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ASSESSING ENVIRONMENTAL INEQUALITY: HOW THE CONCLUSIONS WE DRAW VARY ACCORDING TO THE DEFINITIONS WE EMPLOY

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Abstract

This article demonstrates that the conclusions environmental inequality researchers draw vary according to the definitions of environmental inequality they employ and that researchers can use a single set of results to test for the existence of multiple forms of environmental inequality. In order to illustrate these points, I set forth five definitions of environmental inequality, list the kinds of evidence we must obtain in order to determine whether each form of environmental inequality exists, and show how conclusions drawn from several recent environmental inequality studies vary depending on the definition of environmental inequality we employ. My goal is not to show that any one definition is superior to the others; nor am I trying to generalize from the studies reported here to a broader set of research findings. Instead, my goal is to a) show that we can use a single set of results to address a variety of environmental justice concerns and b) demonstrate that our interpretations of environmental inequality research have been too narrowly focused on one set of environmental inequality outcomes.

INTRODUCTION

In their attempts to ascertain whether minorities and the poor are more likely than whites and wealthier individuals to live near environmental hazards, environmental inequality researchers have raised two critically important methodological issues. First, what unit of analysis should researchers employ to obtain the most accurate results possible (Anderton et al. 1994a, 1994b; Bowen et al. 1995; Mohai 1995; Taquino, Parisi, and Gill 2002; Zimmerman 1994)? Second, which definitions of environmental racism and environmental inequality should researchers use as standards for determining whether environmental inequality exists (Bullard 1996; Downey 1998; Holifield 2001; Pulido 1996; Stretesky and Hogan 1998)?

This article addresses the second question. However, rather than trying to determine which definitions of environmental racism and environmental inequality are best, I argue that it would be more fruitful to ask how the conclusions we draw vary according to the definitions of environmental racism and environmental inequality we employ. In order to illustrate this point, I set forth five definitions of environmental inequality, list the kinds of quantitative evidence we must obtain in order to determine whether each form of environmental inequality exists, and show how conclusions drawn from several recent environmental inequality studies vary depending on the definition of environmental inequality we employ.[1] My goal is not to show that any one definition is superior to the others; nor am I trying to

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generalize from the studies reported here to a broader set of research findings. Instead, my goal is to (1) show that we can use a single set of results to address a variety of environmental justice concerns and (2) demonstrate that our interpretations of quantitative environmental inequality research have been too narrowly focused on one set of environmental inequality outcomes.

LITERATURE REVIEW

Environmental inequality is a relatively new concept that gained national attention in the late 1980s and early 1990s due to the efforts of grassroots environmental justice activists and professional researchers. Calling into question the mainstream environmental movement's assumption that environmental degradation affects everyone equally, early environmental justice activists and researchers made several novel claims including but not limited to the following: (1) the poor, the working class, and people of color are disproportionately burdened by environmental hazards; (2) the poor, the working class, and people of color have significantly less access to environmental amenities—such as parks, open space, and wilderness areas—than do whites and weal-thier individuals; (3) mainstream environmental organizations have ignored environmental problems and concerns in poor, working class, and people of color communities; (4) federal, state, and local governments have been slow to address these communities' environmental concerns; (5) environmental inequality is inseparable from other forms of inequality; and (6) environmental thought and activism need to be broadened to include all the different environments in which people live, work, and play (Bryant and Mohai 1992a; Bullard 1990, 1994b; Hofrichter 1993; Newton 1996; Szasz and Meuser 1997; Taylor 2000).

Sometimes explicit, but often implicit, in early environmental justice thinking was the idea that subordinate social groups are triply harmed by their subordinate social and economic status: not only are they disproportionately burdened by industrial pollution, they also (1) receive relatively few of the benefits deriving from the capitalist production and distribution process and (2) have relatively few resources with which to protect their health. Thus they face a triple bind: not only do they benefit least from capitalist social relations, they are also the most burdened by capitalism's toxic externalities and the least able to protect their health once they are so burdened (Bullard 1990bBullard 1994b; Bryant and Mohai 1991, 1992b; Hofrichter 1993; Taylor 2000).

