context, not only to date such fossils and artifacts, but to establish their function. Human ecologists can contribute to this understanding by examining the environmental contexts in which our ancestors found themselves and mapping these. For example, by mapping the use of fire in ancient times, and interpreting what managing fire and cooking enabled: to change contexts and allow humans to build a better world for themselves.

It has often been said that humans have adapted themselves to every environment on Earth, but this is far from true. What humans have done is to invent technologies that change their environment to suit themselves. In the words of Jonathan Kingdon (1993, p. 3) the emergence of technology:

> had many biological consequences for the path of human evolution: the human form, human diversity, language and our relationship with nature have all been shaped by technology. Humans have become intrinsically different from apes by becoming, in a very limited but real sense, artefacts of their own artefacts.

But we are not self-made organisms. The archetypal scientific frames suggesting that we are essentially mechanistic, or part of some fully determined system, or a product of our own artifacts might suggest this, but such ideas are thoroughly mistaken. Living organisms are active agents interacting with the world, and through their interacting events create change in the world. Maybe Dawkins is right when he argues that evolution is blind (non-teleological) and directionless overall, but this is not the case for the choices of individual organisms. The cumulative effect of the little choices is huge. Grasslands, forests, and coral reefs are huge structures made and maintained by living organisms acting purposively as they develop their behavioral potential. Rainforests and coral reefs may be mindless structures, but other physical structures such as termite nests, bee hives, rabbit warrens, bower bird bowers, and the dams of beavers have associated mental structures that enable bees to find their way back to their hives, bower birds to place each ornament in a precise position, and rabbits to find their way in and around their warrens. It is the mental structures or internalized contexts that need to be studied, and this is the role of human ecology.

Conclusion

Semantic analysis offers a tool for getting into the mindset of organisms by analyzing the meaning underpinning their behavior (in terms of affordances), and dealing with such experiences as *mind* and especially *consciousness*. For mechanistic thinkers, the nature of consciousness poses almost insuperable difficulties. Some have called it the hardest problem that science has to deal with (for a useful overview, see Blackmore, 2003). But consciousness is not something, nor is it a process. Rather, it is a subjective experience of the interactive events that result from living our lives. All living organisms experience some degree of "consciousness," as evidenced by plants when they become dormant and by motile organisms when they are anesthetized. Thinking of plants and microbes as having some level of self-awareness (or consciousness) may be a step too far, but plants vary in their activation levels (as do all organisms) and self-organize depending on external and internal circumstances. For example, plants stop photosynthesizing at night, and motile organisms become less active while asleep. Activation levels include all the internal biochemical and neural activities as well as any external observable behavior. Two chess grand masters may sit opposite each other for hours and all they do is move a small piece of wood a few centimeters every few minutes, but no one doubts their internal level of activation as they interact with those pieces of wood.

What is certain is that motile organisms, in interacting with their environments, demonstrate some sort of behavioral characteristics that enable observers to infer their subjective inner state. Context analysis gives us a new approach for mapping these inner states and dealing with such vexed questions as sentience and consciousness.

With its focus on interacting organisms, ecology needs a framework that explains the nature of an interaction explicitly. In this paper it is suggested the term *event*, defined abstractly as the point of interaction between two or more processes, is at the core of all ecological thinking. Events do not occur in isolation but are catalyzed by context. In other words, like a catalyst in a chemical reaction, features of a context speed up the interaction. Catalyzed events create new entities and processes, which in turn further change contexts. Darwinian evolution explains not only the emergence of new species but also explains the emergence of new contexts or opportunities/pressures for further evolution.

Science has traditionally used three archetypal contextual frames referred to in this paper as the *mechanistic*, *systemic*, and *interactive* frame. The *interactive* frame has a much wider applicability than just evolutionary theory and can be applied at all biological levels and processes from gene expression, through growth and development, to maturation, reproduction, and death.

