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In this Issue

The "Remains of the Dead"
Tan Boon Hui and Brenda S. A. Yeoh

The Paleoepidemiology of Schistosomiasis
in Ancient Egypt
Helmut Kloos and Rosalie David

Environmental Racism Claims
*Sherry Cable, Donald W. Hastings
and Tamara L. Mix*

Gynecological Cancer Mortality in Texas
*John K. Thomas, Bibin Qin and
Barbara E. Richardson*

Attitudes Toward Large Carnivores
Bjorn P. Kaltenborn and Tore Bjerke

Forum on Democracy and Participation in
Environmental Decision-Making
Guest Editor: *Thomas C. Meredith*
Contributors: *Thomas Gunther,
Herman A. Karl, Christine Turner,
Thomas C. Meredith and Gisela Frias*



Human Ecology Review

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NUMBER 1

CONTENTS

Research and Theory in Human Ecology

- The "Remains of the Dead": Spatial Politics of Nation-Building in Post-War
Singapore *Tan Boon Hui and Brenda S. A. Yeoh* 1
- The Paleoepidemiology of Schistosomiasis in Ancient Egypt. . . *Helmut Kloos and Rosalie David* 14
- Different Voices, Different Venues: Environmental Racism Claims by
Activists, Researchers, and Lawyers . . . *Sherry Cable, Donald W. Hastings and Tamara L. Mix* 26
- Economic and Toxic Chemical Influences on Rates of Gynecological
Cancer Mortality in Texas *John K. Thomas, Bibin Qin and Barbara E. Richardson* 43
- The Relationship of General Life Values to Attitudes Toward
Large Carnivores *Bjørn P. Kaltenborn and Tore Bjerke* 55

Human Ecology Forum: Essays, Commentary and Applications

Guest Editor: Thomas C. Meredith

- Editor's Introduction:
Democracy and Participation in Environmental Decision-Making *Thomas C. Meredith* 62
- Place-Based Decision Support Systems: A Bridge Between Democracy
and Sustainability. *Thomas Gunther* 64
- A Model Project for Exploring the Role of Sustainability Science in a Citizen-Centered,
Collaborative Decision-Making Process *Herman A. Karl and Christine Turner* 67
- Using Spatial Decision Support Systems in Expert Workshops *Thomas C. Meredith* 72
- Cross Cultural Participation in Sustainable Development: Canadian
Academic Involvement with Mexican ENGOs *Thomas C. Meredith and Gisela Frias* 77

Contemporary Human Ecology: Book Reviews

We are the champions. Nothing can hurt us. Really?
A critique of Richard K. Ford's review of Herman Daly's Ecological Economics
and the Ecology of Economics [HER 7(2): 75-76, 2000]. by Dieter Steiner 82

Misunderstanding economics is more likely to "hurt" us than is nature:
A rejoinder to Steiner's critique by Richard K. Ford 87

Sprawl City: Race, Politics, and Planning in Atlanta, edited by Robert D. Bullard,
Glenn S. Johnson, and Angel O. Torres Reviewed by Robyn Bateman Driskell 92

Briefly Noted Edited and Compiled by William S. Abruzzi 93

The Environment and Society Reader, edited by
R. Scott Frey Reviewed by Andrew K. Jorgenson 95

Earth and You: Tales of the Environment, by
Charles Officer and Jack Page. Reviewed by Michael M. Welsh 96

The First Sex: The Natural Talents of Women and How They Are
Changing The World, edited by Helen Fisher Reviewed by Terri LeMoyne 97

On the Cover

"A View from Central Park," Central Park, NY. by Heather L. Heckel

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The “Remains of the Dead”: Spatial Politics of Nation-Building in Post-War Singapore

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Abstract

This paper examines the changing constitution of Chinese landscapes of death in post-war Singapore through a close reading of the process of conflict and negotiation between the nation-state and the Chinese community. Using the spatial politics surrounding Chinese burial grounds as a lens, we clarify state strategies of control over land use and explain how they shifted from colonial to the postcolonial era. We also examine how the strategies of resistance and negotiation on the part of the Chinese community to continue to lay claim to their burial spaces. We then explore state rationale behind, and the community's response to, the shift from burial to cremation. In general, the birth of a new nation-state put in place stronger urban planning mechanisms for disciplining the landscape, and at the same time, narrowing the degrees of freedom within which the Chinese community was able to manoeuvre.

Keywords: *Chinese in Singapore, landscapes of death, cemeteries, cremation, nation-state*

Landscapes of Death as Contested Spaces

Sociologists claim that in late modern societies, death is no longer a taboo subject, whether in the discipline itself or more generally within society (Mellor 1993). This overturns Gorer's (1965) earlier assertion that death has replaced sex as contemporary society's major taboo topic. There is also growing interest and accompanying literature on the material expressions and consequences of death, whether in the form of bodily remains and habitations for the dead (the question of the embodiment of death) or in terms of the disposal of the deceased's assets (the question of inheritance) (see Clark 1993). While geographers' current interest in corporeality is primarily focused on the *living* body, and the way it is sexualized or medicalized (Longhurst 1997), this route of enquiry may in the future encourage more attention to the disposal of the *dead* body.

Awareness of the inevitability of death has contributed to the human desire to commemorate and individualize existence through funerary architecture and the elaboration of rituals to accompany the disposal of the dead (Curl 1993; Jackson and Vergana 1989). The explicit function of burial grounds is to house the dead. In the spatial and temporal ordering of places of burial as well as the ritual practices associated with it, however, burial spaces become transformed into sacred landscapes; the burial site “becomes an emotionally highly-charged site, not only for the families concerned, but also at times for the ethnic and cultural group concerned” (Christopher 1995, 43). While a substantial body of work exists which examines how burial landscapes reflect, in the words of Jackson and Vergana (1989, 3), a society's “collective representations of deeply shared attitudes and assumptions,” relatively little has been done to situate burial landscapes in the context of the politics of space (see Bower 1989; Cannon 1989; Francaviglia 1971; Hertz 1960; Howett 1977; Jackson 1967/68; Knapp 1977; Knight 1985; Lai 1987; Ludwig 1966; Nelson and George 1982; Vitebsky 1993; Walter 1993; Wescoat, Jr. 1994; Young 1960; Zelinsky 1975, 1994).

Elsewhere, one of the present authors has attempted to situate burial landscapes as a *contested* space within broader socio-political developments in the context of pre-World War II colonial Singapore (Yeoh 1991). Following the view that space is not a scientific object removed from ideology and politics but is instead political and strategic (Lefebvre 1977), it was argued that the site, location and morphology of burial spaces are invested with different meanings by different individuals and social groups. For example, over and alongside the priorities that immigrant and indigenous groups of different faiths accord to places for the dead are the perspectives of the colonial state which shape and control urban form and structure through successive measures of urban regulation. The clash of priorities is often resolved through a complicated process of conflict and negotiation among individuals, groups and the state: on the one hand, “dominant” groups construct the burial landscape as a site of control; on the other

hand, other “subordinate” groups may also use it as a site of resistance to resist exclusionary tactics and to advance their own claims.

Beyond the colonial period and with the transition to independence, landscapes of death were again implicated as an important focal point of debates in the developing discourses on and experiences of nationhood and nation-building. Elsewhere, we have focused on the way different discourses on Chinese burial grounds changed in strategic ways with the transition from colony to nation-state (see Yeoh and Tan 1995a). While the colonial state had highlighted the unsanitary nature of burial grounds and adopted a utilitarian view of burial space, the subsequent demands of nation-building reconstructed the “problem” of Chinese burial grounds as “obstructive,” “sterilized” land that urgently needed to be disciplined by an urban planning agenda and cleared for “development.” In contrast, the Chinese community under colonial rule advanced the view that their burial grounds were “sacred” spaces situated within the discourse of geomancy and ancestor worship and as such “immune” from state intervention. With independence, the status of the Chinese as a citizen in a nation-state with accompanying obligations made it more difficult for the community to maintain a separate distinctly Chinese discourse on burial space. Consequently, new discourses that stressed the rights of the Chinese as citizens emerged as instruments of negotiation.

These strategic shifts in discourses both undergirded, and are in turn influenced by, the interplay of actual strategies of control and resistance on the ground. The aim of this paper is to examine the changing constitution of Chinese landscapes of death in post-war Singapore through a close reading of these specific strategies drawn upon in the complicated process of conflict and negotiation between the nation-state and the Chinese community.² Through a detailed analysis of the clearance of selected burial grounds, we will demonstrate that, in the post-war period, while the nation-state did succeed in clearing numerous burial grounds, both the state and the Chinese had to make compromises and concessions in the process of negotiation. At the same time, the “microphysics” of the exercise of state power can provide insights into the constitution of the nation-state in Singapore. Power is “not homogeneous but can be defined only by the particular points through which it passes” and an analysis of the spatial politics of burial grounds illuminates one of the “series of interacting wheels or structures” which, on a different level produces the state as the “overall effect” (Deleuze 1988, 25). Before embarking on a detailed reading of the actual processes of negotiation over Chinese burial grounds, we first outline in brief the significance of burial space in Singapore and the strategies of control and resistance that came into play in the post-war era.

State Strategies of Control Over Burial Space

The Exercise of State Power

In Singapore, the use of land and competition for space have featured as significant issues on the state planning agenda since the immediate post-war era. Given the island’s scarce land resources in terms of both limitations of physical size and natural resources, as well as the need, from the colonial era, to optimize land utilization to facilitate rapid economic and urban growth, a “disciplined, rigorous, centrally planned economic and social regime” anchored primarily by the state has been (and is still) a major cornerstone in Singapore’s development (Perry et al. 1997, 153). In this context, extensive burial grounds belonging to the Chinese community have often been regarded as “space wasters” requiring state action to effect control, minimize proliferation and re-map in tandem with the state’s developmental goals.

One of the most urgent tasks confronting the state in the post-war years was the need to reconstruct the urban fabric of what was essentially a city-state that suffered severe social and economic disruptions, and to plan for a rapidly growing population faced with an insecure economic future. In its attempt to regulate Chinese burial grounds as part of a post-war effort to reconfigure urban space to meet developmental needs, the state came in direct confrontation with a complexly organized Chinese community with its own communal perspectives and priorities not necessarily supportive of, or even compatible with, those of the state. The immediate post-war Chinese community was organized according to ties of dialect group, kinship and surname lines, locality and regional affinity, where different groupings are represented by a multiplicity of clan associations and other voluntary and mutual benefit organizations (Cheng 1984; Yen 1986). These associations burgeoned in the era of colonial neglect and the resulting vacuum in areas of social support and welfare services. They represented self-help measures among the Chinese to provide cradle-to-grave services that served to bind each sub-community together, and ranged from the organization of job and trade opportunities to the conduct of rites of passage (including rituals surrounding death). In this scheme of things, burial grounds owned and run by Chinese associations proliferated. They were not only sacred sites but community spaces where kinship ties and group loyalties were cemented, independently of the state. They represented a lens through which to examine the complex structure of the Chinese community and its negotiations with the state over rights and resources.

State power is also often mediated through institutions and organizations. The presence of these mediating institutions often increases the complexity of negotiations over burial grounds. The principal colonial agencies that were in

charge of burial grounds were reinstated to their pre-war functions after the return of the British. The Municipal Commissioners were thus responsible for all burial grounds within municipal limits under section 233 to 236 of the Municipal Ordinance of 1896 (RCRBBG 1952). It is important to note, however, that the state structure was not a monolithic one. In dealing with Chinese burial grounds, the Commissioners would often seek the assistance of the Chinese Advisory Board, which served in the role of mediator between the Commissioners and the Chinese community. The result was that sometimes the Board's recommendations would result in the modification of initial proposals put up by the Commissioners and other planning authorities, in order to accommodate the views of the Chinese community. For example, in 1951, the Burials Committee deliberated on a proposal to limit the size of individual Chinese graves to a plot size of 7 by 14 feet. Many Chinese members of the Board brought up problems relating to geomancy, the needs of the rich, and the space required to worship before the grave. The result was that the final recommendation was altered to 7 by 15 feet (MMCAB 22 May 1951).

State strategies to control burial space reflect certain "modes of domination" that delineate "relations of autonomy and dependence between actors or collectivities of actors" (Giddens 1985, 8). In the nation-state, the power exercised by the state structure is mainly "administrative" in nature as opposed to the brute violence of absolutist states (Giddens 1985). By the administrative power of the nation-state, we refer to the notion that the nation-state has a relatively wide "scope" of rule, controlling large areas of the activities of its citizens, be it health, work, education or procreation. In contrast, traditional states that came before did not develop this ability to penetrate into the daily existence of its subjects. The sovereign power, however, frequently possessed a high "intensity" of rule in that it was able to invoke heavy sanctions to secure compliance, be it death or other forms of violence. As a citizen in the nation-state, such violent sanctions were no longer possible. In Singapore, such violent sanctions were not exacted even during the colonial era (although they were very much in evidence during the short-lived but traumatic Japanese Occupation years between 1942 and 1945, see Yeoh and Ramdas 1999). What we do see, however, is a gradual refinement and increased enforcement of the exercise of administrative power in the transition from a colonial to a nation-state.

The exercise of administrative power entails a distinct strategy of "surveillance" that has two components. The first comprises the collation of information about individuals, while the second involves the actual supervision of the activities of others; in our case, the ability to monitor and control land use as well as the supervision of human activities on the

land (Giddens 1985). The effectiveness of these strategies depends on the extent to which sanctions can be imposed on individuals by the state and are discussed below.

The Post-War Colonial Period

Informational Strategies

The inability of the Commissioners to control land use with regard to burial grounds during the colonial period can be partly attributed to the ineffective informational strategies that the Commissioners used. Even before the war, there were already cases of unlawful burials that were not discovered till after the act had been committed (Yeoh 1991). After the war, accurate records of the location and extent of burial grounds within the municipality were lost during the Japanese Occupation (MPMCOM 29 November 1946). The Burials Committee set up in 1950 was intended to correct this problem. It had, as one of its terms of reference, the duty of conducting "a survey of private and public burial grounds in Singapore Island ..." (MPC2OM 4 September 1950). While appreciating the importance of a comprehensive survey of burial grounds, the Commissioners had to admit that "it would be beyond the Committee to carry out a detailed field survey of all the burial grounds which would entail a considerable amount of work" (MPC2OM 4 September 1950). The matter thus remained unresolved during the colonial era.

Direct Supervisory Strategies

The Municipal Commissioners of Singapore regulated burial and burning grounds by mainly using a set of burial ground by-laws that laid out the administrative and sanitary requirements of such land use within the municipality (MCST 1929). All burial grounds were expected to satisfy criteria which included registering all burials properly in a standard burial register, and specifying depth of graves, size of plots and distance of graves from roads or water courses (MCST 1929). Back in 1906, the commissioners had already stopped issuing new licenses for burial grounds within municipal limits so post-war efforts were centered around regulating existing burial grounds, disused or otherwise (RCRBBG 1952).

However, efforts at control through legislative means were greatly hampered by two factors. The first was that the Commissioners had no powers to close existing burial grounds and order exhumation of the graves *other* than by invoking section 264 of the Municipal Ordinance (MPMCOM 29 November 1946). This particular piece of legislation enabled the Commissioners to close a burial ground if "they think that the cemetery is dangerous to the health of people living in the neighborhood of the cemetery" (PLCS 1948). This greatly circumscribed moves to clear existing

graves that impeded land development plans. For example, in 1949, plans to level a piece of land off Kim Keat Road ran into problems partly because of the presence of two Chinese graves. Although the trustees claimed that the graves were not the ancestors of the deceased owner of the land, they wanted the Commissioners to apply for the Court Order for their removal and indemnify them against costs, in the event that the request was refused. In the end, plans stalled because the Commissioners were wary of “the possibility of a future claim by any party to whom the two graves may later be proved to belong” (MPC3OM 8 July 1948). The Commissioners were thus limited in their legislative powers to clear land needed for new development. The intensity of control was shallow because the Commissioners did not possess sanctions of sufficient strength.

The Period of Independent Nationhood

Independent Singapore saw the Singapore state mustering together an effective set of both informational and supervisory strategies which gave it greater control over the burial space on the island.

Informational Strategies

The main informational strategy was the development of a Master Plan and a series of comprehensive land use surveys of Singapore Island. On 1 February 1960, the Planning Department was instituted under the Prime Minister’s ministry. One of its first major tasks was to undertake the creation of a master plan that would “take into account the greatly increased population and the government’s 5-year Economic Development Plan” (SLADOR 1960, 12).

By instituting a detailed land use survey that determined, *inter alia*, the extent and location of burial grounds, the master plan was an important first step in achieving control over space and providing the groundwork for regulating the temporal and spatial development of the Singapore landscape. While the British had always been frustrated by their lack of knowledge of the extent and location of burial grounds in Singapore which presented itself as a “serious disability” to “any person called upon to frame a master or overall plan for this island ...” (RCRBBG 1952), the combination of detailed land use surveys and the Master Plan served to provide the government after independence with more leverage.

At the same time, we should also note that the Master Plan as a document produced by government planners is both a product of and at the same time constitutive of the larger discourse of urban land use planning in Singapore. The 1965 Master Plan, for example, identifies cemeteries (together with military land, agriculture, quarry and mining, vacant land like swamps) as land “considered available for develop-

ment” (SPD 1967, 11). The rhetoric of planning embodied in these documents produced by the state contributed to a discourse that denied the alternative meanings invested in the burial landscape by the Chinese community. Pushed to the extreme, these narratives can sometimes describe the function of burial space without even noting that they are for the interment of the dead as evident in the following description from the MPFR (1965, 53): “The contribution here is more the ventilation of built-up areas and the breaking-up of amorphous sprawling intensive housing areas.”