This extraordinary set of claims spurred the growth of a new field of study: environmental inequality research. Environmental inequality researchers have studied the distribution of social groups around a variety of environmental hazards, including hazardous waste sites, manufacturing facilities, superfund sites, chemical accidents, and air pollutants (Bowen 2002; Chakraborty and Armstrong 1997; Cutter and Solecki 1996; Derezinski, Lacy, and Stretesky 2003; Lester, Allen, and Hill 2001; Newton 1996; Szasz and Meuser 1997; Weinberg 1998). Researchers have found income and poverty to be consistently associated with hazard presence in the expected direction: as environmental hazard presence increases, incomes decrease and poverty rates increase (Derezinski et al. 2003; Downey 2003; McMaster, Leitner, and Sheppard 1997; Sadd et al. 1999; Stretesky and Hogan 1998; Yandle and Burton 1996). In contrast, findings regarding the existence of environmental racial inequality have been mixed (Bowen 2002; Pastor et al. 2001). Many studies have found strong evidence of environmental racial inequality (Been 1994; Krieg 1995; Hamilton

[1]Two points: first, as I discuss in more detail below, the evidence from recent studies can only be used to draw conclusions about the existence of four of the five forms of environmental inequality defined in this article. Second, although I focus on quantitative environmental inequality research in this article, I agree wholeheartedly with Pastor, Sadd, and Hipp (2001) and Pulido (1996) that qualitative environmental inequality research is critically important and that qualitative and quantitative environmental inequality research complement each other (also see Downey 1998).

1995; Mohai and Bryant 1992; Morello-Frosch, Pastor and Sadd 2001; Ringquist 2000; Sadd et al. 1999; Stretesky and Hogan 1998; Stretesky and Lynch 2002), some have found evidence of environmental racial inequality for some minority groups but not others (Brown, Ciambrone, and Hunter 1997; Pastor, Sadd, and Morello-Frosch 2002; Sadd et al. 1999), and some have found only weak evidence of environmental racial inequality or none at all (Anderton et al. 1994a, 1994b; Atlas 2002; Bowen et al. 1995; Clark, Lab, and Stoddard 1995; Derezinski et al. 2003; Downey 2003; Oakes, Anderton, and Anderson 1996).

These studies have provided researchers and activists with a tremendous amount of information regarding environmental inequality. It is my contention, however, that most of these studies have focused on a relatively narrow set of environmental inequality outcomes because most researchers, including myself, have based their research on a relatively narrow range of environmental inequality definitions. As a result, we have a fairly good understanding of some forms of environmental inequality, but we know very little about the existence of other forms of environmental inequality.

In the following section, I set forth five definitions of environmental inequality, all of which are drawn from the broader environmental inequality literature. Researchers have spent a considerable amount of time testing for the existence of the first two types of environmental inequality discussed below (*discriminatory intent inequality* and *disparate exposure inequality*), but relatively little time testing for the existence of the remaining three types of environmental inequality (*disparate social impacts inequality*, *disparate health impacts inequality*, and *relative distribution inequality*). Nevertheless, because it is often possible to test for the existence of multiple types of environmental inequality at the same time, I contend that researchers should test for the existence of as many forms of environmental inequality as they can with the data they possess.

Before proceeding, let me make three points. First, the five definitions discussed below do not represent an exhaustive list of environmental inequality definitions. Second, the data used in most environmental inequality studies, including those discussed below, do not allow us to test for the existence of *disparate health impacts inequality*. I define *disparate health impacts inequality* despite this limitation because it is a very important form of environmental inequality and because data that allow us to test for the existence of *disparate health impacts inequality* will, in the vast majority of cases, also allow us to test for the existence of the other four types of environmental inequality defined here.

Third, in no way do I wish to impugn the quality of environmental inequality research. Environmental inequality is a relatively new field of study that has made great advances in a relatively short time. Thus, this article should be viewed as an attempt to broaden the focus of environmental inequality research, not as an attempt to criticize previous research.

DEFINITIONS

Definitions of environmental inequality fall into two broad categories, those that focus on racially discriminatory intent and those that focus on inequitable environmental outcomes (Cutter 1995; Downey 1998; Pulido 2000; Stretesky and Hogan 1998). *Intentional racism* definitions, which focus solely on facility siting decisions, hold that environmental racial inequality occurs only when companies intentionally place environmental hazards in minority neighborhoods (Been 1994; Hamilton 1995).