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Book Reviews

Sites Unseen: Uncovering Hidden Hazards in American Cities

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Sites Unseen: *Uncovering Hidden Hazards in American Cities* reads almost like a detective story. And as with all good mysteries, the authors—sociologists Scott Frickel and James R. Elliott—open with a series of provocative and unanswered questions. How many former hazardous industrial sites—often home to what they refer to as "relic wastes"—exist in the urban areas of the United States? Given the lack of a robust inventory of such former sites and the loose or non-existent regulation many of them operated under, how can residents and community leaders understand the scope of hazardous industrial siting over time and across place? Which populations are most exposed to these residual or lingering wastes? How do formerly toxic sites become lost or concealed as they are eventually replaced by other types of land uses?

In their efforts to understand and reveal the generation and spread of industrial hazards in four US cities across four states—Philadelphia, Pennsylvania; Minneapolis, Minnesota; Portland, Oregon; and New Orleans, Louisiana—Frickel and Elliott transgress the boundaries of environmental and urban sociology by engaging other disciplinary realms, including geography, urban planning, industrial ecology, and history. *Sites Unseen* is deeply compelling. It is the type of book that opens the line of vision, questions assumptions about environmental inequalities and injustices, and invites new and different perspectives. The book is powerful because it makes the invisible visible. Through the careful, systematic analysis of relic wastes, *Sites Unseen* renders the mostly forgotten industrial past a part of the present moment. And with that, the authors introduce the possibility to address the injuries that these hidden hazards might cause.

Frickel and Elliott build the core arguments in the book around a process they call "socioenvironmental succession," which underscores the ways that social and environmental forces work in tandem to manifest the "gradual but ongoing contamination of urban lands by industrial hazardous waste" (p. 7) through a variety

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of urban-ecological transformations. Building on classic theories of succession by integrating scholarship on urbanization, risk, and environmental justice, the authors offer unique insights about processes related to what they term industrial churning, residential churning, and risk containment.

In the opening chapter, the authors offer an overview of their argument and the core concepts driving their work. The premise is clear at the outset: the spread of industrial hazards over time and across geographies can be understood as socially produced. They establish a roadmap with three intersecting pathways that describe how hazardous manufacturing facilities and locally unwanted land uses become "sites unseen."

First, there is *industrial churning*, which the authors define as the "how, when, and where" of industrial practices that transform urban environments (p. 6). Here they mean the "ongoing temporal and spatial changes in a city's active hazardous manufacturing facilities as those facilities go in and out of business or move from one location to another" (p. 6). These industries use and discard hazardous substances on-site and move from site to site in response to market forces (p. 24).

Second, and simultaneous to the first process, there is *residential churning*, or the growth and change of human populations whereby "urban residents come and go, entering and exiting cities or moving from one neighborhood to another" (p. 6). Residential churning occurs through migration and as a consequence of "urban renewal, disinvestment, and gentrification," which "reflect and reproduce patterns of economic and racial segregation at the city level" (p. 27). One of many outcomes of this neighborhood turnover and demographic change is the loss of public memory of past industrial actives and the hazardous wastes these industries may have left behind.

Third is the idea of *risk containment*, or the "broad patchwork of local, state, and federal environmental regulatory rules and practices adopted over recent decades to address potential risks posed by hazardous industrial waste on active and relic sites throughout the country" (pp. 28–29). Risk containment is "patterned through policies and practices that focus regulatory attention on publicly visible (and often clearly dangerous) facilities and blighted urban lots and waterways, ignoring far more numerous sites that have since converted to other nonindustrial or less hazardous uses" (pp. 6–7).