By absorbing and recasting burial space into the discourse of urban planning, the Master Plan enables territorial control, specifically through what Piaget and Inhelder call infralogical classification (Sack 1981). This strategy works through assigning things to a category simply by virtue of their location in space. There is no need to define the exact characteristics of things other than their location. Consequently, there is also no need to take into account the complex social organization of burial grounds, such as their division into social-economic background, surname or dialect clan affiliations. Instead, they can be treated as a monolithic category of land use that can be assessed along with other types of land use in terms of their practical utility. Land use on Singapore Island thus became a “unitary field of objects, authenticated by the ‘sciences,’ and thus enabled it to function on a general horizon of ‘truth’” (Foucault 1979, 256).

Direct Supervisory Strategies

The period of nationhood saw the state increasing its powers of direct supervision over land used specifically as burial grounds. The Master Plan formed one of the bases upon which the state increased its powers of direct supervision over land use. This was done through two means: a system of land use zoning and compulsory acquisition of land. While the Master Plan was targeted at increasing the state’s direct supervisory powers over land use in general, it was to have profound effects upon burial land use on the island.

The leaders of the new state realized that previous laws had limited the powers of the state to clear burial grounds. In response, the government altered the laws in 1972 such that the Commissioner of Public Health has powers to “close cemeteries without having to assign reasons for doing so” (PDSOR 3 November 1972, col. 342). This major modification greatly enhanced the ability of the state to control burial space on the island.

Furthermore, there was increased regulation over the routine activities of individuals on the burial landscape. This regulation often involved the strict control of spatial-temporal rhythms of the Chinese through careful inspection. Activities like exhumations or cremations were closely monitored by state officials to ensure that they conformed to the

required routines. An informant, a caretaker at a funeral parlor who has had extensive experience in the exhumation of bodies since the 1960s, describes a typical scene at an exhumation:

The Health Officer from the Ministry will be present at the exhumation. We are not allowed to bring the remains back but have to send them for cremation immediately. If it was for reburial in another location, we would like, recover the body from 7.00am to 11.00 am, a Health Officer would be present to observe the exhumation and he has to certify the exhumation first, then later, certify the reburial (Ang, personal communication 1992).

The process of exhumation was thus subjected to intense supervision. For instance, a glance at the instructions issued to exhumation contractors for the Queenstown cemeteries illustrates this point (HB1018/57/50: Enclosure: Acquisition of Cemetery Sites in Q'Town). Various stages in the exhumation and reburial were supervised closely by putting into place procedures for applying for a license to exhume, seeking approval for the urns used for re-burial, choice of "coffins" to transfer undecomposed bodies, permission to use these coffins and so on (HB1018/57/50: Enclosure: Cemetery Sites in Question, 2-3).

During the period of nationhood, therefore, the state was able to increase its control over burial grounds by extending its powers of information-gathering and direct supervision over land use. Through its production of laws, guidelines, licenses and direct supervision requirements that penetrated every area of the burial process, the nation-state in essence makes visible and articulates Chinese burial landscapes and in the process renders them amenable to state regulation.

Chinese Strategies of Resistance

Chinese strategies may be broadly divided into "covert" or "overt" strategies. Overt strategies include all forms of legislative appeal and actions that utilize official channels such as legal forms of representation to the respective government agencies. On the other hand, covert strategies refer to all the clandestine or illegal activities that rely for their effectiveness on the failure of the state's informational and direct supervisory strategies.

Overt strategies were dominant in the period of nationhood, as seen in the various forms of collective representation that the clan associations make to the state for concessions in return for ceding their burial grounds (discussed later). There were also instances where the Chinese spontaneously formed

informal groupings to negotiate with the state and make known their views. For instance, in 1965, several residents of Kampong Alexandra who had buried their dead in the Cheang Hong Lim burial ground in Stirling Road were faced with the prospect of having their graves exhumed to allow for the government's compulsory acquisition of the land. As a result, they collectively made a representation to the government. The petition letter stressed that they did not intend to "quarrel" with the government's decision but "wish to co-operate with the [g]overnment in its endeavours" (HB1018/57/50: Enclosure: Letter from Tan Hong Kee to Lim Kim San 19 Jun 1965). Among other things they sought individual compensation for the removal and government undertaking that special sites be earmarked for them at the reburial place at Choa Chu Kang.

In contrast, clandestine activities like illegal burials were widespread during the colonial era and were ultimately responsible for the failure of colonial efforts to control burial grounds through surveillance (Yeoh 1991). These diminished in occurrence and importance after nationhood. After independence, for example, there were no large-scale clandestine burials given the proliferation of better informational and direct supervisory strategies on the part of the nation-state.

The Control of Sacred Space: Conflict and Negotiation

In the post-war colonial era, the state's attempts to control burial grounds in a concerted fashion did not go beyond various plans and proposals. The lack of reliable information about Chinese burial grounds, coupled with the absence of legal instruments to force closure and removal of burial grounds at locations needed for development, contributed to the failure of colonial authorities in clearing burial grounds in the City Area.³ Nevertheless, some headway was made towards a systematic land use policy with the publication of the first Master Plan in 1955. The Master Plan served to indicate the manner in which land use development in the colony was to be carried out (MP-RS 1955). The lack of any "settled policy" with regard to Chinese burial grounds meant that municipal strategies to regulate burial grounds were *ad hoc* in nature. As a result of the superficiality of state policies, the Chinese were able to continue their normal customs of burying the dead with considerable immunity and a low incidence of conflict with the authorities. This was to change decisively with self-government in 1959 and nationhood in 1965 as the state acquired wider legal powers to clear and control burial grounds.

The Period of Self Government and Independent Nationhood

Systematic Land Use Planning and Its Implications for Burial Grounds

Although the first master plan was published in 1955, it was not until the 1960s that it was implemented and had any effect on burial space in Singapore. In principle, the plan established the state's primary concerns as first, to reserve "adequate areas of land for places of work for the present and future population of Singapore" (MP-RS 1955, 19); and second, to give priority to "the feature which overshadows all others in the future planning of Singapore . . . the rapid increase in population and its relationship to the limited area of land" (MP-RS 1955, 15). The master plan thereby provided both the main justifications, that is, industrial land use and population resettlement, as well as a means of clearing burial grounds needed for "development." The Master Plan formed part of a three-fold set of state policies aimed at direct control of land use development in Singapore. Two of these aspects (land use zoning and compulsory land acquisition) are pertinent to burial grounds (Lim and Motha 1979).⁴

The System of Land Use Zoning

Through a system of land use zoning, the Master Plan sets out the "permitted uses, not permitted uses and the uses under special considerations" (Lim and Motha 1979, 5). This enabled the state to refuse applications for land to be used as a burial ground and was invoked by the officials of the new nation-state. This is exemplified by their encounter with the Foochow Association (SFA 1972, 86-89).

In 1963, the Association applied to the City Council for permission to use a newly acquired 115 acres of land at 17 1/2 miles, Lim Chu Kang as a private burial ground. The application was rejected by the City Architect for two reasons (SFA 1972, 86). Firstly, citing the Master Plan, it was pointed out that the area under consideration was already gazetted as a rural (agricultural) zone, and to use it as a burial ground would be tantamount to an infringement of the Master Plan. Secondly, the land in question was already close to the City Council Cemeteries and hence there was no need to consider setting up another cemetery nearby.

Unperturbed, the Association petitioned the Prime Minister's Office on 3 May 1963 (SFA 1972, 87). They argued that religious customs that required the Chinese to have a proper burial could not be changed overnight. What was more significant was that they pointed out that like any other association, they had worked for the common good of the nation. Since they did not have their own burial ground, to be fair the government should treat them equally and grant them their own private burial ground. The Foochow

Association went on to reinterpret the state's codified laws on their own terms when they pointed out to the government that current state regulations did allow for, and in fact made it necessary that burial grounds be segregated by ethnicity and religion, which all the more meant that they should be given their own private burial ground.

At a meeting convened later to discuss the petition, state officials drew upon the "texts" of colonial planners dating from the 1930s and 1940s which argued that with population increase and land scarcity, the government was not to issue any more licenses for private burial grounds but were to encourage cremation (SFA 1972, 87). When questioned as to why they needed their own burial ground now when they had managed without one for so long, the Association's representative replied that:

They were like a beggar who had gone without food for many days and had just come begging for a meal. Would one say to the beggar that he could stop eating altogether since he had already gone without food for so long (SFA 1972, 87).

The petition was later rejected again but the Association re-petitioned the Prime Minister's Office as they felt that the "state had not taken into account its citizens' feelings." Finally, after further negotiations, a compromise was reached whereby the Master Plan was altered such that four acres out of the Association's 115 acres was allowed by the Prime Minister's Office to be used as a private burial ground. The license was finally granted in 1966, three years after the application was first made. Negotiations over burial space in this case hence reached a compromise in which certain concessions had to be made to the Chinese in return for clearing their burial grounds.

Except for this isolated case, no further licenses to set up new Chinese burial grounds were granted after the 1960s except in the case of re-internment from other existing locations. By 1972, the government made it clear that it would close all cemeteries in and around the city area "to conserve land" and that it considered cremation as the only viable, long-term solution (APA 1972). However, the government also agreed to "extend existing public cemeteries at Chua Chu Kang as well as add new ones elsewhere" (APA 1972), a move which indicated that, like the colonial authorities before them, the new state had to compromise on the people's aversion to cremation, which could be encouraged but not made compulsory.

Compulsory Acquisition and Clearance

Another aspect of the state's land use development policies involved control over specific or existing development by compulsory acquisition of land for "any public purpose"

(APA 1972). Even though the Land Acquisition Act is generally all encompassing, outlining in detail the procedure to be followed as well as the rules for assessing compensation for land acquired, the expression “public purpose” was not defined in the Act (Khublall and Yuen 1991, 193). A landmark Singapore High Court ruling against a claimant contesting the “public purpose” for which the land was required had the court asserting that “the government is the proper authority for deciding what a public purpose is” (Khublall and Yuen 1991, 193). The Minister for National Development has in effect “absolute discretion in deciding the purposes for which land can be acquired under the Act” (Khublall and Yuen 1991, 193). There has been thus little, if any legal possibilities for challenging the Act directly.

From 1964 to 1973, about 15 per cent of the land area of the Republic had been compulsorily acquired by the government, with about 50 per cent of this solely for public housing (APA 1972). By the mid-1960s, with the Master Plan firmly in place, the state was in a better position to negotiate the removal of Chinese burial grounds. The most “pressing demand for land in the urban area [was] for housing” (MPFR 1965, 32). It was thus not surprising that the government agency put in charge of housing [initially the Singapore Improvement Trust (SIT) and from February 1960, the Housing and Development Board (HDB)] (SLADOR 1960, vol. 13) became a major player in state attempts to clear Chinese burial grounds. Numerous large Chinese burial grounds were cleared from the 1960s onwards for the purposes of New Town housing development at locations like Queenstown, Tiong Bahru, Redhill, Kampong Silat, Telok Blangah and Bishan (HDB 1960-1991).

The clearance process, however, did not involve the state simply steamrolling over the burial grounds of the Chinese community. In fact, even though the Land Acquisition Act conferred wide-ranging powers on the planning authorities, the clearance process was often drawn out and involved the government in a series of complex negotiations with the Chinese community. The discursive elements of Chinese religion and *feng shui* (Chinese geomancy) were still important as instruments of negotiations with the state. As the following discussion will attempt to demonstrate, however, the Chinese community in the post-war independence period frequently stressed their support of government policies, while at the same time petitioning the government for concessions in return for ceding their burial grounds. Their new relationship as citizens to the nation-state led to the emergence of new discursive elements that stressed Chinese participation in the nation-state. It therefore became more difficult to maintain a separate discourse that immunized their burial grounds against state control. The intricacies of the cemetery acquisition and clearance process can only be best appreciated if

we examine specific instances of the clearance process at a micro level.

In the 1960s, the HDB tried to acquire cemetery lands either by “private treaty” or if necessary, by utilizing compulsory legal powers to compel grave removal under the Housing and Development Ordinance and Land Acquisition Ordinance (HB1018/57/50 Enclosure: Ag Lands Manager to CEO 11 October 1962). In 1962, four cemeteries near the existing Queenstown housing estate were deemed by the HDB as “a logical extension of the Queenstown development” after the existing neighborhoods IV and III were completely built-up (HB1018/57/50 Enclosure: Ag Lands Manager to CEO 11 October 1962). Since compensation for acquired land was assessed at current (that is, as a cemetery) rather than potential value, the HDB sought the Planning Department’s co-operation to refuse to grant any planning permission and thereby prevent the lands from being developed until it could be acquired by the HDB. Since “cemetery land [had] no market [value]” and any proposed commercial development would require “an alteration of the Master Plan Zone” for which there appeared to be no justification (HB1018/57/50 Enclosure: Report by Johnny Loh, Lands Officer), the Board could arrange matters such that “no high claims [could] be admitted for loss of development value” when they were ready to acquire the land (HB1018/57/50 Enclosure: Ag Lands Manager to CEO 11 October 1962).

Many of the cemeteries acquired at this time were run by the various Chinese clan associations. For example, three burial grounds at Queenstown were managed by the Hakka association *Ying Foh Fui Kun* (YFFK 1989, 26), while the cemetery at Kampong Tiong Bahru and Redhill belonged to the *Singapore Hokkien Huay Kuan* (SHHK) (HB25/59/II Enclosure: CEO-HDB to Permanent Secretary, National Development: enclosure in -Kampong Tiong Bahru Redevelopment of i) Fire Site, ii) Cemetery Site, iii) Exhumation of Graves 3 October 1964; *The Straits Times* 14 October 1964). In attempting to clear these burial grounds, the HDB often met with resistance from the associations.

The YFFK for example, “objected strongly to the compulsory acquisition of their only cemetery in Singapore” (HB1018/57/50 Collector of Land Revenue to E.M., C.E.O., Chairman 10 August 1966). The association, however, added that they would not “stand in the way of progress by the government. Instead, they requested several concessions from the government. Firstly, that a license for another burial ground elsewhere be granted. Secondly, that a portion of about 4 1/2 acres of their burial ground be returned to them for the purposes of constructing a memorial and re-burial of existing graves. They also wished to keep their existing temple on the burial ground. Lastly, the association requested that exhumation be delayed for another five years

(HB1018/57/50 Enclosure: Penolong Setiausaha (Undang²) to Pegawai Tanah Melalui Pengurus Tanah 2 December 1965). According to the association, the 4 1/2 acres were to be used for re-burial because their members would object to using the government cemetery at Chua Chu Kang for re-burial and would not like to see their only cemetery “extinguished” (HB1018/57/50 Collector of Land Revenue to E.M., C.E.O., Chairman 10 August 1966).

While the authorities did not accede to their requests to grant a re-burial ground elsewhere and to delay exhumation, the other request for a 4 1/2 acre re-burial site was granted in view of the fact that the Hakka people had “no other cemetery.” The proposed vestigial site on the southern fringe of the lot was deemed to have little effect on the Board’s “comprehensive development of the land” (HB1018/57/50 Collector of Land Revenue to E.M., C.E.O., Chairman 10 August 1966). In order “not to create a precedent,” the land was to be designated as a public burial ground with no fresh burials permitted (HB1018/57/50 Enclosure: Penolong Setiausaha (Undang²) to Pegawai Tanah Melalui Pengurus Tanah 2 December 1965). In other words, the ownership of the land was to be effectively vested in the government who would in return alienate on a state lease for a term of 99 years the 4 1/2 acres to the association at a nominal premium of S\$1.00 (HB1018/57/50 Enclosure: Teh Cheang Wan to Permanent Secretary, National Development 25 February 1969). Thus while the government effectively managed to acquire the cemetery for housing development, it also had to take into account some of the wishes of the Chinese. In fact, it was admitted that the concession was given as the government had to take into view “public sentiment as regards [the] government’s many acquisitions of private burial grounds” (HB1018/57/50 Enclosure: Penolong Setiausaha (Undang²) to Pegawai Tanah Melalui Pengurus Tanah 2 December 1965). On another level, the government also had to alter the zoning of the master plan to accommodate the re-burial site and the fact that this was a “concession to the [a]ssociation” was noted by the HDB (HB1018/57/50 Collector of Land Revenue to E.M., C.E.O., Chairman 10 August 1966).

When re-interment had almost been completed, the association requested that the stone tablets be re-set to conform more closely to geomantic requirements as the original layout was thought to be geomantically unfavorable. The government agreed to this request and absorbed the additional cost of the alterations (YFFK 1989, 30). At the same time, the government made arrangements to enable affected families to conduct private exhumations for re-burial elsewhere and also, if they wished, be informed of the date of exhumation so that they could witness the exhumation together with a representative from the association (HB1018/57/50 Enclosure: Johnny Loh., Lands Officer, to Acting Manager,

SIT 11 April 1959). The clan associations were hence involved at various points in the clearance process.

In a second example, the Singapore Hokkien Huay Kuan (SHHK)’s cemetery at Kampong Tiong Bahru was scheduled for acquisition and subsequent clearance in 1959 for housing development (HB25/59/II Commissioner of Lands to Acting Manager, SIT 11 April 1959; *The Straits Times* 14 Oct 1964). Like the YFFK, the SHHK petitioned for a small portion of the said land, on which a temple and outhouses serving it were situated, to be “wholly excluded from the future development of the surrounding area” (HB25/59/II Enclosure: Wee Swee Teow to Commissioner of Lands 9 June 1959). The reasons cited were that the “feelings of the Chinese Community which [they] represent [would] be deeply and seriously hurt” if the buildings in question were destroyed as a result of development (HB25/59/II Enclosure: Wee Swee Teow to Commissioner of Lands 9 June 1959). The Commissioner of Lands in his turn viewed their request “sympathetically” having been impressed upon by the SHHK of their objection to the proposed demolition “on religious grounds” (HB25/59/II Enclosure: Kwa Soon Chuan, f/Commissioner of Lands to M.I.T. 15 June 1959). It was thus recommended that the government accede to their request.