Outcome definitions focus on a variety of environmental outcomes including, but not limited to, disparate exposure, disparate health impacts, disparate social impacts, and what I call "the relative distribution of burdens versus benefits." *Disparate exposure* occurs when members of a specific social group are more highly exposed to some set of environmental

pollutants than we would expect if group members were randomly distributed across residential space (Glickman 1994; Sadd et al. 1999; Szasz and Meuser 1997). Although activists and researchers are concerned about exposure because of its possible health effects, many activists and researchers suspect that epidemiologists, public health officials, and professional risk assessors are often unable to establish links between pollution exposure and negative health outcomes even when these links exist, leading many to argue that disparate exposure is a form of environmental inequality in its own right and grounds, in and of itself, for public health concern (Brown and Mikkelsen 1997; Morello-Frosch et al. 2002; Tesh 2000).

Disparate health impacts occurs when the negative health effects of residential proximity or exposure to environmental hazards are distributed unequally across social groups. Hazards may negatively affect individuals' mental or physical health, and mental health may be impacted by exposure to pollutants or by individuals' perceptions of the risks and desirability of living in environmentally hazardous neighborhoods (Ross, Reynolds, and Geis 2000; Downey and Van Willigen Forthcoming).

When considering the relationship between exposure, proximity, and health, researchers should be careful to recognize that the distribution of health outcomes across social groups is a function of at least three factors, exposure to health risks, biological susceptibility, and access to health care and other health-enhancing resources, none of which are distributed equally across social groups (Morello-Frosch et al. 2002; Williams and Collins, 1995). Thus, groups that are equally exposed or proximate to environmental hazards may not bear the same health burden from exposure or proximity.[2]

The *disparate social impacts* definition holds that in addition to representing a potential health threat, environmentally hazardous neighborhoods are also socially and economically undesirable places to live. Research shows, for example, that environmental hazard presence has a negative impact on local economic activity and property values (Ihlanfeldt and Taylor 2003; Liu 2001) and that regardless of race or income, people prefer living in pollution-free and industry-free neighborhoods (Mohai and Bryant 1998).[3] Moreover, the dramatic increase in recent decades in the number of grassroots environmental justice organizations dedicated to removing or banning environmental hazards from their neighborhoods indicates that access to clean residential environments has become an important social value for many individuals (Austin and Schill 1994; Bullard 1994a; Environmental Justice Resource Center 2000; Hofrichter 1993; Taylor 2000).

Given the economic advantages and social desirability of living in pollution-free and hazard-free neighborhoods, the *disparate social impacts* definition holds that environmental inequality exists when members of a specific social group are more likely to live in environmentally hazardous neighborhoods than we would expect if group members were randomly distributed across residential space.

[2]Research indicates, for example, that poor people and minorities receive lower quality health care and lower levels of health care than do whites and wealthier individuals (Blendon et al. 1989; Williams and Collins 1995; Woolhandler et al. 1985). Research also indicates that poor people and minorities may be less likely than whites and wealthier individuals to possess "health-enhancing personality characteristics" such as "self-esteem and perceptions of mastery or control" and more likely than whites and wealthier individuals to possess health-degrading personality characteristics such as "anger or hostility, feelings of helplessness and hopelessness, and repression or denial of emotions" (Williams and Collins 1995, p.375). This suggests that equal proximity and exposure to pollution may harm the health of poor people and people of color more than they harm the health of whites and wealthier individuals.

[3]Although activists and researchers have argued that environmental hazard presence is likely to be associated with declining neighborhood incomes, increased neighborhood poverty, increased minority presence, and increased residential segregation, few studies have investigated these claims and those that have done so have produced contradictory findings (Downey 2005; Been 1994; Oakes et al. 1996; Pastor et al. 2001; Pulido 2000; Yandle and Burton 1996).

Finally, *the relative distribution of burdens versus benefits* definition holds that those who receive greater benefits than others from the capitalist production and distribution process should bear a greater share of the burdens of this process. In this formulation, benefits refer to the overall distribution of rewards arising from capitalist social relations rather than to the immediate benefits a neighborhood receives due to the existence of a specific industrial facility in that neighborhood (Downey 1994; Bullard 1994b). Thus, the existence of environmental inequality cannot be determined by focusing solely on disparate social impacts, disparate exposure, or disparate health impacts. Instead, we must ask whether groups that receive greater benefits from capitalist social relations (whites, the middle and upper classes) are more burdened by industrial pollution than groups that receive fewer benefits from capitalist social relations (people of color, the poor, the working class). If not, *relative distribution inequality* exists.