To put it simply, hazardous industries turn over, people move, and the government risk containment apparatus is not designed to handle the sheer number of small industrial polluters that exist. The outcome, then, is that the vast majority of hazardous sites simply fade into the landscape as they are built on, paved over, or otherwise reused for non-hazardous purposes. Imagine that your favorite local coffee shop was formerly home to a gas station, or that your child's playground was placed

atop an old plastic manufacturing plant. One of the many startling findings in this book is that "more than 90 percent of sites where hazardous industry has operated over the past half-century—in sectors known to release toxic chemicals and heavy metals on-site—have become lost, hidden from view by less risky land uses" (p. 3). Frickel and Elliott assert that the public should be concerned about relic industrial waste precisely because it is both hazardous *and* hidden. These sites, overlaid with a thin veneer of everything from strip malls to schools, hold within them a multitude of unknown potential hazards for those who live, work, and play on the land today. Furthermore, the ongoing churn and the lack of regulatory oversight contributes to the "relic wastes of tomorrow" (p. 15).

Frickel and Elliott do a masterful job of addressing much broader social, environmental, and economic processes as they contextualize their own rich and locally specific work. The authors chose Philadelphia, Minneapolis, Portland, and New Orleans for further analysis because these cities vary in terms of their demography, regional geography, racial and class composition, and local environmental governance. By placing each of these cities on a continuum along those dimensions (e.g., largest to smallest, least to most racially and ethnically diverse, most to least stringent industrial zoning, etc.), the authors move beyond the common, simplistic explanation that depicts cities as driven primarily by market forces. They offer a sociologically informed and complex understanding of urbanization as a "socioenvironmental process of successively interlocking changes in land, neighborhoods, and regulatory policies and practices" (p. 31).

To conduct their analyses in the four focal cities, the authors built, in painstaking detail, a novel dataset they refer to as the Historically Hidden Industrial Database (HHID). Frickel and Elliott, along with a team of their students, used often hard-to-locate state manufacturer directories to "dig more deeply into the questions of where relic industrial sites are located, how long they operated, and what they have become" (p. 36). The strength of the HHID is its ability to capture in granular detail the temporal and spatial dynamics of industrial turnover. This dataset, which starts in the 1950s and runs through the near present, includes information about the products generated at hazardous industrial facilities, the number of employees, and the locations of the facilities within the four case study cities. *Sites Unseen* contains a series of maps that show the number of relic and active sites over time and at varying scales of analysis. In addition, the authors offer an appendix and do-it-yourself user guide for replicating the HHID across community contexts, encouraging readers to address the mysteries of potential hidden hazards in their own communities.

Ultimately, *Sites Unseen* demonstrates that industrial facilities turnover—or churn—nearly continuously. These temporal dynamics operate alongside spatial ones, leading to the expansion and accumulation of hazardous sites. The ways in which this industrial churning intersects with residential churning, or demographic change, is the puzzle at the heart of the book. The authors find that while industrial churning

tends to occur about every 10 years on average, for the most part, residential change is a slower and more gradual process. Through the long lens of our racialized history it is clear that, as various population groups move in and out of the central core of urban spaces, whites as well as people of color have been and are exposed to various forms of industrial wastes.

Another key finding in the book is related to the volume and number of smaller-scale polluters that are simply not captured in the web of most environmental regulatory frameworks, which tend to focus on the most egregious polluters. When we look with a different lens and at a finer spatial resolution, a landscape littered with former industrial sites comes into focus. The ramifications of this insight in terms of environmental justice scholarship indicates that some environmental fractures cut across racial and socioeconomic groups in ways that weren't previously explored empirically. As the authors make clear, environmental justice scholarship is correct in pointing out the disproportionate and often devastating consequences of injustices on communities of color and low-income populations. However, as Frickel and Elliott began to look over a longer-term horizon and carefully examine smaller polluters alongside the bigger environmental violators, they found that a more nuanced portrait needed to be painted. The resulting image is one that shows that, due to gentrification and other forms of residential churn, white and middle-income city dwellers are also widely exposed to hidden hazards from relic industrial sites. In Chapter 6, the authors write about this finding in a thoughtful way:

> Not surprisingly, the story our data tell about environmental inequality differs from the story that most researchers, students, and policy makers have become accustomed to hearing. The narrative is not populated with heroes and villains, and our conclusions are not rendered with absolute clarity. Instead, the story is about impersonal processes and institutions, and the conclusions we draw are complicated by nuance and ambiguity. The results do not refute existing accounts [of environmental injustice], but they can sit uneasily on the shelf next to them and may raise discomfiting implications that can be emotionally and ideologically difficult to reconcile, especially to those who are committed to a particular narrative arc and ending … This discomfort need not be so, however … These dynamics [that the book reveal] do not mean that minorities and low-income groups are less at risk than earlier studies have indicated; instead our findings show that whites and middle-income groups also face more risk that scholars have previously realized (pp. 104–105).

We are living in a moment where many people seem desperate to find a bridge to span the expansive divides that seem to grow deeper and wider by the day. Frickel and Elliott may indeed have helped us to find that bridge in some kind of sad and unfortunate way. Their work demonstrates that we are *all* living with these hidden risks. At least those of us in cities that are subject to these industrial and residential churns and the basically non-existent framework for risk containment.

The knowledge of how widespread these risks actually are, and the fact that they don't only affect the most marginalized communities, might provide an opportunity for environmentalists, who are historically from whiter, more affluent communities, to work together with environmental justice scholars and advocates—who are more likely to be drawn from communities of color—to use this knowledge to greater effect.

As with all truly fascinating works of sociology, this book left us thinking about the conclusions long after we finished reading the last page. It also raised new questions that we hope may be taken up by the authors or by others. We introduce a few of those here, not because they made us question the veracity of the findings in *Sites Unseen,* but instead because the book inspired us to want to see more work in this vein.

First, does this model, which focuses mostly on relatively slow churn processes, also allow space for the kind of fast-paced churn that might happen after a rapid-onset disaster? Consider Hurricane Katrina, for instance. In a matter of days, it caused widespread industrial contamination as well as large-scale population displacement. Would the model presented in *Sites Unseen* account for that kind of rapid and large-scale residential and industrial churning?

Second, considering that socioenvironmental succession has ramifications for all facets of urban society, what are the practical implications of the work? If deindustrialization really has not slowed the process of socioenvironmental succession and cities are still experiencing an accumulation of smaller hidden industrial sites, what does that mean for clean-up and remediation, as well as for the economic vitality of communities that are increasingly trying to keep those kinds of small businesses alive? Should smaller polluters, who may be vital to local economies, be more heavily regulated? What would the economic, social, and political implications of increased environmental enforcement across more urban spaces look like?

Third, after reading this book, we questioned how the potential health outcomes of the widespread exposure to hazardous relic sites might be assessed over time, especially in light of ongoing residential churn. In an endnote to Chapter 3, the authors write that "Contact with [even] small amounts of the wrong stuff at the wrong time can—and does—cause plenty of harm regardless of the size of the originating source" (p. 129). Is it possible to accurately trace the public health consequences of these sites, especially in an era where our bodies are increasingly filled, even altered, by toxic substances of all sorts? What kinds of interdisciplinary collaborations and methodological approaches would this sort of work require?

Fourth, Frickel and Elliott write that the book is mostly situated in the "impersonal world of statistics and institutions." This is true, even though they randomly sampled 100 sites in each of the four case study communities (meaning they visited 400 sites in total) for deeper investigation using a novel field guide (which they also publish in the book). The authors include some truly fascinating snippets that describe the lengths they went to as they drove around these communities seeking to verify the location of sites from the HHID. We were intrigued by these stories, and they left us wanting more community-level ground-truthing of the dataset. Adding a qualitative component to a work like this would have likely led the researchers to ask the residents and owners of businesses, placed atop hazardous sites, whether the new occupants had any idea of what used to lay below their feet and of the toxins that may still lurk underneath. Because this was a book with voices unheard, it was impossible to understand whether the present occupants of these formerly hazardous sites had any idea of the dangers of their surroundings, let alone how much they might care about that if they were informed. We hope that future work in this space will include quantitative as well as qualitative analyses for broader scientific applications.