This was not the only time that the SHHK had managed to secure a degree of concessions in return for ceding their burial grounds. In 1963, when the government acquired their cemetery at Redhill, the Prime Minister’s Office had approved the association’s application to use four acres of their own land at Mandai as a re-burial site (HB25/59/II Enclosure: Report by Lands Officer 14 September 1964; HB25/59/II, Enclosure: Tan Kah Jin to Permanent Secretary, National Development 3 October 1964). Subsequently, about 15,300 graves were exhumed and relocated to Mandai by 3 October 1964.

For their cemetery at Kampong Tiong Bahru, the association petitioned to shift the estimated 5,200 graves to be cleared to Mandai. An application was then made by the association to acquire ten more acres at Mandai for the re-interment of the graves from Kampong Tiong Bahru. In addition, the association indicated that they needed the extension because they proposed to exhume their cemeteries at Whitley Road and Kheam Hock Road. The HDB’s response was that only one acre was needed to re-bury the graves from Kampong Tiong Bahru, and on 20 October 1964, the Master Plan Committee agreed to let the association open up one acre adjacent to the previous four acre cemetery site at Mandai for the re-burial of the estimated 5,200 graves (HB25/59/II LM Enclosure: Lands Manager to Singapore Hokkien Huay Kuan 23 November 1964; HB25/59/II, Enclosure: Tan Kah Jin to Permanent Secretary, National Development 3 October 1964).

Other than negotiating for concessions, the SHHK also took particular interest in the exhumation *per se*. For the exhumation of their Redhill cemetery, the association “strongly recommend[ed]” that the exhumation contract be awarded to the caretaker of one of their burial grounds, Aw Tong Hung (HB/25/59II Enclosure: Singapore Hokkien Huay Kuan to Lands Manager, HDB 27 April 1961). According to the association, Aw was recommended on the basis of his 30 years of service and his familiarity with the rites and practices of the Hokkien community. The SHHK highlighted the fact that they were “solely responsible to the descendants of the Hokkien community” who had vested trusteeship of their various burial grounds in the association. They also stressed the fact that they had helped to supervise previous exhumations, kept detailed records of the graves exhumed for the use of the dead person’s descendants and dutifully visited the graveyards every year during the “grave visiting festival” to perform “the necessary offerings, in accordance with the Hokkien community[’s] customs and rites.” They thus justified their “very keen interest” in the exhumation and re-burial as their “responsibility” (HB/25/59II, Enclosure: Singapore Hokkien Huay Kuan to Lands Manager, HDB, 27 April 1961).

For the exhumation of their Kampong Tiong Bahru Site in 1964, the SHHK took their participation a step further by actually securing the exhumation contract of S\$70,000 to remove about 3,500 graves (HB/25/59/II Enclosure: Lands Officer to Lands Manager 26 October 1964). However, the burial records were destroyed during the war and hence the exact number of graves could not be ascertained. After the completion of negotiations for the purchase of the cemetery and the compensation had been agreed upon, the association informed the HDB that there was a mass re-internment at the site 30 to 40 years earlier (HB/25/59/II Enclosure: Lands Officer to Lands Manager 19 October 1964). They thus requested an additional S\$8,000 from the HDB to clear the extra graves (HB/25/59/II Enclosure: Lands Officer to Singapore Hokkien Huay Kuan 28 November 1964). Initially, the HDB, claiming that the “mass re-internment” was not made known during the calling of tenders, insisted that the association bear the extra cost (HB/25/59/II Enclosure: Chief Clerk to Lands Officer, 27 October 1964). However, they later agreed to pay an additional “compromise figure of \$5,000” to the SHHK in view of the “urgency for clearance” while admitting that the Board was in a “weak position” (HB/25/59/II, Enclosure: Lands Officer to Lands Manager 3 December 1964).

Other than having to deal with the various clan associations in charge of the burial grounds, at times the state also met with direct resistance from the descendants of the graves

who sought individual compensation for the exhumation. State negotiations with individual citizens with claims on the acquired land would often also include squatters on the cemetery land, not an uncommon occurrence (HB25/59/I Redevelopment of Kampong Tiong Bahru Fire Site: Enclosure: Commissioner of Lands to Acting Manager, SIT 11 April 1959; HB1018/57/50, Enclosure: Lands Manager to C.E.O. 11 October 1962). At the Queenstown cemetery site belonging to the YFFK for example, there were approximately 338 families squatting on the site (HB1018/57/50 Enclosure: Report by Johnny Loh, Lands Officer). Thus, state attempts to clear burial grounds for development often met with resistance on both individual and collective levels. The state could not afford to ignore these problems when they surfaced. Instead the changing geography of burial space had to be carefully negotiated, often with concessions and compromises made by both the Chinese and the state.

The Success of State Attempts to Clear Burial Grounds

In general, the nation-state, armed with new legislative instruments, was considerably successful in clearing extensive areas of private Chinese burial grounds in the name of the “economic and social good of all citizens of Singapore” (PDSOR 7 April 1978, col. 1492). In the 1970s, the nation-state was to further enhance its regulatory powers with amendments to existing legislation that gave it the power to close cemeteries “without having to assign reasons for doing so,” hence breaking the last legislative deadlock that had rendered the former Municipal Commissioners (under the colonial state) powerless to close cemeteries except for “health” reasons (PDSOR 7 April 1978, col. 1491).

By 1978, the government was in a position to state that all private cemeteries “will be acquired as and when required for development” (PDSOR 7 April 1978, col. 1491). In 1967, 619 hectares making-up 1.1 per cent of land area on Singapore Island were given over to burial grounds (RMP 1985). That amount was down to 534 hectares, a drop of 13.7 per cent, by 1982 indicating the success of the state’s attempts to clear private burial grounds (RMP 1985).

The success of the state’s attempts to clear burial grounds therefore reflected the progressive consolidation of state power after independence. Unlike the colonial state, the nation-state was able to enact legislation that gave it greater power over the use of space as burial grounds. As a result of the greater intensity of state moves to clear burial grounds, the processes of conflict and negotiation can be more readily discerned as the Chinese responded to government moves by seeking concessions and compromises from the state.

The Shift to Cremation

The state's use of legislative instruments was part of the negotiations over Chinese burial grounds that took place at a more visible level. Beneath these large-scale changes were the more micro-level aspects of the state's attempts to control burial grounds. An important prong of the debate resided with the state's renewed attempt to promote cremation. The success of the state's attempts to clear private burial grounds could not have been possible if cremation was not accepted by the public as an alternative way to deal with the dead.

Although, as the colonial authorities had noted, cremation was not entirely alien to the Chinese before 1965, 89.8 per cent of the Chinese dead were buried with only 10.2 per cent opting for cremation (Tong 1988). By 1988, the majority of the Chinese dead, 68.1 per cent were cremated with only 31.9 per cent buried (Tong 1988), thereby contributing to the general (all ethnicities) increase in cremation instead of burial in Singapore during the period of nationhood. By the 1990s, cremation was preferred by four in five of those for whom burial is not required by their religion (i.e., all communities apart from the Muslim, Ahmaddiya Jama'at, Jewish, Parsi and Bahai populations) (*The Straits Times* 9 August 1994).

The change from burial to cremation as the main mode of disposal among Chinese Singaporeans is often seen as a reflection of the weakening hold of "traditional" ideas and beliefs concerning death and the after-life (Tham 1984). However, it must also be remembered that the decline of ritual practice is itself also inextricably linked to the diminished role that regional, dialect and clan associations play in Chinese social life after independence. With independence, in order to re-orient the new citizenry away from the more parochial, ethnically-bounded concerns towards acceptance of the nation-state framework, many of the functions of these Chinese voluntary associations including control over funeral and burial matters were transferred to the government which assumed responsibility for the welfare of the people. The acceptance of cremation in the period of nationhood is also partly a result of the government's provision of crematoria and columbaria as viable alternative means to dispose of and accommodate the dead (Tong 1988). For instance, the government built columbaria to house the cremated remains of the exhumed at places like Yishun and Mandai, both of which were built in the late 1970s (HDB 1978-1981; *The Straits Times* 31 August 1982). Clan associations like the Pek San Theng Association were also allowed to build a columbarium to house the exhumed, cremated remains from their cemetery after it had been acquired by the government for public housing (HDB 1983/84; *The Straits Times* 9 April 1986; PST 1988, 118-119).

At the same time, while cremation was encouraged, burial grounds were provided for those who insisted upon a burial so that the Chinese would not feel "threatened or forced into using cremation" (HDB 1983/84; *The Straits Times* 9 April 1986; PST 1988, 118-119). Earlier attempts to encourage cremation by the municipal authorities had failed due to Chinese opposition. This time, the state avoided direct confrontation. However, the change to cremation was certainly more complex than a matter of government provision of alternatives. It in fact entailed the state using strategies of persuasion.

The funeral specialists, the traditional managers of death in the Chinese community were instrumental to the promotion of cremation. Within the Chinese community, the power relations between the funeral specialists, be they caretakers, priests or even geomancers, and the Chinese masses, were such that ritual practices were often directed by the funeral specialists with the Chinese people paying for their expert knowledge of the various rites of each of the Chinese dialect groups. For example, the caretakers have expert knowledge of all the varied burial practices of the respective dialect groups (Ang, personal communication 1992). As they also had more contact with the Chinese masses, these middlemen were able to slowly ameliorate the previous distrust of cremation without any semblance of threat or coercion.

As citizens in the nation-state, one of the rights enjoyed by the people was "religious freedom." It was pointed out that:

the government cannot very well say everyone in Singapore has to be cremated since there is supposed to be religious freedom in Singapore . . . so they ask us (funeral parlor owners/caretakers) to promote cremation (Ang, personal communication 1992).

The same informant who also ran a coffin-making shop near Kampong San Theng in the early 1970s related the initial difficulties with cremation initially as there was no suitable coffin for cremation of the Chinese dead. The old Chinese coffins could not be cremated as they were too thick and the only ones available were the "Catholic religious coffins" (Ang, personal communication 1992). The Chinese objected to their use because of the presence of "crosses" on the coffins so he had to alter the designs himself into a form that was acceptable to the religious sensibilities of the Chinese. He relates his experience thus:

When we first tried to alter them it was so difficult, the suppliers said they didn't have the "flowers and grasses" design so then we went to find "lion head" designs, the bronze ones, plated them white and then put them together ourselves (Ang, personal communication 1992).

These “middlemen” were therefore able to convert the Chinese people to the idea of cremation because, firstly, as the traditional managers of death, they were the people who possessed the specialized knowledge about Chinese death practices that the Chinese depended on in dealing with death. Secondly, unlike the state officials, the funeral specialists had more intimate dealings with the Chinese and hence were in a better position to persuade the Chinese to adopt cremation. Lastly, by providing coffins and other religious paraphernalia which were suitably adapted for cremation and which gained acceptance among at least the less “traditional” Chinese, they were able to remove some of the religious objections to cremation.

This did not mean the demise of traditional discourses governing the disposal of the remains of the dead. In recent years the discourse of geomancy has been resurrected to encompass the siting of cremation urns in columbaria, a development which the government had not anticipated. For instance, in 1983, the government had to drop its previous practice of allocating niches at its Mt. Vernon Crematorium by sequential serial numbers and allow free selection “following requests from families, some [of whom] would keep ashes until they can get niche of their choice” (*The Straits Times* 23 December 1983). The upper two rows were preferred to the lower two rows which were “unfavorable” as urns there were in danger of being touched by sweeping brooms as well as being exposed to dust and dirt (*The Straits Times* 23 December 1983). There were also instances of people consulting geomancers to determine the favorable niches (*The Straits Times* 9 April 1986).

The nation-state was largely successful in promoting the acceptance of cremation as an alternative means of disposing of the dead. It succeeded mainly due to the use of a different strategy of control. Instead of promoting cremation directly to the Chinese like what the colonial-state did, the officials of the nation-state utilized “middlemen” like the caretakers and funeral parlor owners to gradually change the views of the Chinese to using cremation. By the 1980s, cremation had been accepted as the “norm” in Singapore. Whereas in the past descendants looked after their ancestral tombs, increasingly it became their duty to take care of the ashes of their ancestors (*The Straits Times* 9 April 1986).

Conclusion

We have argued in this paper that landscapes of death such as the Chinese burial spaces discussed here provide an important lens to understanding the transition between colonial rule and the incipient years of nation-building. This is because the politics of space accompanying such a transition come into sharp focus in examining a landscape that is mul-

tiple interpreted from different perspectives. From the state’s vantage point, the extensive burial grounds of the Chinese community are “dead” space which should be recycled for developmental purposes for the living, and particularly so in a land-scarce city-state with a rapidly growing population and a burgeoning economy. From the perspective of the various Chinese sub-communities, the burial grounds were not only a sacred landscape of repose but represented a major focal point for community-bonding.

We also argue that the politics of space needs to be examined in terms of a microphysics of multiple strategies and counter-strategies drawn upon by different fragments of the polity. It is by mapping out a detailed and substantive account of these strategies that we seek to clarify the transition in the nature of state-people relations in the post-war era. The negotiation between the state and the Chinese for control of burial grounds had markedly different outcomes in the colonial period and the period of independent nationhood. In the colonial state, even though there was much discussion and plans, no moves were taken to clear Chinese burial grounds mainly because the state lacked the legislative tools to do so. As a result, the Chinese were able to continue their traditional burial practices undisturbed. With the transition to nationhood, the process of negotiation resulted in the state succeeding in clearing Chinese burial grounds. In the nation-state, the Chinese were unable to ignore the state and instead became engaged in a process of negotiation with the state. As has been shown, even though the state did manage to clear numerous burial grounds, frequently, both the state and the Chinese had to make compromises and concessions in the process of negotiation. By examining the microphysics of power over burial spaces, this study has attempted to illuminate the intricate involvement of human agency in the nation-building project. In sum, following independence, the nation-state took the “unformed and unorganised” Chinese burial landscape with its “unformalized and unfinalised functions” and translated it into a generic land use category that could be articulated in terms of urban planning discourses. This movement also produced a narrowing of the range of human conduct possible within the territorial boundaries of the nation-state. This reduction is done by “distributing in space, laying out and serializing in time, composing in space-time, and so on” (Deleuze 1988, 34). As a result, while landscapes of death were continually shaped by strategies of negotiation using official channels on the part of the Chinese, clandestine burial and other evasion tactics, once widespread and effective as strategies of resistance during the colonial era, were increasingly circumscribed. This heralds the birth of a nation-state undergirded by a new set of relations between the state and the people.

Endnotes

1. E-mail for Brenda Yeoh: geoya@nus.edu.sg.
2. Our work has links with the substantial body of geographical work which do not deal directly with burial grounds but examine the role of conflict in constituting the landscape. These studies often acknowledge that different social groups invest different meanings in a particular landscape and examine the spatial politics that result (see for example, Duncan 1990; Jackson 1988; Ley and Olds 1988).
3. For a more detailed discussion of developments in the post-war colonial era, see Yeoh and Tan, 1995a; Yeoh and Tan 1995b).
4. The third aspect involves direct public authority participation in providing land development that mainly involves reclamation of land from the sea or swamp.

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The Paleoepidemiology of Schistosomiasis in Ancient Egypt

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Abstract

*This paper reconstructs the paleoepidemiology of schistosomiasis in Egypt in the context of the parasite, host snail, and human ecology. The fossil snail fauna of the Sahara suggests that after its origin in East Africa, schistosomiasis existed in North Africa in prehistoric times. The oldest human cases were dated to Pharaonic Egypt. The development of irrigation in Egypt provided conditions favorable for schistosomiasis, especially *Schistosoma haematobium* infection, and infection rates apparently increased until recent years. Recent countrywide epidemiological studies tend to confirm these findings. Implications of the paleoepidemiology of schistosomiasis for its control in modern Egypt are examined in relation to socioeconomic, demographic, and public health developments. Studies using new diagnostic tools that permit the screening of large numbers of mummies and naturally preserved bodies and correlation of their infection status with local environmental conditions may further elucidate the evolution of the schistosomiasis disease complex.*

Keywords: Schistosomiasis, paleoepidemiology, Egypt, disease control

Introduction

Schistosomiasis transmission takes place where the ecologies of the schistosome parasite, the aquatic snail intermediate host, and the human definitive host converge in space and time in surface waters. Climate and the distribution of surface waters suitable for snail intermediate hosts and the free-swimming parasite are crucial in the macrogeographic distribution of schistosomiasis worldwide. Microgeographic variations in the physical environment, human settlement patterns, the distribution of freshwater bodies and the intensity

of exposure and contaminative contact by humans and the prevalence of the pathogenic worms and host snails largely determine the prevalence of infection within endemic areas and communities. Schistosomiasis transmission depends, unlike the transmission of malaria and other insect-transmitted diseases, on the active role of the human host in the transmission process, through excretory contamination of snail habitats and direct contact with infective water. This ecological relationship thus makes schistosomiasis a disease closely linked to rural water resources development, population increase, inadequate sanitation and lack of effective medical treatment (Kloos and Thompson 1979). In the 1990s, one or more of the five species of schistosomes causing disease in humans were endemic in all countries in Africa and in parts of the Southwest and East Asia and Central and South America and responsible for more than 200 million infections world-wide (WHO 1993). Egypt, which depends on the waters of the Nile for nearly all of its agricultural output, has some of the highest schistosomiasis rates in the world (Farley 1991).

The survival of the shells of snail intermediate hosts in favorable environments for thousands of years facilitates the study of schistosomiasis during historic and even prehistoric times. The two major schistosome species pathogenic to humans in Africa and the Middle East are *Schistosoma haematobium* and *S. mansoni*. The former, which causes urinary schistosomiasis and requires snails of the genus *Bulinus* for its life cycle, is known to have been endemic in ancient Egypt. *S. mansoni* causes intestinal schistosomiasis and is transmitted by *Biomphalaria* snails. Ruffer (1910) was the first to diagnose *S. haematobium* infections in mummies, a finding that caused widespread interest among medical scientists, historians, archeologists and linguists in the occurrence of schistosomiasis in ancient Egypt. The development of new diagnostic tools that are both nondestructive and reli-

able contributed to renewed interest in the study of the occurrence of schistosomiasis in ancient Egypt in recent years. The new diagnostic tools can provide more reliable diagnosis of schistosomiasis in preserved mummified materials than the written record, which is less specific, biased toward the nobility and difficult to translate from ancient Egyptian texts (Filer 1995). The earlier view that the Egyptian medical papyri contained descriptions of the symptoms of *S. haematobium* infections has recently been rejected (Nunn 1996, 2000; Westendorf 1992, 251), placing further emphasis on the study of infections in mummies, the distribution of snails transmitting schistosomiasis and life conditions of the ancient Egyptians.