EVIDENCE NEEDED TO SUPPORT EACH DEFINITION

Although environmental inequality researchers have been interested primarily in uncovering evidence of disparate exposure and discriminatory intent (Been 1994; Pastor et al. 2001; Pastor et al. 2002), exposure and intent are very difficult to measure, leading many to use residential proximity as a proxy for exposure and intent (Pastor et al. 2001; Sadd et al. 1999). Thus, disparate proximity—which can be defined as occurring when members of a specific social group live closer to some set of hazards than we would expect if group members were randomly distributed across residential space—has been used to infer disparate exposure and the possibility of discriminatory intent (see footnote 7 for a discussion of the kind of data typically used to infer discriminatory intent), and equitable proximity has been viewed as being inconsistent with disparate exposure and discriminatory intent (Anderton et al. 1994a, 1994b; Bowen et al. 1995; Pollock and Vittas 1995; Sadd et al. 1999).[4]

Since environmental inequality researchers typically assume that individuals live in proximity to an environmental hazard if they reside in the same analysis unit as that hazard, disparate exposure and the possibility of discriminatory intent have been inferred when, for a given set of analysis units, researchers have found a significant positive correlation between subordinate group presence and hazard presence. Conversely, a negative or non-significant correlation between subordinate group presence and hazard presence has been viewed as being inconsistent with the hypothesis that disparate exposure inequality and discriminatory intent inequality exist (Anderton et al. 1994a, 1994b; Bowen et al. 1995; Brown et al. 1997; Oakes et al. 1996; Pollock and Vittas, 1995; Sadd et al. 1999).[5]

Proximity data can also be used to test for the existence of disparate social impacts inequality. The hypothesis that this form of environmental inequality exists is supported when, for a given set of analysis units, a statistically significant positive correlation exists between subordinate group presence and hazard presence. This hypothesis is contradicted when the correlation between subordinate group presence and hazard presence is negative or non-significant.

The standard of proof is lower for establishing the existence of *relative distribution inequality*. The hypothesis that this form of environmental inequality exists is supported as long as there is *not* a statistically significant negative correlation between subordinate group

[4]Disparate proximity is viewed here as an indicator of environmental inequality rather than a form of environmental inequality in its own right.

[5]Strictly speaking, of course, a negative correlation between subordinate group presence and hazard presence suggests that dominant groups may live in closer proximity to some set of environmental hazards than we would expect if dominant group members were randomly distributed across residential space.

presence and hazard presence or a statistically significant positive correlation between dominant group presence and hazard presence.

Finally, proximity (and exposure) data are insufficient for establishing the existence or absence of *disparate health impacts* inequality. Thus, we cannot use evidence of disparate proximity or exposure to infer disparate health impacts inequality or evidence of equitable proximity or exposure to infer health impacts equality.

In order to test the hypothesis that disparate health impacts inequality exists, researchers need to merge proximity or exposure data with individual-level health data and individual and neighborhood-level demographic data so that they can determine whether there is a statistically significant association between proximity or exposure on the one hand and negative mental or physical health outcomes on the other, and whether these associations vary according to social group membership and neighborhood demographic composition.

CASE SELECTION STRATEGY

The evidence used in this article is taken from eight environmental inequality studies conducted between 1994 and 2002. These studies were drawn from seven different refereed journals; use a variety of statistical tests; and examine several different social groups, hazards, and regions. Because I am interested in demonstrating that the conclusions we draw regarding the existence of environmental inequality can vary depending on the definitions of environmental inequality we employ, these studies were not chosen randomly. Instead, they were selected in order to ensure an overrepresentation of studies providing little or no evidence of discriminatory intent or disparate exposure, the two forms of environmental inequality that have received the most attention from environmental inequality researchers (Pastor et al. 2001; Sadd et al. 1999).