Sites Unseen makes it abundantly clear just how much more there is to be learned about hidden hazards in urban spaces—and likely suburban and rural spaces, as well. We strongly recommend this book for upper-division undergraduate and graduate courses on environmental sociology, urban sociology, demography, hazards and disasters, and the sociology of risk. We also suggest that faculty who teach research methods consider assigning this book, as it represents the gold standard for those seeking to build and share new datasets that help illuminate our social world. While we are cautious about recommending this book for courses outside our own discipline, it is no stretch to imagine that those who teach human ecology, cultural and human geography, urban planning, and even history might find this book compelling in the classroom.

Ultimately, we hope that readers of this book will be invigorated with a new or renewed sense of urgency to fight for environmental protection and justice. Frickel and Elliott are owed a debt of gratitude for this important contribution to sociology, which shares methodological insights and leaves space for further questions and future work. This book is an enduring and lasting gift to both academic researchers and communities across the nation. May it help create a safer future through a shared vision of sites now seen.

Ramp Hollow: The Ordeal of Appalachia

By Steven Stoll

New York: Hill and Wang, 410 pp., 2017
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Reviewed by Ganesh Trichur[1] and Paul S. Ciccantell[2]

There has been a surge of interest in Appalachia in recent years, especially in the wake of the 2016 presidential election and President Trump's pledge to revive the coal industry. While a variety of books have sought to explain Appalachia today—including Rebecca Scott (2010), Shannon Bell (2016), J. D. Vance (2016), and more recently Elizabeth Catte (2018)—Steven Stoll's *Ramp Hollow: The Ordeal of Appalachia* constructs a much longer-term, materially and historically grounded analysis of Appalachia.

Although the title focuses on Appalachia, Stoll's goal is much broader:

> the central event in Ramp Hollow is the scramble for Appalachia, or the rapid onslaught of joint-stock companies to attain the rights and ownership needed to clear-cut the forests and dig out the coal. How this happened and what was lost is the subject of this book. This book is also about country people throughout the Atlantic World over the last four hundred years … My purpose is to unite the experience of backcountry settlers of the southern mountains with that of agrarians elsewhere (p. xiv).

Stoll traces the history of Appalachia over the centuries, beginning from what he sees as its origins in the Enclosures in England as capitalists dispossessed small agriculturalists and transformed marshland and other marginal landscapes into capitalist farms. This process would be repeated in Appalachia from the 1800s onward as small agriculturalists were displaced by logging and coal mining. Some aspects of this history are well-known, including the importance of absentee landlords who received land titles even before the first white settlements were built, the resulting conflict and confusion over land ownership and separation of surface and mineral rights, the national government's efforts to incorporate Appalachia into the nation via taxation and force, the role of coal as the center of the economy since the late 1800s and its negative impacts on the land and people, coal companies' use of multiple distinct racial and ethnic groups as miners to make unionization more difficult, and the role of company stores and company scrip as means of labor control. Stoll presents an engaging analysis of these factors while focusing as

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well on other key factors in the evolution of Appalachia that we emphasize in this review: the political economy and ecology of Appalachia, the role of dispossession of Appalachian agriculturalists, and the parallels and connections with processes in other times and places in the world economy.