Paleoepidemiology has become an important science in the reconstruction of disease histories in ancient societies. Most studies of schistosomiasis in ancient Egypt have used the paleopathological approach, which focused on diagnosis and history of disease, with little consideration of the ecologies of the schistosomes, the snail intermediate hosts and humans. Paleoepidemiology, a processual and population science which developed as a reaction to the narrow focus of paleopathology, considers the ecological and cultural relationships in disease complexes (Goodman 1998). In one of the earliest paleoepidemiological studies Dunn (1968) suggested that past and present hunter-gatherers were less afflicted with infectious disease than agriculturalists. By using ethnographic analogy (Inhorn and Brown 1997), Dunn was able to project current health levels of isolated hunter-gatherers into the past to describe infectious disease in prehistoric populations. The evolution of disease in hunting-gathering and agricultural societies was more intensively discussed by Cohen and Armelagos (1984). Extending the paleoepidemiological paradigm into the political sphere, Martin et al. (1984) argued that health levels in ancient Nubia were inversely associated with sociopolitical status and adversely influenced by political upheavals. Currently, paleoepidemiological studies are exploring avenues to better understand intergroup and local differences in health levels from a political-economic perspective (Goodman 1998).

No study has examined the distribution of fossilized snail species known to currently transmit schistosomiasis in Egypt and surrounding areas within the context of human ecology and schistosomiasis in ancient Egypt. Archeological studies have found *Bulinus* and *Biomphalaria* snails in numerous localities in much of Africa, including the Sahara and Sahel regions (Wendorf et al. 1976a; Beadle 1981; Brown 1994). The present distribution of intermediate host snail species and subspecies has facilitated the search for their evolution and the spread of schistosomiasis in Africa and questions the argument by some Egyptologists that it originated in Egypt (Wright 1976).

The objective of this paper is to reconstruct the paleoepidemiology of schistosomiasis in ancient Egypt and to evaluate the role of socioeconomic, demographic, and public health developments for its control. The prehistoric and historic record of schistosomiasis and its snail intermediate hosts, as well as archeological, ontological and historical evidence from Egypt and other Middle Eastern and African areas are examined to put the Egyptian material in a wider geographical context. Infection levels in contemporary Egyptian populations living in different localities and using different types of irrigation are projected into the past, to facilitate the reconstruction of the paleoepidemiology of schistosomiasis. The use of ethnographic analogy may be appropriate in the rural Egyptian population, whose lifeways and relationship with surface waters have not changed substantially in many ways through history. Particular attention is given to the probable origin and distribution of schistosomiasis in East and North Africa and the conditions which are known to favor its transmission and spread at the regional and, where possible, at the local level.

Evolution and Distribution of Schistosomiasis in Africa

The discovery of schistosome parasites in humans in 1851 by Dr. Theodor Bilharz in Cairo, the demonstration of their life cycle by Dr. Robert T. Leiper in Egypt in 1915 and Western political interests focused further attention on the early history of schistosomiasis in this country (Farley 1991). The great interest of European archeologists and historians in Egypt and the relative neglect of other civilizations in Africa also contributed to the view that schistosomiasis and several other infectious diseases originated in the lower Nile valley (Von Oefele 1901; Wright 1976). This anthropocentric approach to schistosomiasis put too much emphasis on the human phase of the schistosome life cycle and neglected the ecology of the parasite and snail hosts. Studies of the paleoecology of the parasite, the intermediate hosts and humans argue that schistosomes existed together with their human host around the headwaters of the Nile much earlier, at least as early as the Paleolithic (Wright 1970). According to Davis (1992), both schistosome species and their snail hosts originated in Gondwanaland. But recent phylogenetic studies indicate that *Biomphalaria* came to Africa from South America or North America after the breakup of the super continent, about 2 to 5 million years ago, and that the human schistosomes originated in Asia (DeJong et al. 2001; Morgan et al. 2001; Snyder and Loker 2000). An early date is also supported by the adaptation of schistosome parasites to primates (Platt and Brooks 1997). In East Africa, where the australopithecines and their successors lived in close proximity

to freshwater bodies, baboons continue to be an important reservoir host of *Schistosoma mansoni* (Fenwick 1969; Wright 1970). Subfossilized *Bulinus* and *Biomphalaria* snails have also been found in the more arid parts of East Africa (Beadle 1981, Brown 1973; Gautier 1976). The presence today of a rich snail fauna in East Africa (about half a dozen species each of *Biomphalaria* and *Bulinus*, including four subspecies of *Bulinus truncatus* in Ethiopia (Brown 1994)), further suggests that schistosomiasis evolved in that region. The relative scarcity of snail fossils in the East African Lakes region is apparently due to its humid and acidic soils, which disfavor the survival of snail shells, unlike the soils of arid areas (Sparks 1970).

The wide distribution of subfossil *Biomphalaria alexandrina* (currently the major transmitter of *S. mansoni* in Egypt), *B. pfeifferi* and *Bulinus truncatus* at numerous Paleolithic sites in the Sahara (including the desert of Egypt) as far south as the Sahel belt in Sudan and Chad, indicates that schistosomiasis was endemic in North Africa during prehistoric pluvial cycles which ended during the early Neolithic period. Several wet phases have been identified in the Sahara between 22,000 BC and 3,000 BC, based on lake levels. In pre-Dynastic times, high lake levels existed throughout Africa between 7,000 BC and 6,000 BC and again from 4,500 BC to 3,000 BC. Populations inhabiting the present region of the Sahara fished and collected shellfish for food in extensive freshwater lakes and marshes in a region characterized by a rich flora and fauna. The fauna included wild and domesticated cattle, fish and shellfish, crocodiles, rhinos, buffalos, hippos and many other species of tropical Africa (Beadle 1981; Street and Gasse 1981; VanDamme 1984; Wendorf et al. 1976a).

This archeological record questions Adamson's (1976) suggestion that schistosomiasis entered Egypt during Pharaonic times along trade routes from the south and subsequently spread throughout the Middle East. It is more likely that schistosomiasis was endemic in various parts of North Africa much earlier. Movements of settlers from the slowly desiccating Sahara to the fertile Nile valley and the southern margin of the Sahara and adoption of an increasingly nomadic economy based on animal husbandry in the affected areas (Barker 1981; Close 1987) provided opportunities for the spread of schistosomiasis and its host snails throughout North Africa, and especially into Egypt. Live snails could have been disseminated by hunters, farmers and pastoral nomads transporting them in water containers and on birds, as reported in recent years (Kloos and Thompson 1979).

The Fossil Snail Record

Although schistosomiasis-transmitting snails were widespread in Africa and the Middle East during prehistoric times,

the advent of irrigated agriculture and concomitant rapid population growth greatly favored the spread of schistosomiasis. The finding of fossilized *Bulinus truncatus* (but not *Biomphalaria*) shells at late Paleolithic sites at Edfu and Esna in Upper Egypt (Wendorf et al. 1976b) indicates that conditions suitable for *S. haematobium* transmission existed in the Nile valley at that time. Failure to recover snail shells elsewhere in the Nile valley and delta at later Pharaonic sites appears to be related to the long massive aggradation of alluvial soil which tends to cover and obliterate fossil remains. Similarly, in the Gezira irrigated area of Sudan, no *Biomphalaria* and *Bulinus* subfossils were found in alluvial soil but they were common in unaggregated soil. Large-scale irrigation schemes, typically located on alluvial soil, have been afflicted with some of the highest schistosomiasis infection rates (Malek 1958; Hunter et al. 1994). The recovery of numerous fossilized *Bulinus* shells from mudbrick houses along irrigation canals and around several palaces in Mesopotamia dating from 4,000 BC to 300 AD further indicates that irrigation systems were suitable schistosomiasis transmission sites in ancient times (Zakaria 1959). Recovery of *Bulinus truncatus* from a well in the town of Jericho dated at 1,650 BC (Biggs 1960) also suggests that snail hosts became adapted early to human-made aquatic habitats in and around early settlements. As with other density-dependent parasites, especially *Ascaris* and hookworm, the change from hunting/gathering to a sedentary agricultural lifestyle created conditions that facilitated schistosome transmission (Cockburn 1971). Thus the creation of human-made snail habitats through the construction of canals and ponds, intense human use of Nile water and the rapidly increasing human population near these waters without adequate sanitation facilities all favored the close interaction between humans, the parasite and the snail intermediate host.

Mummy Studies

The earliest case of human schistosomiasis (*S. haematobium*) identified using immunodiagnosis (ELISA) occurred over 5,000 years ago in an Egyptian adolescent (Deelder et al. 1990). ELISA also revealed *S. haematobium* in two mummies 3,000 and 4,000 years old (Contis and David 1996). The two *S. haematobium*-positive mummies diagnosed by Ruffer (1910) were dated to the Twentieth Dynasty (1250-1000 BC). Ova of this parasite and of tapeworm were found radiologically in the naturally preserved (by desiccation) body of a 14 year old boy of similar archeological age who was a weaver by trade and had liver cirrhosis, a common symptom of chronic schistosomiasis (Lewin 1978). Calcified schistosome ova were identified radiologically in several mummies from later periods by the Manchester Mummy Project (Contis and David 1996). Radiological examinations also

strongly suggest that the calcified bladders in two other mummies were due to *S. haematobium* infection (David 1997). As yet, the research shows no evidence that *S. mansoni* existed in ancient Egypt. The recent use of non-invasive diagnostic tools will permit epidemiological studies of larger and representative mummy populations. The Manchester Mummy Project, using computed tomography (CT) scanning, scanned electron microscopy (SEM), the enzyme linked immunosorbent assay (ELISA) and immunocytochemistry, has developed a program to study the paleoepidemiology of schistosomiasis in ancient Egypt (David 1979, 1997; Contis and David 1996). Cockburn (1998) estimated that several million mummies remain in Egypt. Partly because the highly effective Egyptian method of mummification was not used in other African and Middle Eastern civilizations, apparently no human remains with soft tissues have been studied in Mesopotamia, Israel, or other schistosomiasis-endemic areas.

The only archeological evidence of schistosomiasis haematobium endemicity in ancient Assyria and Mesopotamia, besides subfossil snails, were phallic-shaped boundary markers (*kudurru*) made of stone. Inscriptions on these stones warned persons intending to move them of urinary diseases and painful urination (Richter 1913). Used first exclusively for the royalty, mummification increasingly became the choice of burial method for the upper and middle classes during the time it was practiced in Egypt (2600 BC to 600 AD). The poor continued to be buried in shallow graves in the desert, another effective method of preserving the body in Egypt's arid environment. The process of mummification is essentially the evisceration and drying out of the body, usually by using natron (sodium carbonate). The kidneys and the heart were usually left in place but the intestines, stomach, liver and lungs were removed and placed in canopic jars. Mummification practices were discontinued after the Arab invasion in the seventh century AD (David 1997). Coprolite studies, which have already contributed substantially to the paleoepidemiology of intestinal helminthiasis in prehistoric populations in several countries (Inhorn and Brown 1997), could be used to expand the Egyptian evidence. The survival of numerous human remains in other parts of North Africa, Asia, Europe and the Americas, and the development of new diagnostic techniques that permit diagnoses from minute amounts of tissue, are increasingly facilitating paleoepidemiological studies outside Egypt (Cockburn et al. 1998).

The Historic Record

The proposed existence of historical evidence of schistosomiasis in ancient Egypt in the form of medical writings and art forms (paintings, relief and sculptures) presumes that Egyptians either were able to identify the parasite or the specific symptoms of schistosomiasis, particularly the urinary

form. Some Egyptologists interpreted the hieroglyph for *âââ* disease, shown in the Ebers Papyrus as the determinative discharging phallus, to mean haematuria was caused by schistosomiasis (Ebbell 1937; Ghalioungui 1962). But there is no unequivocal word in ancient Egyptian for haematuria and since 1961, after extensive philological debates, Egyptologists have generally accepted that the determinative meant semen or poison, reflecting the Egyptian concept that disease can be transmitted by an incubus, impregnating a victim with poisonous semen (Nunn 1996, 2000; Westendorf 1992). The larger *Ascaris* and pinworms, by contrast, were recognized and correctly described in the papyri and in medical treatises of other early civilizations (Nunn 2000; Sandison 1967).

Schistosomiasis Exposure Risk in Ancient Egypt

Due to the focus of past Egyptology research on mortuary and religious complexes, relatively little is known about the daily life of Egyptian peasants during the three millennia of Pharaonic rule other than what the royal scribes and artists wrote and painted and what we know from Greek writers. However, existing evidence suggests that many aspects of their lives differed little from today, even though the Aswan Dam and the introduction of modern education, electricity, radio, television, motor pumps and chemical fertilizers have changed some aspects of rural life. Conditions in the village communities would have predisposed the population to infection, and working and recreational activities would have brought many people into direct contact with infective water near riverbanks and in the canals.

Beginning in pre-Dynastic times (before 3200 BC) the Egyptians developed an extensive irrigation system, characterized by the Nile's annual flooding of basins but was increasingly based on the control and regulation of the Nile. Once the waters had receded from the land in the fall, the peasants began the cycle of cultivating Egypt's food crops. Two kinds of wheat (spelt and emmer) and barley were grown, providing the basic ingredients for the staple diet of bread and beer. Seed was scattered on the earth and then plowed into the soil; the harvest was gathered in the spring (Caminos 1997). Another agricultural crop was flax, used to spin linen, which was widely used for clothing and domestic purposes as well as for mummy bandages (David 1999). Irrigation was carried out only once a year in antiquity, allowing the fields to be watered and cultivated, but Egyptian peasants also grew a variety of vegetables, fruits and other crops near the irrigated basins using perennial irrigation. These basins were regularly fed with water by the river, and the gardeners also transported water to these areas, either bringing it from the Nile in large pots or by using water-lifting devices known today as *shaduf*

(pole and bucket lever) (Hemden 1961).

Daily life in ancient Egypt also resulted in frequent and intense contact with Nile and canal water in the domestic sphere. Fetching water, washing clothes and utensils, and bathing were carried out at the riverbank and in canals, and sailing and swimming were constant activities. Fishing was an important source of protein for the population due to the general scarcity of meat. Brickmaking was another activity, which involved close contact with water. Some tomb paintings of peasants, boatmen, papyrus carriers and other rural people in the Sakkara necropolis show distended abdomens and other deformities that may be due to schistosomiasis (Ghalioungui 1962). Numerous written records and illustrations depict a rural life style characterized by a strong dependence on the Nile for all occupational, domestic and recreational needs and poor sanitary conditions in the villages that have hardly changed over time (Caminos 1997).

However, it is not surprising that evidence of schistosomiasis is present in the mummified bodies of both the wealthy classes and the peasants. Upper class Egyptians commonly sailed on the Nile, hunted waterfowl, and had close contact with the ornamental lakes and ponds featured in the gardens of their villas.

Population Growth and Irrigation Development in Egypt

Land use and demographic development in Pharaonic Egypt were increasingly determined by irrigation agriculture. Butzer (1976) estimated that Egypt's population was 0.35 million around 4,000 BC during the pre-Dynastic period, when about 16,000 square kilometers of land were available for cultivation using rudimentary flood irrigation methods. This period was characterized by low population pressure on the land, with a substantial component of pastoralism, hunting, gathering and fishing. By 150 BC, the population had increased to an estimated 4.9 million and the cultivable area to 27,000 square kilometers, with the animal-drawn waterwheel (*saqia*) and the *shaduf* in use, permitting basin irrigation of levees and valley margins outside the sphere of gravity flow. This population was considerably larger than Egypt's population of 3 million in the early nineteenth century (Watts and El Katsha 1997). The annual fluctuations and long-term decline in Nile floods after the end of the last major wet phase around 3,000 BC, together with population increase, large labor-demanding state projects and later colonial agricultural exploitation by Rome, increased the need for more food through intensive basin irrigation and multiple cropping. In addition to the summer flood crops, during the Ptolemaic period it was possible to raise a second crop during the winter (Butzer 1976).

The large extent of the irrigated area in Dynastic Egypt is illustrated by the fact that this acreage was not surpassed until around 1880 (Butzer 1976). The Fayum and the Memphis area at the head of the delta, together with the Luxor and Aswan areas in Upper Egypt, had by far the largest population densities and the most intensive irrigation technologies due to their proximity to regional capitals. The characteristic urban-rural sociopolitical relations and government ownership of all irrigated land put pressure on peasants to produce food and fiber to supply the royal, nobility, clergy and lower administrative segments. Butzer (1976) identified 217 Dynastic cities, large and small centers, and villages (excluding many smaller villages not mentioned in the official records). He estimated that population densities ranged from under 75 persons per square kilometer to over 500/sq km, with a mean density of 172/sq km. The location of villages on Nile levees within the irrigated areas for the purpose of protection from floods and proximity to the fields and canals assured close contact of the rural population with the canal system.