As a result, the findings reported here cannot be generalized to the broader universe of environmental inequality research from which they are drawn. Moreover, because a disproportionate number of these studies find no evidence of discriminatory intent or disparate exposure, the use of alternate definitions of environmental inequality is more likely to affect the conclusions we draw from these studies than it is to affect the conclusions we would have drawn from a random sample of environmental inequality research.

Nevertheless, this case selection strategy is justified. Not only does it allow me to demonstrate that the conclusions we draw regarding environmental inequality can vary depending on the definitions of environmental inequality we employ, it also allows me to focus on (1) a set of studies that suggest, collectively, that environmental inequality may not be a serious social problem and (2) a specific study, Anderton et al. (1994a), that has been cited as providing proof that race-based environmental inequality is not a serious social problem (Boerner and Lambert 1995; Szasz and Meuser 1997; Yandle and Burton 1996).[6]

Anderton et al. (1994a) and some of these other studies have been criticized on methodological grounds (Downey 1998 and Mohai 1995, 1996). If it turns out, however, that the results found in Anderton et al. and these other studies provide evidence of *disparate social impacts inequality* or *relative distribution inequality*, and if in addition we agree that these are valid forms of environmental inequality, then our interpretation of the Anderton et al. study and the broader literature will change regardless of our evaluation of Mohai's and Downey's methodological critiques.

[6]To my knowledge, Anderton et al. (1994a) never argued that their results provided proof that race-based environmental inequality is not a serious social problem. But as cited in the main text, others have used their study to make this argument.

EVIDENCE FROM RECENT STUDIES

Table 1 summarizes results from the eight environmental inequality studies and indicates whether or not these results are consistent with the hypothesis that discriminatory intent inequality, disparate exposure inequality, disparate social impacts inequality, and relative distribution inequality exist in the study areas examined by each study. Table 2 provides additional information about the original studies. It tells us which tables these results are taken from as well as the unit of analysis, hazard, and statistical test used in each of the original tables. Units of analysis, statistical tests, and hazards vary widely across the studies. For example, Anderton et al. (1994a) test for differences in demographic variable medians between TSDF census tracts (census tracts containing hazardous waste facilities) and non-TSDF census tracts in U.S. metropolitan areas; Stretesky and Hogan (1998) test for differences in demographic variable means between superfund tracts and non-superfund tracts in Florida; Bowen et al. (1995) use zero-order correlation analysis to examine the distribution of social groups around Toxic Release Inventory (TRI) facilities in Cleveland; and Yandle and Burton (1996) use percentile ranking to examine the distribution of social groups around hazardous waste facilities in metropolitan Texas.

The second (and sixth) panels in Table 1 tell us whether each study found statistically significant associations between income and race on the one hand and hazard presence on the other. “Pos” stands for statistically significant positive association, “neg” for statistically significant negative association, and “non” for non-significant association. For the correlation studies, a positive income association means that as analysis unit incomes increase or percent poverty decreases, hazard presence increases; and a positive race association means that as percent minority, percent black, or percent Hispanic increases, hazard presence also increases (the table indicates whether the studies use income, poverty, percent minority, percent black, or percent Hispanic as demographic indicators). For the difference in means (t-test) or medians (Wilcoxon Z-statistic) studies, a positive income association means that analysis units with hazards have higher income levels or lower poverty levels than analysis units without hazards, and a positive race association means that analysis units with hazards have higher percentages of minorities, Hispanics, or blacks than analysis units without hazards.

The remainder of the table tells us whether the results summarized in panel 2 are consistent with the hypothesis that discriminatory intent inequality, disparate exposure inequality, disparate social impacts inequality, and relative distribution inequality exist in each study area. A “yes” listing indicates that a hypothesis is supported, a “no” listing indicates that a hypothesis is contradicted, and “possible” indicates that the evidence is consistent with the hypothesis that racially discriminatory intent *may* have guided the siting process.[7]

Looking under the heading “discriminatory intent” (Table 1, panel 3), we see that the majority of studies listed in Table 1 contradict the hypothesis that siting practices were guided by racially discriminatory intent, although evidence of discriminatory intent is stronger for Hispanics than it is for blacks. Due to the case selection strategy employed in