Stoll highlights the *process* of dispossession of agrarians—"settlers, peasants, *campesinos*, smallholders"—or simply "country people" (p. 65) by looking at their mode of reproduction of everyday life. Stoll argues that backwoods settlers maintained a healthy relationship with mountain ecology in their use of swiddens (clearings) created using fire (p. 69), a process also known by other names like *forest fallow*, *burnbeating*, and *shifting cultivation* (p. 107). These practices are common today, Stoll notes, among the rice-planters in Mindoro, the Philippines, where shifting cultivation subtly restores and reproduces the ecological base (pp. 251–252). Stoll offers an engrossing account of Appalachian country households in relation to their "own provision ground," often a two-acre garden space for growing vegetables and fruits (p. 141); and in relation to provision grounds hidden in the woods (p. 84). These provision grounds are part of a wider ecological base, the name for that "vast renewable fund of resources that provides spaces for fields, food for gathering, fodder for cattle, and habitat for wild game" (p. 33). Ramps and hollows are part of this ecological base. Stoll explains that the term *ramp* in its old English sense refers to bear onion, wild leek, and *ramson*; foraging for ramps and other plants was a seasonal event and a cherished custom in common. Stoll also relates "ramp" with the German *rampen*: a platform that connects two uneven surfaces: "Ramps provided a subsistence bridge between spring and summer. They represented the role of the forest in providing direct subsistence in addition to commodities" (pp. 142–143).

In a somewhat different but related sense, the term "ramp" serves as a metaphor for a bridge that spans two different transactional realms. Like peasants in the Andean highlands, whose social relations within the village community grounded their transactions without confining those transactions to the village, but in fact extended them to a realm of impersonal exchanges and trade beyond the mountains (p. 72), Appalachian highlanders also transacted in two realms. The Appalachian backcountry "*churned with exchanges*" of goods like furs, whiskey, ginseng, iron, glass, salt, and spices, as well as glassware and books (p. 113, italics in original). Exchanges between Appalachian households and the ecological base resembled the working of a "subsistence economy" but *without* the poverty that often tends to attach itself to that term, as Pierre Clastres (1989) has forcefully observed about Amerindian civilizations. Since the concept of "subsistence economy" often mistakenly suggests poverty, Stoll offers the more adequate concept of *makeshift economy* to represent Appalachian households, insofar as makeshift means "to do the best that one can with whatever one has" (p. 67), and to "live within limits imposed by land and labor" (pp. 75–76). However, taking full advantage of environments

and opportunities for exchange also extended household participation into the wider commercial world, outside of the mountains, where money played an important, but not a determinant, role (p. 75). Stoll invokes Braudel's concept of market economy (pp. 63–65) to observe that "no one has ever willingly lived without exchange" and "market-less households do not exist," but the household's integration into the market was always partial, and money a mere means for participation in the circuit of simple commodity circulation (Marx's C-M-C circuit), "to sustain and reproduce the household without end" (p. 68). Mountaineers sought money only to acquire useful goods like "dishes, dresses, candy, guns, toys, and tools" (p. 145). Agrarian entrepreneurs emerged in these makeshift economies—like "the farmer who distills whiskey from his own rye, harvested by his family and neighbors, and uses the money to improve his fences or buy a new rifle" (p. 75). The use of money could wreck agrarian systems through a combination of debt and taxation on the one hand, and through the destruction or enclosure of common resources on the other (p. 74). Although Appalachian households willingly participated in this second transactional realm as a matter of convenience, Stoll explains how capitalist coercion and state violence forcibly alienated highlanders from their fundamental ecological base. This political economy and ecology of Appalachia over the past three centuries is compelling and insightful.