Large-scale perennial irrigation in Egypt began with the reign of Mohamed Ali (1805-1848), who promoted the cultivation of long staple cotton, a major Egyptian export crop (Watts and El Katsha 1997). With the construction of the Low Dam at Aswan and the barrages north of Cairo after 1900, the period of winter irrigation closure could be further reduced to 6-7 weeks, and after the construction of Aswan High Dam in 1964, to 2-3 weeks. The shorter closure period permitted aquatic snails to flourish in the absence of the annual drying out of canals. The impact of perennial irrigation was recorded in four villages in the Kom Ombo area in Upper Egypt, all under basin irrigation. In 1934, 11 percent of their inhabitants were infected with *S. haematobium* and by 1937, after the introduction of perennial irrigation using water pumps, infection rates had increased to 44-75 percent (Khalil and Azim 1938). Thus within three years infection rates had become as high as those in the delta, where perennial irrigation had been in use since the mid-nineteenth century. Conversely, relocation of Nubians displaced by the Aswan High Dam in the Kom Ombo area was associated with a decline in *S. haematobium* infection rates from 23 percent in 1964 to 5 percent in 1976. This decline has been attributed to their relocation on rocky outcrops and along the Nile at a greater distance from their irrigated land, employment of hired laborers from outside communities and provision of wells for domestic use (Miller et al. 1978, 1982). The beneficial effect of wells and Nile rather than canal water on schistosomiasis has been reported by different investigators (Kloos et al. 1983; Miller et al. 1978).

These divergent outcomes illustrate the complexity of environmental, socioeconomic, and human behavioral factors

in microgeographical and temporal changes in schistosomiasis distribution during relatively short time periods. These findings also serve as a caution against generalizations about the impact of irrigation and rural living conditions on schistosomiasis distribution and suggest that similar variations may be found in ancient Egypt. Comparative biological studies already underway on DNA sequencing of modern and ancient Egyptian populations that focus on kinship research, sex identification, population movements and diagnosis of disease are providing new information on the geographic and cultural demography (Filer 1995) necessary for paleoepidemiological studies.

Schistosomiasis in Egypt Since the Pharaonic Period

Little is known about the occurrence of schistosomiasis in Egypt and the Middle East during the two millennia between the end of the Pharaonic period and the mid-nineteenth century, when the schistosomes and their life cycle were discovered by modern science. The only evidence of the occurrence of schistosomiasis in medieval Egypt is its immunodiagnosis in 15 out of 23 mummies from 35-550 AD in the Wadi Halfa riverine area near the Egypt-Sudan border (Miller et al. 1992). This study is of particular epidemiological interest because it provides information on the sex and age distribution of infection: 7 males and 7 females, with one mummy's sex not identified, and all heavy infections were in individuals above 15 and below 40 years of age. This age/sex distribution of schistosomiasis still prevails in Egypt today. During the period of Roman occupation the use of the ox-driven water wheel in Upper Egypt permitted intensive irrigation. In the sixteenth century, the Prospero Alpini observed and reported on haematuria in Egyptian males and the widespread problem of bladder stones in the population of Lower Egypt. French army physicians focused on these symptoms during Napoleon's invasion of Egypt, but without knowing the etiology of schistosomiasis, attributed them to the local climate and faulty perspiration (Hoepli 1969; Renoult 1803), and soldiers were instructed to wear condoms as a preventive measure (Girges 1934, 1). Other French writers reported on the occurrence of haematuria in caravans crossing the Sahara from Timbuktu (Girges 1934).

Lack of information on the distribution and transmission of schistosomiasis in ancient Egypt does not permit inferences about its evolution and persistence during Egypt's history. However, there is evidence that *S. haematobium* is still being transmitted in some localities in Saudi Arabia and Iraq where it was endemic in the past. The Prophet Mohamed cautioned worshipers against drinking water from a certain spring north of Mecca to prevent red blood in urine.

Reference to haematuria in the medical texts of several well-known Arabian physicians, including Ibn Sina (Avicenna), Ibn Hubal and Al-Majousi (Alio 1967), indicates that urinary schistosomiasis was still endemic in the Arabian peninsula between the tenth and thirteenth centuries. *Bulinus truncatus* is still found today in springs in the surroundings of Medina (Brown and Wright 1980). In Iraq, the fossilized *Bulinus* snails were found in the same areas where schistosomiasis was endemic in recent decades (Baquir and DeMoraes 1963).

In the mid 1990s, 12 percent of the Egyptian population was infected with *S. mansoni* and 6 percent with *S. haematobium*, but in smaller agricultural villages where life continues much like in ancient Egypt, prevalence rates over 50 percent are still found (El-Khoby et al. 1998). The most intensive epidemiological research project ever carried out by the Egyptian government (17,172 households in 251 rural communities and in 9 of the country's 14 governorates) showed considerable variation in the prevalence of the two types of schistosomiasis among the different governorates. Much of the variation in prevalence among villages and governorates was due to the type of irrigation used, with the highest rates in localities where perennial irrigation prevailed and the lowest rates in basin irrigated areas. Rates were also higher in smaller villages, where nearly all residents are *fellahin* (subsistence farmers), poverty is most severe, and contact with the canals most intense (El-Khoby et al. 2000b). These conditions prevailed in ancient Egypt, except that few canals were used for basin irrigation.

S. mansoni overtook *S. haematobium* as the predominant schistosome species in Egypt between the 1930s and 1990s because of increasing river regulation, intensified farming and population increase in the Nile valley and delta. *Biomphalaria alexandrina* snails spread into Upper Egypt, where they were first reported in the 1970s. *Bulinus truncatus* populations declined and *S. haematobium* rates ranged from 5 to 9 percent in the 3 governorates studied in Upper Egypt, peaked at 14 percent in Fayum and were generally lower than 1 percent in the 5 Lower Egyptian governorates studied. *S. mansoni* ranged from 0.4 to 1 percent in Upper Egypt, 4 percent in Fayum and from 17 to 43 percent in Lower Egypt. The intensity of infection, which tends to be closely associated with severity of disease, varied similarly among these governorates (Cline et al. 1989; El-Khoby et al. 2000a; Scott 1937).

Construction of the low dams (barrages) around the turn of the nineteenth century and especially Aswan High Dam in 1964 and concomitant increases in canal systems and perennial irrigation, changes in the flow regime, silt load and pollution levels of Nile water, and increases in aquatic vegetation were all instrumental in these changes. Specifically, *Biomphalaria* snails are more tolerant of low oxygen and pol-

lution (organic and chemical) levels and prefer more slowly flowing water than *Bulinus* (El-Khoby et al. 1998; Watts and El Katsha 1995). Preference of host snails of *S. mansoni* for perennially irrigated areas and of transmitters of *S. haematobium* for natural water bodies has been noted elsewhere in Africa (Kloos et al. 1988). Greater suitability of the ancient, more pristine and less controlled riverine environment for *Bulinus truncatus* and failure to recover fossilized specimens of *Biomphalaria* in Egypt's Nile Valley, as well as other parts of the arid Middle East, indicate that *S. mansoni* infections were rare in ancient Egypt.

Although living conditions and water use behavior in rural ancient Egypt are now fairly well known, reliable reconstruction of the distribution of schistosomiasis by age, sex and socioeconomic status in different parts of the country will have to await the study of larger and representative populations of mummies and naturally preserved bodies using modern diagnostic techniques. The extensive epidemiological studies of the Ministry of Health in the 1990s showed that males generally had higher infection rates than females, due to gender division of agricultural work, swimming and bathing in canals. Older children and adolescents were the most heavily infected age group. Similarly, the male/female infection ratio was much higher among farming populations and in Upper Egypt due to differences in gendered water contact behavior and transmission patterns. Moreover, both *S. haematobium* and *S. mansoni* infection rates varied considerably among communities (El-Khoby et al. 2000b; Watts and El Katsha 1997).

Implications for Schistosomiasis Control

Although the extension of perennial irrigation and the increase of the Egyptian population provided conditions favorable for schistosomiasis transmission, the national schistosomiasis control program that was gradually expanded after 1918 (together with increased urbanization, diversification of the economy and the changes in the rural villages) resulted in the accelerating decline of schistosomiasis. The population increased from 28 million in 1960 to an estimated 69 million in 2000, of which 46 million lived in urban areas. In 1993, 99 percent of the Egyptian population had access to health services and 90 percent to safe water, the highest rates of any African country (United Nations Development Programme 1995, 158). *S. haematobium* rates declined from around 60-70 percent in most districts in 1925 (Girges 1934, 107) to 56 percent in 1935 and 5 percent in 1996, and *S. mansoni* rates declined from 32 percent in 1935 to 12 percent in 1996 (Cline et al. 1989; El-Khoby et al. 1998).

In spite of the recent decline of schistosomiasis rates in Egypt, both *S. mansoni* and *S. haematobium* became endem-

ic in all desert areas reclaimed for irrigation agriculture since 1952 and surveyed for schistosomiasis, including farms on the Sinai Peninsula and in the eastern delta (Mehanna et al. 1994). This situation again suggests that schistosomiasis (especially *S. haematobium*) spread rapidly among the irrigated areas of ancient Egypt.

The strongest link between epidemiological patterns of ancient and modern Egypt were found in small rural villages (*ezbas*), which are characterized by the highest *S. haematobium* and *S. mansoni* infection rates, large proportions of *fellahin*, and the fewest safe (piped) water supplies, sewage disposal sites, clinics and other public services. In this traditional environment, exposure intensity with canals, which is strongly correlated with intensity of infection, resulted in schistosomiasis prevalence rates several times higher than in larger villages and towns (El-Khoby et al. 2000a).

It is of interest that no clear descriptions of haematuria survive from ancient Egypt although they may be couched in different terminology in the medical papyri. Evidence from the Assyrian boundary markers and the oral history from the time of the Prophet Mohamed suggest that ancient Egyptian physicians and the general population were also familiar with haematuria in schistosomiasis. By the early twentieth century, the Egyptian population was well aware of the widespread occurrence of haematuria to the point where the passing of blood by boys was considered as a normal and even necessary part of growing up, a form of male menstruation linked with male fertility (Girges 1934, 103). They also knew that contact with canal water was more likely to result in "bilharzia" (schistosomiasis) than Nile water, which has traditionally been highly revered for its "sweet water" with life-giving properties. But Egyptians apparently learned only recently about the disease itself and the role of snails in transmission from clinic and school teaching (Girges 1934, 521; Kloos et al. 1983). Other illnesses have reportedly been linked to schistosomiasis, such as exposure to the sun, eating unripe sugar cane and walking barefoot (Kloos et al. 1982; Mehanna et al. 1993), further indicating that the ancient Egyptians did not know the specific cause of schistosomiasis — the hardly visible schistosomes.

The discrepancy between the high level of knowledge about the association between contact with canal water and schistosomiasis on the one hand and continuation of risky contact behavior on the other is due to the population's continued dependence on the canals and Nile for all aspects of life — food production, domestic chores, recreation and religious ablution. This situation and the perception that this common disease is relatively mild contributed to the continuation of the transmission cycle of the schistosomes. Contaminative activities such as washing soiled clothes of children, excretion directly into the water by children, ablu-

tion, and discharge of raw sewage still result in high snail infection rates. Further, exposure type activities such as bathing, swimming and washing utensils have also been associated with high transmission rates to humans (Kloos et al. 1983; El-Khoby et al. 2000a). The discrepancy between the perception of high schistosomiasis risk and persisting exposure has been a barrier to recent nationwide health education campaigns using TV spots (Mehanna et al. 1994) that emphasized the need to eliminate contacts with the canals and the Nile without providing alternatives (Loza and El-Tawil 1992). The few pilot projects providing swimming pools for children failed due to their poor maintenance and opposition by local civic and religious leaders (Mostafa 1993; Kloos et al. 1983). Provision of piped water from wells often failed to reduce contact with the Nile and canals significantly due to its brackish nature (Kloos et al. 1983; El Katsha et al. 1989). In 1952, the Egyptian government made it a policy to upgrade the standard of living of the rural population, especially through the provision of potable and safe water, resulting in exceptionally high water supply coverage among developing countries. Nevertheless, smaller villages and the more isolated Upper Egypt region continued to be relatively neglected (Watts and El Katsha 1995). Rockefeller-supported research projects in the 1930s and in 1948-1952 concluded that the introduction of household latrines in several villages in the Nile delta had no significant impact on schistosomiasis because most contamination of water supplies occurred in the fields, and the pit latrines were unsanitary and seldom used (Scott and Barlow 1938; Weir et al. 1952). Other preventive measures, including the elimination of surface canal and drainage water by underground drains and sprinklers, have not been considered on a large scale. Earlier attempts to kill the host snails by periodic drying of perennially irrigated fields and closure of drains, as well as application of molluscicides, failed due to the ability of host snails to hibernate in mud and its reinvasion of treated areas from untreated areas upstream (Leiper 1915; Farley 1991). Area-wide use of molluscicides has been increasingly opposed by the Egyptian government and the World Health Organization due to their inefficiency in extensive canal networks, their high cost, potential health risks and ecological impact (fish kill) (Kessler et al. 1987). Although the ecologies of the snail intermediate host, the parasite and human behavior are influenced by the activities of various government agencies, there is no intersectoral collaboration between ministries that could foster the expansion of preventive strategies. This lack of a broadly based control strategy that extends beyond the present emphasis on chemotherapy is thus impeding progress toward schistosomiasis control (Watts and El Katsha 1995).

In spite of the current predominance of *S. mansoni* in most Egyptian communities, the provision and utilization of

diagnostic services in rural areas failed to consider this change in schistosome ecology. A combination of the long predominance of *S. haematobium* in Egypt, the easily recognized signs and symptom of haematuria and bureaucratic bottlenecks were instrumental in this misconception. As a result, the great majority of villagers in different parts of the delta associated schistosomiasis with haematuria and *S. haematobium* infection, even though *S. mansoni* was by far the most common parasite. Several investigators have recommended that both villagers and local health workers receive health education to remedy this situation (El Katsha and Watts 1995; Mehanna et al. 1994).

The ever-increasing consumption of Nile water for agricultural, industrial and domestic needs in Egypt is at risk of being curtailed by international agreements between the Nile countries concerning ecological problems. In addition to the 55.5 billion cubic meters granted to Egypt under the 1959 Nile Waters Agreement, 2.6 billion are available from sub-surface sources and 4.6 billion from recycled drainage water. But Egypt is using another 5 billion cubic meters a year due to limited utilization by the Sudan of its share. This additional supply will most likely be curtailed as Sudan and Ethiopia continue to expand their own irrigated areas and industries (Radwan 1997). The increasing demand/availability ratio is predicted to lead to a serious water shortage in Egypt by 2010 (Watts and El Katsha 1995). Additional problems of water wastage, drainage, water logging, a rising water table and associated sanitation problems demand increased conservation and irrigation efficiency measures. They also point out the need for water conservation, especially since irrigation agriculture consumes by far the largest amount of water in Egypt (Radwan 1997; Egyptian Environmental Affairs Agency 1992). Elimination of canals and open drains through sprinkler and drip irrigation and concomitant expansion of piped systems providing safe and acceptable domestic water would significantly contribute to the control of schistosomiasis and other water-related diseases. The current bureaucratic approach, characterized by central planning and the failure to consider the ecological impacts of irrigation and water conservation, has resulted in excessive irrigation due to erroneous assumptions and calculation of water needs and supplies. Failure to meet the specific irrigation needs for different crops and soil types in many areas has also alienated many farmers. The oversupply is reflected in the accumulation of excess water at the distant end of canals and drains (Radwan 1997), which are important in schistosomiasis transmission (Watts and El Katsha 1995; Farooq et al. 1966). Heavy-handed government involvement in irrigation agriculture similarly increased risk of schistosomiasis infection in ancient Egypt, as described above. Increased farmer water control through the water user associations has been associ-

ated with greater irrigation efficiency, which not only boosts crop production in the increasingly diversified agriculture of Egypt (Hvidt 1996) but also reduces the problem of water logging and salinization.

The general decline in schistosomiasis rates in Egypt in recent decades is in contrast to the situation in most other African countries where rates have increased, apparently due to the intensive schistosomiasis control and water supply programs (Bergquist 1998). Two non-African countries stand out for their achievements in control. First, in Japan, another irrigation society, the combined effects of socioeconomic development and an intensive molluscicidal and chemotherapy program led to the disappearance of schistosomiasis. Mechanization of agriculture, especially the change from water buffaloes (the major definitive host of the parasite besides humans) to tractors, urbanization/ industrialization and environmental modification (especially cementing of canals and leveling of snail habitats) were major factors in Japan's control of schistosomiasis (Sasa 1970). Second, Puerto Rico achieved control merely through socioeconomic development after the termination of its schistosomiasis control program in 1980 (Hillyer and Soler de Galanes 1999).

Conclusion

The archaeological and written record of ancient Egypt and surrounding countries and the projection of recent trends and patterns in schistosomiasis into the past permit a preliminary reconstruction of the paleoepidemiology of this disease complex. Available information on the evolution of the parasite, the snail intermediate hosts and humans indicates that schistosomiasis originated in East Africa and became widely distributed in North Africa during prehistoric wet phases. The physical and human environment of the Nile valley and delta provided increasingly favorable conditions for the transmission and spread of schistosomiasis caused by *S. haematobium* after the development of irrigation agriculture during the early Pharaonic period. Although the snail fossil record is poor in the ancient Nile valley and delta, *Bulinus truncatus* host snails were probably widespread, also indicated by their recovery from irrigated areas and wells elsewhere in the Middle East. The occurrence of *S. mansoni* during historic times cannot be determined from available information but seems to have been rare, based on environmental data and the ecology of its intermediate host. The ascendancy of this parasite as the major schistosome species in Egypt during the last few decades appears to be related to the ecological changes caused by the construction of Aswan High Dam, subsequent perennial irrigation and the relatively greater adaptability of its host snail, *Biomphalaria alexandrina*. The accidental introduction of the South American snail

Biomphalaria glabrata into Egypt around 1990 is resulting in further changes in the prevalence and transmission dynamics of *S. mansoni* (Yousif 1998).