[7]The cross-sectional and longitudinal data employed in most environmental inequality research cannot be used to directly test the racist intent hypothesis because the datasets used by most environmental inequality researchers do not contain information on why firms decided to site specific hazards in specific locations. Thus, researchers are generally forced to infer the *possibility* of racially discriminatory intent from the current distribution of hazards or from the characteristics of neighborhoods at the time of siting (Been 1994). If siting distributions or current hazard distributions are racially inequitable, researchers argue that intentionally racist siting decisions may have been made. If, on the other hand, these distributions are found to be racially *equitable*, researchers conclude that discriminatory intent did not guide siting practices. Although data about the characteristics of neighborhoods at the time of siting are preferable to data on current hazard distributions, neither type of data allows us to directly test the racist intent hypothesis. Thus, Table 1, panel 3 uses the term “possible” rather than “yes” when the data are consistent with the possibility that racially discriminatory intent guided the siting process.

this article, most of the studies also contradict the disparate social impacts and disparate exposure hypotheses (Table 1, panels 4 and 7), though there is greater support for the income-based disparate social impacts and exposure hypotheses than there is for the race-based disparate social impacts and exposure hypotheses, and in some studies the disparate social impacts and exposure hypotheses are supported for one racial/ethnic group but not for another.

Unlike the first three hypotheses, the relative distribution hypothesis receives overwhelming support (Table 1, panel 8). All the studies that include an income-based measure provide evidence consistent with the hypothesis that income-based *relative distribution inequality* existed in the study areas under examination, and seven of the eight studies provide evidence that *relative distribution inequality* existed for at least one racial group. The eighth study, Yandle and Burton (1996), provides evidence that race-based *relative distribution inequality* existed in metropolitan Texas in 1990 but not when TSDF facilities were sited.

DISCUSSION

Although it is not surprising that the relative distribution hypothesis receives more support from these studies than do the discriminatory intent, disparate social impacts, and disparate exposure hypotheses, we can still draw several important conclusions from the evidence presented in Table 1. First, Table 1 demonstrates that we can use a single set of data to test for the existence of multiple forms of environmental inequality. This is important because environmental inequality research is conducted by a variety of people—including environmental justice activists, public health officials, social scientists, epidemiologists, and lawyers—who are motivated by a variety of concerns and who define environmental inequality in various ways. Thus, when we use a single definition of environmental inequality to determine whether or not environmental inequality exists in a particular study area, we are restricting ourselves, often unnecessarily, to a relatively narrow set of environmental inequality concerns. This makes sense, of course, when different kinds of data are needed to test the different definitions researchers use. It does not make sense, however, when multiple definitions can be tested simultaneously using a single data source. When this is the case, researchers should make every effort to test as broad an array of definitions as possible.

Second, Table 1 clearly demonstrates that the conclusions we draw regarding the existence of environmental inequality can vary according to the definitions of environmental inequality we employ. Although this point follows from an understanding of basic research methodology, Table 1 does not simply illustrate a basic methodological point. It also shows us that the conclusions that have been drawn from the studies examined here are not the conclusions that would have been drawn if alternative definitions of environmental inequality had been used to evaluate the evidence.

Third, setting aside methodological concerns for the moment and assuming that the four definitions of environmental inequality examined in Table 1 are equally valid, our conclusions are now different for a set of studies that were previously interpreted as providing little or no support for the existence of environmental inequality. For example, Anderton et al (1994a), Bowen et al. (1995), and Brown et al. (1997) no longer provide evidence that environmental inequality does not exist for specific hazards and social groups, in specific locations, at specific times. Instead, these studies provide evidence that (1) discriminatory intent inequality, disparate social impacts inequality, and disparate exposure inequality do not exist for these hazards and social groups, at these times, in these locations, but that (2) relative distribution inequality does exist for these hazards and social groups, at these times, in these locations. This new conclusion provides us with a broader, more

nuanced understanding of environmental inequality than is possible when our conclusions are based on a single definition of environmental inequality.

Fourth, none of the studies listed in Table 1 are able to tell us whether or not disparate health impacts inequality existed in the study areas they examined. Thus, even if all these studies had contradicted the hypothesis that at least one of the other four forms of environmental inequality existed, we would not be able to conclude that environmental inequality did not exist in these study areas. It should be clear, then, that researchers cannot make broad claims about the existence of environmental inequality unless they test for the existence of all the types of environmental inequality identified by researchers and activists.