Stoll's approach emphasizes Wallerstein's world-systemic relational perspective on the incorporation of peripheral regions into larger worldwide capitalist processes of accumulation—without perhaps doing adequate justice to Wilma Dunaway's works on the incorporation of Appalachia. Stoll's themes resonate strongly with the work of Rebecca Scott (2010) on mountaintop removal in West Virginia. A key focus in Stoll's narrative is the process of "accumulation by dispossession," a concept introduced by the anthropologist Gillian Hart (2002)—whose work is absent from Stoll's long bibliography—and popularized in David Harvey's (2003) attempt to engage with Giovanni Arrighi's (1994) monumental work on *The long twentieth century*. As Arrighi (2007) explains in his response to Harvey, "accumulation by dispossession" is indeed an effect of the historically recurring process of financial expansions in the world-system, closely related to militarism, wars, and violence practiced on the global South. War-making on American Indians and Appalachian mountain households is central to what Stoll calls "the scramble for Appalachia" (p. xiv) after the US Civil War (1861–1865). The scramble for Appalachia unfolded during one of the historically recurring financial expansions (1870s–1930s) of the world-system that coincided with the late 19th-century "scramble for Africa" by European Great Powers that contemporaries referred to as Imperialism. Stoll's preface claims that his focus is on the Appalachian highlands and West Virginia in particular, whose ordeal he wants to narrate; and yet the net that Stoll casts is much wider than his mark when it seeks to devote almost as much attention to spaces outside of Appalachian America. This may perhaps be both the strength of Stoll's text, in that it offers a comparative historical account that situates the Appalachian ordeal

within a larger world-systemic perspective, as well as its weakness because the global relational perspective that Stoll wants to offer sometimes appears overextended, especially when it dilutes concentration on the Appalachian ordeal itself.

Stoll writes about the situation in which Appalachians find themselves today, as the coal industry continues to fade away despite the Trump Administration's efforts to encourage coal consumption. Ghost towns dot the state of West Virginia, as the population has fallen 40% since 1950 (p. 270). Environmental destruction continues apace, such as the pollution of the Elk and Kanawha Rivers when Freedom Industries dumped toxic chemicals and poisoned drinking water supplies in nine counties (pp. 264–265). Most of the counties in eastern Kentucky, western Virginia, and southern West Virginia qualify as "food deserts"; markets that sell fresh fruit and vegetables are more than 20 miles away or residents lack the means to travel 10 miles to go shopping (p. 269). So what is to be done about all this?

The concluding chapter is rather unfocused and unsatisfying. Stoll argues that Appalachians require "a viable political identity" that requires that "the white working class of the southern mountains … stop identifying their interests with those of the rich and powerful … They should also consider abandoning false and imploding racial distinctions" (p. 270). It is difficult to find anything Appalachians have gained by voting for the Republican Party (p. 271). Stoll is familiar with J. D. Vance's (2016) *Hillbilly Elegy*. Stoll suggests that Vance's escape from the vicious cycle of "domestic violence, drug abuse, and hopelessness" in poverty suggests that these problems are rooted in social causes: "They require solutions that do not place the burdens on the sufferers themselves to transcend their circumstances" (Stoll, p. 278). While these are correct assessments, Stoll offers little elaboration on them, especially in the context of the November 2016 presidential elections. Stoll advocates a "reconstituted commons." He favors democratic socialism as well as "a realm of democratic autonomy" in Appalachia outside of centralized government, sponsored by West Virginia or Kentucky or Tennessee (p. 271). Drawing upon the ideas of various progressive thinkers, including the Kentucky farmer Wendell Berry as well as Lewis Mumford, Gandhi, and Schumacher, Stoll proposes "The Commons Communities Act" (pp. 272–274), based upon collective local governance and land reform. It would preserve and encourage a makeshift economy that mountain farmers are familiar with (p. 275) by emphasizing small-scale food production and recognizing subsistence households as caretakers of ecological landscapes. While these proposals are indeed imaginative, they are not altogether radically novel. Stoll does not connect these proposals with similar proposals made by movements that emerged in 2011 and beyond—like the Occupy Wall Street Movement. Nor does Stoll make connections with a strong anti-prison movement that contests the transformation of the United States into one of the largest prison complexes,

including in the Appalachian highlands. Instead, Stoll concludes, somewhat anticlimactically, that Enclosures are indeed a part of the present moment in the form of a new global land grab gobbling up large expanses of arable land in Africa.

Overall, Stoll develops important new insights into the history and current reality of Appalachia. His work deserves a place among seminal works on Appalachia that complement those of Wilma Dunaway (1996), Shannon Bell (2016), and Rebecca Scott (2010).

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