Institutional control of irrigation and agricultural production are linked to the past. The extensive dam and canal building programs of the government had their incipient beginnings in Pharaonic Egypt. They are the major underlying causes of the recent increase in *S. mansoni* and decrease in *S. haematobium*. Although the national control program and socioeconomic development have made major inroads into schistosomiasis, they have not been able to prevent its spread into newly reclaimed areas. This situation further reflects the inappropriateness of outdated, water-wasting, state-planned perennial irrigation methods. The availability of new, efficient irrigation techniques and the urgent need to conserve Egypt's limited water resources argue for major structural changes in irrigation agriculture involving increased farmer control of water. But this will also require increased health education of the rural population informing them of the changing epidemiology of the two types of schistosomiasis and the health risks of *S. mansoni* infection. Whether this is possible will depend largely on the ability of the Egyptian government to restructure the ministries of agriculture and irrigation to eliminate irrigation inefficiency and promote farmer involvement in all aspects of irrigation and community development. Moreover, the activities of various ministries dealing with irrigation and rural development need to be integrated to more effectively deal with all aspects of schistosomiasis transmission and control. The intersectoral approach with a focus on prevention has repeatedly been advocated by the World Health Organization in view of the complexity of schistosomiasis ecology and the difficulty of disrupting the transmission cycle (WHO 1993).

Using the paleoepidemiological approach and the method of anthropological analogy, we addressed questions of the origin, spread and environmental prerequisites and conditions for the transmission of schistosomiasis in ancient Egypt. Further study of larger, representative mummy populations and of naturally preserved human remains in archeological sites using new diagnostic techniques can elucidate epidemiological patterns of schistosomiasis at the community and district levels.

Endnote

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Different Voices, Different Venues: Environmental Racism Claims by Activists, Researchers, and Lawyers

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Abstract

Environmental Justice Movement activists have mobilized on the basis of grievances involving the disproportionate exposure of working class and minority subgroups to various environmental risks. Academics have frequently offered empirical documentation of such exposure. Public interest lawyers have sought legal remediation for injustice claims. But substantial structural changes to ameliorate disproportionate exposure have not occurred. Why? We argue that activists, researchers, and lawyers speak with different voices in different venues, with the consequence of creating “noise,” instead of uniting to speak in one voice. We review the sociological literature to identify the separate voices of activists, researchers, and lawyers, analyzing each one’s focus, target audience, and types of evidence offered. Then we discuss the consequent noise and conclude with some suggestions for uniting the voices in a cooperative, coherent argument for amelioration of the unequal distribution of environmental risks.

Keywords: *environmental justice, environmental activism*

We live in a risk society with pressures from population growth, resource depletion, and increased levels of exposure to environmental hazards as byproducts of the economic growth machine. But these risks are not equally distributed. Working class and minority groups suffer greater risks of exposure to environmental risks than do whites and the more affluent.

Since the 1980s, activists in the Environmental Justice Movement (EJM) have identified various kinds of risks and

mobilized to ameliorate them using political and legal tactics. Social science researchers have documented inequalities in risk exposure under the rubric of environmental racism (ER). Lawyers argue before courts and administrative agencies on behalf of their activist plaintiffs for relief from environmental insults. Despite such prodigious efforts by so many people, environmental injustices persist. Why?

We hypothesize that activists, researchers, and lawyers speak with different voices and operate in different venues.² The consequence is that they often talk past one another, creating “noise” rather than a unified voice. Our purpose in this paper is to identify and analyze those different voices. After a review of the emergence of the EJM to establish its distinction from other environmental movements and to identify the different voices raised in the demand for greater environmental equity, we describe the characteristics of each voice and analyze its operation in its own venue. We then discuss the outcomes of each voice in its own venues and the “noise” that it may produce in the other venues. We conclude with suggestions for uniting the voices and developing a working coalition with the potential to generate substantial structural changes that may ameliorate the unequal distribution of environmental risks.

The Environmental Justice Movement and Academic Research

Evidence abounds that humans have been concerned about environmental quality for nearly as long as written records are available. Ancient Roman laws and codes evolved in response to the increasing social, economic, and political demands of an expanding urban population (Johnston 1999; Robinson 1992; Wolff 1951). For example, laws banned cart

and horse traffic at certain hours for the safety of residents walking and conducting business, laws stipulated particular times for dumping offal and sewage into the rivers and streams to assure that the pollution did not coincide with families' washing clothes in the rivers, codes even mandated urban garden spaces for recreational use. Local medieval statutes regulated the number of animals in the community to control the amount of waste left in the streets and legislated water and sewer systems aimed at safe drinking water and public sanitation (Zupko and Laures 1996). Concerns about urban filth derived from the belief that stench alone could cause illness. Some codes recognized that environmental quality was distributed on the basis of status, as slaves and the poor lived in more degraded environments than the elites. But, in societies relying on the extensive use of peasant or slave labor, environmental inequalities were not the basis for protest mobilization.

With the advent of the Industrial Revolution, environmental conditions further deteriorated, and concern for environmental quality increased commensurately. In the United States, the environmental effects of industrialization and urbanization in the late 19th century spawned two forms of elite-sponsored movements, the sanitation movement and the conservation movement. The sanitation movement derived from concerns with urban crowding and the associated spread of diseases such as typhoid, typhus, smallpox, diphtheria, and tuberculosis (Andrews 1999). Although the poor were disproportionately burdened, they did not mobilize on the basis of environmental inequalities. Instead, reform-oriented elites lobbied for public health regulations and achieved significant improvements in environmental quality (Andrews 1999).

The conservation movement evolved from the larger Progressive movement. The conservation movement combined Progressivist views of excessive capitalist exploitation of the environment with the formal closing of the frontier to generate activism among affluent whites who lobbied for resource management and the protection of public lands (Brulle 1996; Cable and Cable 1995; Cole and Foster 2001; Hays 1959; Humphrey and Buttel 1982; McCormick 1989; Nash 1967; Oelschlaeger 1991). Andrews refers to the New Deal as the successor of Progressivism (1999), and it similarly impacted the conservation movement. Conservationism emphasized production processes that served the interests of the public; that is, economically efficient production processes, based on the wise use of resources and on waste prevention that promoted middle-class economic progress. The movement "was led and implemented from the top down, by what might be called enlightened and pragmatic paternalism rather than by citizen activism" (Andrews 1999, 177). Conservationism waxed and waned during the 20th century, its membership dominated by middle and upper class white

males. It received support from corporations that benefited from government policies permitting exploitation of resources on public lands. Movement grievances focused on the scientific management of resources for maximum economic benefit without destruction of the resource base (Andrews 1999; Cable and Cable 1995; Humphrey and Buttel 1982; McCormick 1989). These elites were little concerned with environmental equity.

The contemporary environmental movement emerged in the mid-1960s, catalyzed by the appearance of Rachel Carson's *Silent Spring* (1962), the flowering of the decade's counterculture, and the proliferation of a variety of other social movements. Conservationism was fused with values stressing communalism over individualism and emphasizing steady-state economics over ever-expanding economic growth. The result was a youth-centered, "hippie" movement that culminated with Earth Day 1970.

After Earth Day and the passage of significant environmental legislation, general public concern for the environment increased in the 1970s, as measured in numerous national surveys (Dunlap and Scarce 1991). The movement became less counter cultural and more mainstream; it was nationalized and institutionalized through the combined efforts of established conservation organizations, such as the Sierra Club and the National Audubon Society, and several new organizations, such as the Environmental Defense Fund and the Natural Resources Defense Council (Brulle 1996; Cable and Cable 1995). Currently, the majority of the national environmental groups focus on reform policies, engaging in congressional lobbying and electoral campaigns. Analysts assert the elitist character of this movement: leaders and members of these professionalized organizations typically are white males of middle or higher social status. Movement grievances emphasize the preservation of lands, water resources, and wildlife and regulation of air and water quality (Andrews 1999; Cable and Cable 1995; Cable and Shriver 1995; Mitchell, Mertig and Dunlap 1992).

In the 1980s, a new, grassroots wing of the contemporary environmental movement emerged in the wake of the 1978 Love Canal revelations and the 1979 Three Mile Island nuclear accident (Cable and Shriver 1995). The constituency and aims of the grassroots wing significantly differ from the national wing of the movement (Freudenberg and Steinsapir 1992). The grassroots wing is primarily comprised of working class individuals without prior movement experience who organize when their communities are faced with environmental contamination (Boyte, Booth and Max 1986). They seek avoidance of environmental threats, remediation of environmental damages, and compensation for the adverse health effects from contamination. They use direct action tactics to pressure government agencies to enforce existing environmental regula-

tions. Sometimes they resort to litigation to force regulatory compliance, using research or expert testimony from behavioral and natural scientists (Cole and Foster 2001).

The grassroots wing of the contemporary environmental movement differs from the dominant national wing in two ways. First, grassroots activists' grievances center on "a new species of trouble" (Erikson 1991) that derives from changes in postwar industrial technologies using synthetic organic chemicals and radioactive materials. Such production processes and their associated wastes, end-products, and accidents all pose much higher health risks than found in wood, glass, and steel manufacturing technologies (Commoner 1992; Schnaiberg 1980; Schnaiberg and Gould 1994). Accidents and unsafe storage and disposal of the chemical and radioactive byproducts led to contaminated neighborhoods and communities (Brown 1979, 1987; Cable and Shriver 1995; Commoner 1992; Freudenberg and Steinsapir 1992).

Second, grassroots activists express greater mistrust of government and big business than does the dominant wing membership (Cable and Cable 1995; Brown and Mikkelsen 1990; Krauss 1989). In the Love Canal and Three Mile Island disasters as well as environmental insults in other communities, the government's failure to protect the public adequately disillusioned many grassroots activists (Levine 1982; Walsh 1981, 1988). They became suspicious and critical of the government's role in protecting citizens' rights and safety. Similarly, corporations' failures to design safe production processes, to reduce toxic wastes, to develop safe waste storage and disposal technologies, and to assume responsibilities for accidents without being compelled through litigation has engendered activists' belief that they are victims of a corporate state structure that denies their democratic claims (Cable and Benson 1993; Cable and Shriver 1995; Krauss 1989). Grassroots activists view contamination and victimization as the inevitable byproducts of the economic growth machine, a production system supported by government and corporate officials and predicated on the practice of externalizing the social and environmental costs of production to the public (Brown and Mikkelsen 1990; Cable and Cable 1995; Cable and Degutis 1991; Krauss 1989; Schnaiberg 1980; Schnaiberg and Gould 1994).

Although reformers and other elites occasionally expressed concerns about environmental inequalities, the disproportionate distribution of environmental risk was not the basis of protest mobilization until the EJM formed in the 1980s. Our discussion of the EJM provides the context for the movement's emergence and serves as the empirical basis for our analysis of the different voices of activists, social science researchers, and public interest lawyers. The EJM is part of the grassroots wing of the contemporary environmental

movement and represents a fusion of the grassroots wing's economic analysis of environmental problems with the civil rights movement's racial critique of political and economic institutions (Cole and Foster 2001). Environmental justice activists mobilize collective resistance by claiming that minority and low-income groups are disproportionately exposed to environmental risks because of racism and classism. Their grievances focus on the inequity of exposure to sources of contamination and the desire for environmental, economic, and social justice (Bullard 1983, 1990a, 1990b, 1993, 1994b; Bullard and Wright 1986-87, 1989; Cole and Foster 2001; Lavelle and Coyle 1993).

Collective resistance rallying to the charge of racial discrimination was precipitated by a 1982 incident in which North Carolina officials chose predominantly black Warren County as the site to construct a landfill for the disposal of polychlorinated biphenyls (PCBs) (Brulle 1996; Bullard 1990b; Cable and Shriver 1995; Lee 1992). Residents formed a grassroots organization to protest the siting of the PCB landfill. They requested assistance in their struggle from the United Church of Christ's Commission for Racial Justice (CRJ), a civil rights organization formed in 1963. Warren County residents, CRJ members, and representatives of the Southern Christian Leadership Conference (SCLC) and the National Association for the Advancement of Colored People (NAACP) engaged in civil disobedience to protest racial discrimination in the choice of a black community for the landfill site. Walter Fauntroy, a Washington, DC congressional delegate, was among the 500 people arrested in the demonstrations (Bullard and Johnson 2000). After the PCB landfill was constructed over residents' protests, Fauntroy requested a US General Accounting Office (GAO) investigation of the demographic characteristics of Southern communities hosting four commercial hazardous waste sites in the Environmental Protection Agency's (EPA) Region IV. The US GAO (1983) complied and released its findings that the majority of the population in the host communities was black.

Also in 1983, sociologist Robert Bullard published his study of Houston's municipal waste disposal sites, finding that six of eight city incinerators, all five city landfills, and three of four privately owned landfills were located in black neighborhoods. Bullard's findings were used by Linda McKeever Bullard who filed a class action lawsuit on behalf of a grassroots organization to block the construction of a landfill in a black neighborhood of suburban Houston. The citizens lost the 1979 lawsuit, *Bean v. Southwestern Waste Management, Inc.*, but it was the first case to use civil rights law to challenge the siting of a waste facility (Bullard and Johnson 2000).

In 1987 the CRJ released their study on the location of Southern hazardous waste landfills at a press conference at

which CRJ Executive Director Ben Chavis, Jr. reportedly coined the term “environmental racism” to describe the CRJ findings on racial disparity in locating hazardous waste sites. Findings from the GAO, Bullard, and CRJ studies as well as the claim of “environmental racism” were used to mobilize supporters in the EJM. This early alignment of the EJM with civil rights organizations was founded on the presumption that “the disproportionate impact of environmental hazards was not random or the result of neutral decisions but a product of the same social and economic structure which had produced de jure and de facto segregation and other racial oppression” (Cole and Foster 2001, 20). The civil rights alignment also distinguished environmental racism as a separate grievance from those of the anti-toxics movement.

Community-based protest organizations were formed, drawing supporters with the theme of disproportionate exposure to environmental risks; many protests were relatively successful. In 1989, residents of predominantly black Richmond, California protested against pollution from a petrochemical refinery. The facility is still operating, but activists won significant concessions on emissions levels (Bullard 1993). Residents of predominantly Latino Kettleman City, California, organized against a 1990 proposal to build a hazardous waste incinerator in the neighborhood; construction was prevented (Bullard 1993). Native American residents of Rosebud, South Dakota in 1991 protested against a proposed solid waste landfill and prevented construction.

In late 1991, over 650 grassroots and national leaders congregated for four days in Washington, DC for the First National People of Color Environmental Leadership Summit, an event organized by CRJ Executive Director Ben Chavis, Charles Lee (director of the CRJ’s environmental justice program), EJM activists from across the country, and researchers such as Bullard and Bryant. Delegates attended from all 50 states and from Puerto Rico, Chile, Mexico, and the Marshall Islands. The summit brought academic researchers into the environmental justice movement and broadened its scope “beyond its antitoxics focus to include issues of public health, worker safety, land use, transportation, housing, resource allocation, and community empowerment” (Bullard and Johnson 2000, 557). Cole and Foster (2001) identify several important outcomes from the conference, such as the formation of alliances and the dissemination of movement tactics, but probably the most significant outcome was consciousness raising among community activists. They recognized the nature of the links between racism and economic exploitation and viewed environmental inequalities as symptomatic of larger, structural forces.

Community-based environmental justice organizations tend to exhibit some common characteristics. The grievances claim environmental discrimination based on race or class.

The organizations, seldom funded by national environmental groups, are often led by women and are composed primarily of working class people of color without prior social movement experience. Their tactics involve demonstrations, petitions, lobbying local elected officials, letter-writing, public meetings, citizen-conducted health surveys, educational forums, and litigation. The targets of protest are usually local, state, and federal officials whom residents deem accountable for their direct or indirect influence in environmental siting and enforcement decisions. Generally, movement organizations tend to be most successful when the goal is to block the construction of a proposed facility, rather than to close an existing facility. In the latter case, groups frequently win some concessions from the facilities, such as capacity reduction, emissions controls, and monetary compensation (Bullard and Johnson 2000; Cole and Foster 2001).

Prior to 1992, few academic researchers conducted empirical studies of environmental racism. But Bullard’s advocacy and scientific work provided a bridge between movement activists and academics interested in environmental racism. Bullard and colleagues continued research on environmental racism, publishing a series of articles in the 1980s leading to the 1990 book, *Dumping in Dixie*. A small group of academics, including Bullard and Bunyan Bryant of the University of Michigan, met with Charles Lee in 1990 to discuss the topic. They sent letters that described the findings of disproportionate impact and requested meetings with the Secretary of the US Department of Health and Human Services and with the head of the EPA (Cole and Foster 2001). EPA head William Reilly agreed to meet with the group of academics and the Office of Environmental Equity was subsequently created. In 1992, Bullard and Ben Chavis were named to President-Elect Bill Clinton’s Transition Team on the Natural Resources and Environment Cluster, formed to provide input into the policies that the new administration would try to implement.

A flurry of academic research was published in 1992 and 1993 that confirmed the presence of environmental racism. Some were case studies, such as Bailey and Faupel’s (1992) study of Emelle, Alabama and White’s (1992) study of Alsen, Louisiana, but most were quantitative studies. Lavelle and Coyle (1993) reported on a study of 1,177 Superfund sites that found racial bias in government-imposed penalties against corporate polluters, in government response to environmental hazards in a community, and in government choice of a solution for such hazards. In separate studies, Zimmerman (1993) and Hird (1993) found that the location of Superfund sites was associated with race. Several studies documented the relationship between race and the location of facilities required to report their emissions for the Toxic Release Inventory (TRI) (Burke 1993; Szasz and Meuser 1997). Mohai and Bryant

(1992a) examined the distribution of commercial hazardous waste facilities in a three-county area surrounding Detroit. They found that the 16 facilities in the Detroit area represented 76% of all state facilities, the relationship between race and the location of waste facilities was independent of income, and in a comparison of facilities inside and outside the city that race remained the best predictor.