Fifth, although a disproportionate number of the studies included in Table 1 provide evidence contradicting the discriminatory intent, disparate social impacts, and disparate exposure hypotheses, the pattern of "negative" findings observed in these studies is still representative of a small but important body of environmental inequality research (Atlas 2002; Downey 1998; Pastor et al. 2002); and as noted above, Anderton et al. (1994a) has also been cited as providing proof that race-based environmental inequality is not a serious social problem. Thus, the evidence in Table 1 not only demonstrates that Anderton et al. and most of the other "negative" finding studies included in Table 1 can be interpreted differently, it also suggests that the larger universe of negative finding studies from which these studies were drawn can be interpreted differently. In other words, although we cannot generalize from the studies included here to the broader universe of environmental inequality research, these studies suggest that we may need to reinterpret the broader literature in light of the findings presented here.

CONCLUSION

The preceding discussion and analysis leave two important questions unanswered. *First, is there a relationship between the definitions environmental inequality researchers use and the proper unit of analysis for environmental inequality research?* Since it is likely that the size and shape of the areas adversely affected by environmental hazards vary depending on the type of adverse effect we are investigating, and since the types of adverse effects we investigate depend on the definitions of environmental inequality we employ, it is likely that the unit of analysis best suited to studying environmental inequality also varies according to the definitions of environmental inequality we employ (Anderton et al. 1994b; Mohai 1995; and Taquino et al. 2002 make the same or similar arguments). Unfortunately, determining which analysis unit is best suited for studying each potential adverse effect is no easy task (Anderton et al. 1994). Thus, although most researchers would probably agree that the adverse social impacts arising from proximity to environmental hazards operate at a different spatial scale than the adverse health impacts arising from exposure to environmental hazards, and that the adverse health effects arising from exposure operate at a different spatial scale than those arising from proximity, it is not at all clear at which scale most of the adverse impacts discussed in the literature operate.[8] What is clear, however, is that determining the scale at which different adverse effects operate and using this knowledge to match analysis units to specific adverse effects is an important next step for environmental inequality researchers.

Second, is relative distribution inequality really an important form of environmental inequality? Some researchers might argue that relative distribution inequality is not an important form of environmental inequality, either because it does not depend entirely on

[8]This is not true for all adverse effects. Mohai (1995), for example, cites evidence that property values are negatively affected within a 2.5 mile radius of solid waste landfills.

the distribution of social groups around environmental hazards and is not, therefore, solely an environmental outcome, or because it is less amenable than other forms of environmental inequality to public policy remediation.

This argument is problematic because it suggests that environmental inequality researchers should restrict their research efforts to a narrow range of environmental issues. Interest in environmental inequality is motivated, however, by a wide variety of concerns, ranging from social movement activism to litigation to theory development. For example, relative distribution inequality is likely to be of great interest to social movement activists seeking to create a more just society and to social scientists interested in developing a greater practical and theoretical understanding of inequality in modern industrial societies. Thus, we should not dismiss a definition of environmental inequality simply because it does not meet our own criteria for what is important or interesting. Moreover, restricting ourselves in this way reduces the number of people who will find environmental inequality research interesting and useful. It also flies in the face of environmental justice activists' efforts to expand the notion of environmentalism and justice beyond the bounds that have traditionally contained them (Taylor 2000).

Finally, as Pulido (1996), Stretesky and Hogan (1998), and Downey (1998) demonstrate, different definitions of environmental *racial* inequality are predicated on different definitions of race and racism and on competing explanations of racial inequality. Thus, restricting our attention to some forms of environmental inequality but not others limits our ability to contribute to broader academic and policy debates regarding race, racism, and racial inequality.

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Table 1

Results from eight recent environmental inequality studies

	Association (2)		Discriminatory intent (3)		Social impacts (4)	
Study (1)	**Income**	**Race**	**Income**	**Race**	**Income**	**Race**
Anderton et al. 1994a	NEG(d)	NON(b,c)	—	NO	YES	NO
Bowen et al. 1995	NON(d,e)	NON(a)	—	NO	NO	NO
Brown et al. 1997						
–Boston	NON(e)	NON(b,c)	—	NO	NO	NO
–Pittsburgh	NON(e)	NON(b,c)	—	NO	NO	NO
–Seattle	NON(e)	NON(b), POS(c)	—	NO(b), POSSIBLE(c)	NO	NO(b), YES(c)
Oakes et al. 1996	NEG(d)	NON(b), NEG(c)	—	NO	YES	NO
Pastor et al. 2002 (TSDF)	—	NEG(b), POS(c)	—	NO(b), POSSIBLE(c)	—	NO(b), YES(c)
Pastor et al. 2002 (TRI)	—	NON(b), POS(c)	—	NO(b), POSSIBLE(c)	—	NO(b), YES(c)
Sadd et al. 1999	NEG(e)	POS(a,c), NON(b)	—	POSSIBLE(a,c)	YES	NO(b), YES(a,c)
Stretesky and Hogan, 1998	NEG(d,e)	POS(b,c)	—	POSSIBLE(b,c)	YES	YES(b,c)
Yandle and Burton 1996*	NEG(e)	NEG(a)	—	NO	YES	NO
Yandle and Burton 1996**	NEG(e)	NON(a)	—	—	YES	NO

	Association (6)		Exposure (7)		Benefit=burden (8)	
Study (5)	**Income**	**Race**	**Income**	**Race**	**Income**	**Race**
Anderton et al. 1994a	NEG(d)	NON(b,c)	YES	NO	YES	YES
Bowen et al. 1995	NON(d,e)	NON(a)	NO	NO	YES	YES
Brown et al. 1997						
–Boston	NON(e)	NON(b,c)	NO	NO	YES	YES
–Pittsburgh	NON(e)	NON(b,c)	NO	NO	YES	YES
–Seattle	NON(e)	NON(b), POS(c)	NO	NO(b), YES(c)	YES	YES
Oakes et al. 1996	NEG(d)	NON(b), NEG(c)	YES	NO	YES	YES(b) NO(c)
Pastor et al. 2002 (TSDF)	—	NEG(b), POS(c)	—	NO(b), YES(c)	—	NO(b), YES(c)
Pastor et al. 2002 (TRI)	—	NON(b), POS(c)	—	NO(b), YES(c)	—	YES(b), YES(c)
Sadd et al. 1999	NEG(e)	POS(a,c), NON(b)	YES	NO(b), YES(a,c)	YES	YES
Stretesky and Hogan 1998	NEG(d,e)	POS(b,c)	YES	YES(b,c)	YES	YES

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	Association (6)		Exposure (7)		Benefit=burden (8)	
Study (5)	**Income**	**Race**	**Income**	**Race**	**Income**	**Race**
Yandle and Burton 1996*	NEG(e)	NEG(a)	YES	NO	YES	NO
Yandle and Burton 1996**	NEG(e)	NON(a)	YES	NO	YES	YES

* Data from time of siting.

** 1990 data.

(a) Minority, (b) Black, (c) Hispanic, (d) Poverty, (e) Income

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Table 2

Basic information about the studies listed in Table 1

Study	Tables	Analysis unit	Statistic	Hazard
Anderton et al. 1994a	1	Census Tracts	Wilcoxon Z-Statistic	TSDF*
Bowen et al. 1995	5	Census Tracts	Zero-order Correlations	TRI**
Brown et al. 1997				
–Boston	5	Zip Codes	Pearson's Correlations	TRI
–Pittsburgh	5	Zip Codes	Pearson's Correlations	TRI
–Seattle	5	Zip Codes	Pearson's Correlations	TRI
Oakes et al. 1996	1	Census Tracts	Wilcoxon Z-Statistic	TSDF
Pastor et al. 2002	2	Census Tracts	T-test	TSDF/TRI†
Sadd et al. 1999	1, 2	Census Tracts	T-test	TRI
Stretesky and Hogan 1998	1	Census Tracts	T-test	Superfund***
Yandle and Burton 1996††	1, 2	Census Tracts	Chi-Square/Cramer's V	TSDF
Yandle and Burton 1996†††	3, 4	Census Tracts	Chi-Square/Cramer's V	TSDF

*Hazardous Waste Facilities.

**Toxic Release Inventory Facilities.

***Superfund Sites.

†Figure 3 in Pastor et al. (2002) presents a different pattern of results than those summarized here. However, it is not clear if the results in figure 3 are statistically significant. So they are not summarized here.

††Data from time of siting.

†††1990 data.