Been (1993) suggested that identifying the *current* demographic characteristics of neighborhoods containing waste facilities left open the possibility that market forces had reduced property values in those communities *after* the facilities were sited and subsequently attracted poor and minority folks who had little choice but to live in less desirable neighborhoods. To ascertain whether the discriminatory outcome was due to discrimination in the initial siting process or to post-siting market forces, she re-examined the 1983 GAO report and Bullard's Houston study (1983), expanding both by adding demographic data on the communities at the time the siting decisions were made and then tracing the changes in those demographics in the next census (Been 1994a, 1994b). In her extension of the GAO study, she concluded that the initial siting processes had been discriminatory; market forces had not. In her extension of Bullard's study, she found that the siting processes and subsequent market forces had been discriminatory. In 1994, the CRJ released a report on an update of its 1987 study in which the researchers adapted Been's technique. With the use of 1990 census data to identify demographic changes in the communities between 1987 and 1990, they found that environmental racism increased: compared to 1987 figures, areas with at least one facility had more than twice the percentage of non-whites than areas without facilities.

In 1994, President Clinton signed Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The order reinforces Title VI of the Civil Rights Act of 1964, which prohibits racially discriminatory practices in programs receiving federal funds and directs federal agencies to ensure that their actions "do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination . . . because of their race, color or national origin" (Section 2-2, Executive Order 12898). The order calls for improved methodologies for data collection and encourages participation by affected populations in the various phases of impact assessment. Clinton subsequently created the National Environmental Justice Advisory Council (NEJAC), whose task was to advise the EPA on methods for attaining environmental justice. Bullard was appointed to the Council, along with 24 others from the EJM, the federal government, industry, and academia.

In 1994, Bullard formed the Environmental Justice Resource Center at Clark Atlanta University in Atlanta, Georgia, in an attempt to bring together community activists and academic researchers. The Center acts as a research, policy, and information clearinghouse on issues of environmental justice, race and the environment, civil rights, facility siting, land use planning, brownfields, transportation equity, suburban sprawl, and sustainability.³ Staff members assist, support, train, and educate people of color, students, professionals, and community leaders to facilitate their inclusion in environmental decision-making.

In the wake of the Executive Order 12898, the EPA planned to conduct a six-month community study of cumulative risk assessment and in 1994 selected Chester, Pennsylvania as the site. Just south of Philadelphia, predominantly black Chester hosts several waste facilities that process a combined total of 2.1 million tons of waste per year. Chester residents, who had previously organized over health concerns associated with the facilities, welcomed the EPA's study. The results, released in 1995, confirmed activists' fears, finding unacceptable cancer risks and serious non-cancer risks, such as kidney and liver disease and respiratory problems. But the regional EPA director cautioned residents that the study showed only a correlation, not a *causal* relationship between elevated health risks and the presence of noxious facilities in the community (Cole and Foster 2001).

When the state's Department of Environmental Protection (DEP) granted a permit for yet another waste treatment facility in Chester, in 1996 residents filed a complaint in federal court under Title VI of the Civil Rights Act accusing the state, the DEP, and state officials of racial discrimination. Bullard's Environmental Justice Resource Center aided the grassroots group in data collection. But the case was declared moot by the US Supreme Court in 1998 when the corporation applying for the permit withdrew the request.

A significant shift among academic researchers occurred between 1994 and 1996. A number of studies did *not* confirm the presence of environmental racism; they found class and other factors were better predictors of environmental exposure than race. Anderton and colleagues (1994a, 1994b) found that the most consistent significant correlation with location of waste facilities was the proportion of industrial workers in a tract and, criticizing the methodologies of earlier studies, concluded that no nationally consistent and convincing evidence exists for environmental racism. Glickman and Hersh (1995) examined differential levels of risk from TRI facilities in the Pittsburgh area and noted that five groups were at higher risk than the general population: all blacks, all poor, poor blacks, poor whites, and the elderly. Bowen et al. (1995) conducted a similar study in the Cleveland area, finding that TRI facilities were more likely to be located in poor-

er and less affluent communities than in areas with minority concentrations. Pollack and Vittas (1995) examined TRI sites in Florida and held that location was most closely related to the degree of urbanization and industrialization, population density, and housing prices. Cutter et al. (1996) investigated the association between demographic characteristics and environmental threats in South Carolina and found that, at the county level, race and income were associated with the presence of a facility, but in the opposite direction from earlier findings: the disproportionate burden was on white, more affluent communities in metropolitan areas. At the census tract and census block levels, no association obtained between race and the presence of a facility.

Been (1995) countered Anderton et al.'s (1994b) findings, exploring alternative explanations for their results, and found that the neighborhoods most likely to host a waste facility were those characterized by: median family incomes between \$10,001 and \$40,000; black proportions of the population between 10% and 70%; and Hispanic proportion of the population more than 20%. She concluded that the outcome described as environmental racism is an "ambiguous and complicated entanglement of class, race, educational attainment, occupational patterns, relationships between the metropolitan areas and rural or non-metropolitan cities, and possibly market dynamics" (Been 1995, 21).

In 1997, the academic research pendulum swung back (Szasz and Meuser 1997). Findings of environmental racism were reported in studies by Boer et al. (1997) on waste facilities in Los Angeles County, by Ringquist (1997) on TRI facilities in the United States, by Downey (1998) on TRI emissions in Michigan, by Foster (1998) on hazardous facilities in Chester, Pennsylvania, by Hird and Reese (1998) on environmental quality, by Stretesky and Hogan (1998) on Florida Superfund sites, and by Szasz and Meuser (2000) on TRI facilities in Santa Clara County in California.

Cole and Foster assert that the EJM remains one of the most active social movements today and indicate that the movement suggests the possibility of a broad-based, progressive coalition that could transform society (2001, 165). The issues adopted by the movement have broadened to include: unequal enforcement of environmental, civil rights, and public health laws; differential exposure of some populations to harmful chemicals, pesticides, and other toxins in the home, school, neighborhood, and workplace; faulty assumptions in calculating, assessing, and managing risks; discriminatory zoning and land use practices; and exclusionary practices that prevent some individuals and groups from participation in decision making or limit the extent of their participation (Bullard and Johnson 2000; Bullard, Warren and Johnson 2001). As for the case that started it all: the state of North Carolina is slated to spend over \$25 million to clean up and

detoxify the Warren County PCB landfill (Bullard and Johnson 2000).

Voices and Venues

Community-based environmental justice organizations won some highly publicized victories against corporations and government agencies. Movement charges of environmental inequity resonate with deeply held mainstream American values of fairness. Activists' and researchers' efforts increased public awareness of the unequal distribution of environmental problems. Yet no significant structural changes have occurred to ameliorate problems associated with disproportionate exposure to environmental risk. Why?

The three groups whose actions are most relevant to the EJM are activists, academic researchers, and lawyers. Each group has a unique voice and works in a specific venue. Their efforts are not necessarily consonant or cooperative; in fact, sometimes their efforts clash. We suggest that this separateness represents an obstacle in the EJM's quest to effect structural changes that would ameliorate environmental inequities. In this section, we analyze each group's voice and venue. We differentiate the voices of activists, academic researchers, and lawyers by identifying each group's *claim*, *major task*, and *targeted audience*. We describe the venue associated with each voice by analyzing the *method of reasoning* and *notion of causality* underlying the *strategies* employed in each venue to convince the targeted audience that the claim has been demonstrated.

Activists

Activists' grievance is that exposure to environmental risk is inequitably distributed and disproportionately impacts people of color and the poor. (Initially, they explained these differentials as a direct product of discrimination; later, they explained them as a result of racism and classism in policies shaping decision-making and institutional practices.) Activists' *major task* is to mobilize large numbers of people to persuade legislators to redistribute environmental risks and benefits more equitably. Their *targeted audience* is composed of: the aggrieved — those who are threatened by environmental exposure; conscience constituents (McCarthy and Zald 1977) — sympathetic bystanders who are not themselves exposed to such environmental threats, but generally support issues of social and economic justice; and the general public. The mode of argument is largely rhetorical, using semantic definitions of concepts that emphasize emotional appeal and that favor fuzziness over mutual exclusivity.

Activists favor a *method of reasoning* that relies primarily on the use of qualitative data-gathering techniques, such as the case study (Bailey and Faupel 1992; Bullard 1983;

Bullard and Wright 1986-87, 1989; Lavelle and Coyle 1993; White 1992). They typically select cases that are confirmatory, choosing communities that host noxious facilities rather than those that do not. In their reasoning, activists seek to affirm their claim rather than to test alternative hypotheses for describing the distribution of exposure to environmental threats (Liebersohn 1991). That is, activists' aim is to demonstrate the presence of discriminatory outcomes in environmental exposure.

Activists employ a lay *notion of causality* by which people may easily conclude that X is associated with Y; the connection is visible and it operates in a particular setting, but not in others. The temporal connection between cause and effect is not specified precisely; the timing may be either instantaneous or of long duration. A sufficient number of cases of environmental racism/classism are documented so the layperson recognizes differences between pre- and post-siting conditions. Activists in contaminated communities reason: "Before we lived next to that incinerator, we didn't get sick. But, after we moved here, my kids came down with respiratory diseases and lots of my neighbors' kids have respiratory diseases." Movement leaders facilitate that kind of external attribution for illness among the aggrieved to substantiate their claim and to increase movement participation.

Activists' *strategies* involve framing environmental justice grievances to appeal to the aggrieved, conscience constituents, and the general public. With the original frame of environmental racism, activists used concepts such as racism, intentional discrimination, and racist society to explain inequities in environmental risk (Pulido 1996). They urged black residents of threatened communities to seek legal redress in court or to demand greater participation in the decision-making processes shaping local and national policy on toxic waste siting and cleanup (Blais 1996; Bullard 1993, 1994a, 1999c; Foster 1993; Gelobter 1994; United Church of Christ Commission for Racial Justice 1987).

But activists soon re-framed their grievances under the banner of "environmental justice." With the environmental justice framing of grievances, activists adopted a broader, political economy framework to explain the ways in which institutional arrangements perpetuate American apartheid and shape life chances (Bullard 1994b). This framing change not only broadened their membership pool to include people of *all* colors and the poor, but also transformed their message from a confrontational condemnation of whites to a non-confrontational plea for fairness. Environmental justice advocates seek to empower people of color and the poor to demand meaningful participation with elected officials and their designates and greater influence in decision-making processes to achieve a more equitable distribution of benefits and risks where people live, work, play, and learn (Cole and Foster 2001, 14-16).

Thus, activists demonstrate their claims to the aggrieved, conscience constituents, and the general public by rhetorical appeal to basic values of fairness and by framing credible arguments. First, the presence of environmental risk in a neighborhood composed primarily of minorities and/or the poor is *prima facie* evidence of discrimination. Second, it makes little difference to those threatened whether the discriminatory outcome is intentional or unintentional.

Researchers

Researchers' *claim* is that only by conducting scientific studies can one accurately assess the role that race plays in exposure to environmental risks.⁴ Their *major task* is methodological — drawing samples from population subgroups by areas that adequately reflect differential risk of exposure, using appropriate measures on theoretically relevant variables, effecting proper controls to eliminate biases, and conducting appropriate evaluations of statistical models. Researchers' *targeted audience* is primarily other researchers in their sub-discipline in the scientific community and secondarily knowledge users. Researchers are aware that their work will be scrutinized by peers prior to publication. Their work must conform to normatively accepted standards emphasizing logic, clarity of language, proper specification of theoretical connections between concepts, and useful explanations or meaningful interpretations of events and processes. Knowledge users employ findings to understand social issues and solve a variety of problems.

Researchers engaged in hypothesis testing may follow more or less prescriptive rules of argumentation in their *method of reasoning*. The method of reasoning is linked to either mechanistic or inferential *notions of causality*. Some researchers try to conform to the more prescriptive rules of the logical deductive model with well-defined criteria for constructing propositions, arguments, and reaching valid conclusions. Others use less prescriptive rules relying on associational reasoning and inference. The mechanistic notion of causality employs a strict definition of cause and effect. It also assumes that the causal explanation be extended to apply under covering laws to other instances at different times and places (Bunge 1959, 1963; Culhane 1997; Kaplan 1964; Snyder et al. 1997). The inferential notion of causality finds a connection between cause and effect, establishes that both are present, hypothesizes a causal link, evaluates alternative explanations, and, where warranted, dismisses them in favor of the original hypothesis (Culhane 1997). This inferential notion of causality rests on probabilities. Social scientists generally require three kinds of evidence to establish inferential causality: association — the pattern of changes in one variable must be related to the pattern of changes in the other variable; the direction of influ-

ence — a cause must precede its effect; and non-spuriousness — the relationship persists when other possible explanatory variables are not significant.

Research *strategies* in studying race relations have historically focused on individuals or on organizations.⁵ For individuals, researchers focus on the attitude/behavior nexus — prejudice and discrimination — to identify the conditions that predispose an individual to selectively perceive and target others for unequal treatment and to examine the consequences of such treatments (Allport 1958; Merton 1957). For organizations, researchers explore the motive/action nexus using concepts such as institutional racism, caste and quasi-caste, American apartheid, and institutional discrimination to describe and understand the historical processes that perpetuate social, economic, and political inequalities (Davis 1949; Feagin and Feagin 1986; Hamilton and Carmichael 1967; Knowles and Pruitt 1969; Myrdal 1944). Both strategies are used to account for differentials in risk and their persistence. Researchers want to convince their colleagues and knowledge users in the public that their research is reliable and, hence, their explanations valid.

Lawyers

Typically, the lawyers who accept environmental justice cases are public interest lawyers.⁶ In contrast to, for example, personal injury lawyers who seek compensation for the client's injury with large sums of money to be divided between lawyer and client, public interest lawyers tend to view themselves "as surrogate representatives of under-represented people" (Rivkin 1999, 474). Lawyers representing environmental justice activists *claim* fundamentally that even those with little political power deserve to have their voices heard. They argue that citizens who suffer unjust exposure to environmental threats have the right to a legal redress of their grievances and the right to be included in environmental decision-making that affects them. The *targeted audience* of such public interest lawyers is the client. The lawyers' *major task* depends on the client's wishes, but usually involves the use of legal procedures to obtain for their clients the avoidance of environmental threat, the remediation of environmental damages, and/or compensation for the adverse effects of contamination. Lawyers' mode of argument is based on the objectives of law — efficiency, certainty, predictability, continuity, equity, and fairness. They attempt to establish the intent of an agency or other entity either to avoid its legally defined duties or to deny citizens their legal rights.

The *method of reasoning* is based on interpretations of legal grounds as defined by criminal law, tort law, or administrative law. The lawyer must adhere to procedural rules in making an argument that is appropriate to the venue in which the case is brought. Procedural rules concern such factors as

standing before the court, admissibility of evidence, and standards of proof.

The same basic *notion of causality* holds across the legal system, but criminal law carries significantly more stringent standards for causality than tort or administrative law; the standards for causality in administrative law are varied, bringing a high element of unpredictability to lawyer and client. Legal cause is proximate cause and it concerns intent. Intentionality is a complex legal concept, distinct from motive. While motive impels a person to act to achieve a result, intent involves the defendant's purpose to use a particular means to effect that result. For the purposes of establishing a case, only the intent is relevant. Even though a defendant acts without a hostile motive or desire to do any harm, s/he may be liable. Both cause (intent) and effect (harm) must be present; other explanations must be dismissed. The goal is to prove a causal connection between intent and harm to demonstrate culpability (Brennan 1988; Culhane 1997; Evans 1998; Kanner 1995, 1997a, 1997b; Snyder et al. 1997). Legal cause is proved for the plaintiff when the weight of factual evidence establishes with a high degree of certainty the proximity of the causal factor to the effect.

Legal *strategies* vary with the court in which the case is brought because criminal law, tort law, and administrative policy differ in their purposes and procedural rules. Criminal law and tort law are both rooted in common law, but have different aims (Buck 1996). Criminal law was established to protect the lives and property of citizens; criminal court action, then, is taken to punish violators through fines and/or imprisonment. In contrast, tort law was formed to govern the relationships between citizens; court action in tort cases is used to correct an imbalance in citizens' relationships through compensation or damages that restore balance.

Despite their different purposes, criminal law and tort law are both based on precedent because of their shared grounding in common law. In these courts, judges base their decisions on past court interpretations of the criminal statute or rule that has allegedly been violated. The burden of proof in criminal court is proof beyond a reasonable doubt; in tort law, the burden of proof involves the presentation of a preponderance of evidence. The logic is for judge/juries to determine the facts of the case and the burden of proof, identify previous cases with similar facts, and then choose between the competing precedents offered by opposing lawyers (Buck 1996). If the case is brought in criminal or civil court, the strategy is for the prosecutor or plaintiff's lawyer to design an argument that: identifies the statute or rule allegedly violated; establishes the intention of the offending party to violate the statute or rule by avoiding responsibility or denying citizens their rights; and presents a set of precedents that supports the case. By using precedent, the lawyer tries to relate the facts

of the case connecting cause and effect to previously admitted principles of causal explanation, thereby increasing the level of certainty.

Hearings concerning administrative policy are guided by significantly different purposes and procedural rules. Administrative agencies are created by government to establish broad policies within a restricted area, such as environmental protection. The agencies then establish rules for investigation and adjudication regarding those broad policy directives. Administrative rules are required to meet two constitutional standards: *procedural* due process (involving the agency's adherence to the legal requirements of notice and hearing) and *substantive* due process (pertaining to the agency's operating only within its designated policy boundaries) (Vago 2000). The purpose of court action using administrative laws is to force compliance with the established rules through fines or, invoking the criminal or civil provisions frequently contained in administrative laws, through compensation, damages, or imprisonment. Instead of being based on common law and precedent, administrative laws are based on the interpretation of civil laws described in detailed codes and emphasize a search for alternatives rather than the enforcement of rights and duties (Vago 2000). Judges locate the appropriate section of the code and interpret the statute by examining the original intent of the lawmakers, contemporary administrative interpretations of the statute, any relevant non-legislative changes that occurred after the statute was enacted, and past judicial opinions on the statute where available. They then apply their interpretations to a set of past actions and results and make a decision either against or in favor of the plaintiff, or stipulate some partial remedy as a compromise. In administrative agencies such as the EPA, the agency administrator is appointed by the president (Buck 1996). Frequent turnover in the administrator position causes discontinuity in agency interpretations of the statutes, politicizing the policy process and increasing the ambiguity in court actions using administrative law.

In administrative law, the *method of reasoning* and the *notion of causality* are the same as those for criminal and tort law. That is, the notion of causality employs proximate cause, the connection between intent and harm, and the dismissal of alternative explanations for the harm. The method of reasoning is based on the procedural rules for administrative court. But, because the procedural rules are not based on precedent, the strategy for activists' lawyers using administrative law differs somewhat from those using criminal or tort law. The lawyer must design an argument that identifies the statute allegedly violated and establishes the intent of the offending party to violate the statute by avoiding responsibility or denying citizens their rights. But, instead of offering a set of *precedents* to support the case, the lawyer offers an *interpretation* of the statute that supports the case.

Thus, lawyers retained by environmental justice activists attempt to demonstrate to members of the legal system their claims of the right of citizens unjustly exposed to environmental threats to a legal redress of their grievances. Their intention is to gain for clients some relief from exposure. They use criminal, tort, and administrative laws to prove the legal intent of the offending party to violate environmental statutes by avoiding responsibility or denying citizens their rights.

Outcomes and Noises

Each of the three voices has achieved some measure of success in its own venue. But one group's voice is frequently heard as noise in other groups' venues. In this section, we briefly describe some outcomes of each group in its own venue; then, we discuss the noise produced in intergroup interaction.

Outcomes

Environmental justice advocates were successful in their efforts to mobilize the aggrieved, conscience constituents, and the general public and in persuading lawmakers to acknowledge the unequal distribution of environmental risks in society. The messages that minorities and the poor are disproportionately exposed to risk are social facts generally recognized by the media and the public. Activists have been successful in stopping the planned construction of facilities and in gaining some concessions from operating facilities. Their voices are heard by decision-makers in all branches of local, state, and federal government. The movement continues to expand in community efforts, law school programs, and on the web. The 2000 edition of the Directory of People of Color Environmental Groups lists 350 people of color groups, 189 separate environmental justice resource groups, and 67 legal resources groups. A number of law schools sponsor an environmental law journal or offer a specialization in environmental law. The web site of Clark Atlanta University's Environmental Justice Resource Center lists 37 Environmental Justice/Environmental web sites (www.ejrc.cau.edu).

Researchers, in conducting scientific research, are expected to identify which main effects are significant, assess the relative magnitude of each, and untangle any interactive effects on environmental risks. In general, researchers focus on the first issue specifying social, economic, and demographic correlates of environmental racism. On this task they obtained consensus: people of color and low-income people are disproportionately exposed to a wide variety of environmental risks (Asch and Seneca 1978; Berry et al. 1977; Bullard 1983; Burch 1976; Freeman 1972; Gelobter 1987, 1992; Gianessi et al 1979; Goldman 1994; Goldman and Fitton 1994; Handy 1977; Harrison 1975; Krivant 1975; Lee

1992; US GAO 1983; West et al. 1992; Zupan 1975). On the last two matters, they have been less than systematic.⁷ They merely conclude discriminatory outcomes are a product of a number of factors.

Lawyers pursuing environmental justice cases have sometimes convinced the court to find in favor of their environmental justice clients. They have been most successful in cases accusing a state regulating agency of violating procedural rules for siting a facility. An example is *CANT v. Louisiana Energy Services*, a case that began in 1989 when the Nuclear Regulatory Commission (NRC) reviewed a proposal from Louisiana Energy Services to build the nation's first privately owned uranium enrichment plant in Louisiana's predominantly black Claiborne Parish. Residents formed Citizens Against Nuclear Trash (CANT) and employed administrative law to sue the company and the NRC for environmental racism (Bullard and Johnson 2000). In 1997, the NRC's three-judge panel of the Atomic Safety and Licensing Board ruled that racial bias had played a role in the site selection process, and the judges chided the NRC staff for not addressing the specific mandate of Clinton's Executive Order 12898. Lawyers' efforts have met with less success in cases charging that a company's operating procedures violated rules and resulted in the contamination of a community. Sometimes concessions have been won, but the facilities remain in operation.

Lawyers have only rarely used civil rights laws to level a charge of environmental racism by arguing that an entity receiving federal funds engaged in a pattern of racially discriminatory procedures in facility siting. An example is the 1996 federal complaint filed by the grassroots group in Chester, Pennsylvania, accusing the state, the state's environmental regulatory agency (which received federal funds), and various state officials of *unintentional* environmental racism in granting a permit for a company to build a facility to treat contaminated soil. Although Title VI bans only intentional discrimination, it permits federal agencies to adopt regulations that also ban unintentional discriminatory effects. The US Supreme Court in 1983 ruled that federal anti-bias laws allow private lawsuits when intentional discrimination is alleged, but the court did not rule on whether such lawsuits are allowed over unintentional discriminatory effects. The Chester case was the first to try, by charging that the outcomes of the state agency's permit-granting process were racially biased. A US district court judge dismissed the suit, ruling that the suit had to be based on intent. But his ruling was subsequently overturned by a US Circuit Court of Appeals decision that interpreted the 1983 US Supreme Court ruling as the high court's endorsement of the right of private citizens to sue over discriminatory effects, regardless of intentionality. The Commonwealth of Pennsylvania

appealed the case to the US Supreme Court in early 1998. The Supreme Court later that year declared the case moot because the grassroots organization requested a dismissal after activists were informed that the soil treatment company had withdrawn their permit request. Thus, the legal issue of unintentionality remains unresolved in the courts.

Noises

Extensive interaction between activists and researchers has not transpired. Researchers may support the movement's goals, but their explanations for discriminatory outcomes may frustrate activists. Researchers' emphasis on precise semantic and operational definitions meets the standards of their targeted audience — their scientific peers — but fails to evoke the emotions that activists employ to mobilize the aggrieved. Researchers neither completely relied on intent as the causal variable nor analyzed variables influencing the wide variety of specific discriminatory outcomes to which activists pointed. Activists' claim that racism may be inferred from discriminatory outcomes without demonstration of the presence of prejudicial intent violates the researcher's procedural norms on demonstrating adequacy of proof (Heiman 1996a, 1996b). For the researcher, institutional discrimination is a reasonable claim only if historical arguments establish that intent to discriminate played a role in formalizing institutional arrangements in the exercise of powers as well as the assignment and conduct of responsibilities.

Although the association of two variables is a reasonable basis for attributing cause for activists, the general public, and the media, researchers may not draw causal inference from association. For the researcher to subsume correlative differentials under the causal umbrella of racism or institutional discrimination is to confer explanatory power and legitimacy to an unproven causal connection. If the rhetorical argument becomes the accepted causal interpretative frame, then further research to identify and prove cause is foreclosed, and alternative explanations remain unexamined. Activists seek a simple cause as the basis for mobilization; researchers offer multi-causal, rather than single-cause, models. Researchers' identification of the influence of factors other than race — market forces, degree of urbanization, proportion of industrial workers — dilutes activists' rhetorical appeals in raising consciousness. The existence of multiple causes undercuts activists' arguments that race be given high priority as a factor in ethical policy debate over redistribution of risks and benefits.

Litigation frequently hinders mobilization because as protest activities ebb, lawyers increasingly make the decisions and the grassroots organization must dig deeper for funds to support the litigation. The lawyers' use of a binary logic of culpability to prove guilt or not guilt frustrates

activists who typically use ethics and moral reasoning to identify inequalities in the distribution of goods and bads. Although each logic is binary, little overlap occurs in what constitutes not-guilt, truth, and good and what constitutes guilt, falsity, and bad. Activists' argument that racism may be inferred from racially disproportionate outcomes without demonstration of the presence of prejudicial intent violates lawyers' rules on adequacy of proof (Heiman 1996a, 1996b). The court rejects explanatory claims that rest on assertion without supporting statistical evidence or supporting testimony. The activist's lay notion of causality finds no acceptance among lawyers. Evidence must establish that discriminatory intent and harm occurred, as well as offer proof of causal connection. Litigation may not be the best strategy for activists seeking social change. As Cole and Foster (2001, 47) suggest: "While legal action brings much-needed attention to environmental justice struggles, legal strategies rarely address what is, in essence, a larger political and structural problem . . . lawsuits take place in a forum in which the resources of private corporations and government entities far outweigh community resources."

Lawyers rely on a mono-causal mechanistic notion of causality that demands the demonstration of a causal connection between intent and consequence. Such a causal model based on intent frustrates researchers who build multi-causal models of explanation based on probability. Researchers and lawyers diverge widely in their understanding of intent. Lawyers distinguish between motive and intent, and only intent is relevant in a tort case. A defendant may be liable for harm even if s/he did not intend to cause *harm*, as long as s/he did intend to bring about the *consequences* that are the basis for the case. That is, the defendant is considered to intend the consequences, if the goal of his/her actions was to bring about those consequences. In contrast, social science researchers tend to consider motive and intent as synonymous and captured in the concept of attitude. They distinguish between attitude and behavior and measure the correlation between them. Regarding racial discrimination, the relevant attitude is prejudice, which is equivalent to intent; the relevant behavior is discrimination, equivalent to consequence. Researchers' statistical efforts to establish prejudicial intent in targeting people of color for placement of waste management facilities or other locally unwanted land uses are generally inconclusive.⁸ Researchers prefer to build multi-causal models to explain *institutional* discrimination. Institutional discrimination refers to a discriminatory consequence that is not reducible to an individual's prejudicial intent, but rather is a complex result of several variables, including a long history of racial practices that left an institutional imprint even after enactment of civil rights legislation. Researchers have clearly established in correlational studies the disproportion

of environmental risks borne by minorities and low income groups. But their work is useless to lawyers basing a case on discriminatory intent because courts do not allow the extrapolation of cause based on mere association.

In fact, such research often identifies predictors other than race that explain the disparities in harmful outcomes, including: age, income, historical patterns of land use, population density, proximity, rural, suburban, and urban, and type of site and its activity status (Greenberg 1993; Hird 1993; Hird and Reese 1998; Mank 1995; Pollock and Vittas 1995). Some argue that minorities are disproportionately exposed by dint of market forces (Been 1993). Others argue that informal covenants, redlining, and block busting lead to white flight to the suburbs, create hyper-segregation of blacks in urban areas (Massey and Denton 1989; Massey, Gross, and Shibuya 1994), and limit blacks' access to jobs, housing, and medical care (Bullard 1994a; Cable and Mix 2000). But, for the lawyer, the introduction of any other explanation discredits the plaintiff's claim that race is the grounds for discrimination. Multiple explanations of differential risk undermine the legal criterion of sufficiency of evidence in arguing racism as the cause of discrimination.

Reflections

Some progress has been made since the earliest days of the EJM. For example: one direct consequence of Executive Order 12898 was the Institute of Medicine's report (1999) on a National Academy of Science committee's recommendations for addressing environmental justice issues via public health, biomedical research, education, and health policies. Such attention suggests a widening forum for the discussion of the causes and consequences of disproportionate environmental risks. Activist/academic and Bullard's associate Glenn Johnson observes in his review of this manuscript that the "walls" separating activists, researchers, and lawyers have weakened since 1995. He bases his observation on anecdotal evidence such as the increased advocacy of environmental justice by health care practitioners and officials and the introduction of environmental justice materials in academic curricula. Johnson's diagnosis of the EJM is that the most significant problem "is not the 'science' of environmental justice, but the 'political science' among various decision makers who determine whether an environmental justice problem is legitimate or not."

Still, the efforts of activists, researchers, and lawyers remain less than successful in ameliorating environmental injustices, ideally obtainable by building coalitions. In the past, each group was constrained, pursuing its own subgoals: for activists, recruitment and political mobilization; for researchers, hypothesis testing and knowledge building; and

for lawyers, appropriate juridical arguments and winning. To create a more effective coalition, these “old” voices must modulate to “new” voices.

The old voice of activists is characterized by: the redress of grievances in a single community or in a limited number of sites; the mobilization of only one given ethnic group in a community; and an audience restricted to community residents. The old voice of researchers features hypothesis-testing relevant to the theoretical issues of a particular discipline and an audience comprised primarily of fellow researchers and only secondarily of other knowledge-users. The old voice of lawyers emphasizes practices associated with vested, self-interest law and adherence to the court’s procedural rules that do not permit multi-causal models as evidence. In intergroup interaction, these old voices produced noise.

In contrast, the new voices diminish the clamor. The new voice of activists must target system inequities and the institutional practices of capitalism that generate differential risks; reach out to a broader constituency to include, not only the poor of all colors, but also middle-class and white sympathizers; and carry their appeals for fairness to political arenas such as the court of public opinion because, although cultural values emphasize equality, the courts of justice do not hear arguments against class-based discrimination. The new voice of researchers must augment discipline-required hypothesis testing with participatory research models that respond to community needs; enlarge their audience to include community residents; and promote their research findings in political arenas such as Congress, governmental agencies, state legislatures, and local city councils. The new voice of lawyers must permit space for the more complex arguments of researchers; emphasize a client-centered model; and include the public as an important segment of their audience. Underlying the old voices is an emphasis on monolingualism in which each party typically acted in accord with its own agenda and spoke to a delimited audience. In contrast, underlying the new voices is an emphasis on polylingualism in which each party recognizes the agenda of the others, acts to achieve some degree of cooperation with them, and speaks to a broader audience.

Such new, polylingual voices would bring beneficial effects for more effective cooperation among activists, researchers, and lawyers. One effect of the new voices would be to produce an agendum that broadens the base of participation at the grassroots level, simultaneously shaping the nature of policy-making debates to involve various publics, legislators, and bureaucrats. The new agendum would call for a risk free society, no end-production pollution, and equitable exposure to risks of morbidity and mortality by region, class, and race/ethnicity (Bullard 1999a, 1999b; Cole and Foster 2001). The EJM has already begun to focus attention on

issues that signal an improved agendum by highlighting: the effects of current federal and state laws, administrative regulations, and procedural guidelines on the implementation and enforcement of pollution policies; the unfairness of requiring victims to shoulder the burden of proof of harm rather than mandating that polluters prove their actions caused no harm; and the need to adjust the prioritization of community health and welfare relative to corporate profits and private property rights. Kuehn (2000) suggests further potential agendum items involving: the identification of criteria for defining minority and low income communities that both researchers and lawyers may use; the specification of political standards for determining when a disparate impact is inequitable; and the determination of the appropriate reference for community when determining the degree of disparity legally significant under Title VI.

A second beneficial effect of the new voices of activists, researchers, and lawyers is the replacement of specialized vocabularies with a common language of environmental justice that is denotatively meaningful. Highly abstract and theoretically detailed models must be unpacked, the complex made simple. In general, the vocabulary of social scientists, the logic of hypothesis testing, and the complexity of findings must be reinterpreted and simplified by lawyers to be useful in courts. Activists must learn both academic and legal terminologies, researchers must connect with activist and legal communities, and lawyers must work to incorporate these groups into the courtroom. The rule that governs all communication must not be forgotten: write so that both insiders and outsiders can understand it.

A third beneficial effect of the new voices is the opportunity to create new strategies in the courts of justice, the court of public opinion, and in political institutions. EJM activists have typically sought redress of grievances through the courts by framing suits under equal protection, environmental, and civil rights laws (Mank 1999; Poirer 1994; Schwartz 1997). Different arguments could be tendered in the courts to modify existing jurisprudence. Activists, researchers and lawyers acting together might convince judges to allow arguments which permit plaintiffs’ lawyers the same freedom as defense lawyers to introduce multicausal arguments that involve the relative influences of race and other variables on disproportionate risk. Allowing such arguments would replace the mechanistic notion of causality that presently discounts scientific assessments of disproportionate risk. In addition, new strategies might be developed for audiences *outside of* the courts of justice. The court of public opinion might be addressed via media and public forums in ways that inform and educate the public in the new polylingualism.

Perhaps the most important arena for the new, polylingual voices of the EJM is political institutions at all levels.

These new voices resonate to facilitate political action locally, nationally, and globally. Courts of justice may only rule on established law, and, although racial discrimination is prohibited, no laws exist against class-based discrimination. But, by appealing to cultural values of fairness, the EJM and public opinion together can potentially exert the political pressure to move even the most intransigent politicians in the direction of a more equitable distribution of environmental risks. At the national level, such political action will be most successful when politicians sympathetic to green/fairness issues hold office. When the EJM faces resistance in Washington from a predominance of politicians favoring capital formation, regional and community coalitions in the movement can target state and local issues. With a broader audience and with more articulated structural ties among the parties, the new, polylingual voices of the EJM will more successfully promote thinking globally while acting locally.

Endnotes

1. Phone: (865) 974-6021; E-Mail: scable@utk.edu.
2. We distinguish between the concepts of "discourse" and "voice." Discourse involves the social construction of meaning and follows postmodern theorists such as Brown (1990), Laclau and Mouffe (1985), Simon (1990), and Teymur (1982) and is used by such social movement analysts as Brulle (1996), Deitz and Burns (1992), and Dietz, Stern, and Rycroft (1989). Discourse refers to a group's commonly held version of reality "that constitutes the legitimate definition of the situation" (Brulle 1996, 60). Activists use a particular discourse to create a group identity distinct from the general social identity whose different interpretation the activists contest. In contrast, we use voice to refer to differences in vocabularies and venues that inadvertently impede cooperation among groups who *do* hold a common definition of the situation. That is, EJM activists share with many social science researchers and public interest lawyers a movement discourse that features environmental equity concerns. Their interpretations do not conflict but their vocabularies unintentionally constrain coordination of their efforts toward a common goal.
3. www.ejrc.cau.edu
4. Epidemiologists and demographers have long documented differentials in life chances by age, sex, race, ethnicity, etc., in patterns of cause-specific morbidity and mortality, generally relying on vital registration census data on large geographic units such as nations and regions. Studies at the community level sometimes rely on surveys collecting retrospective incident histories for individuals. For studies with large numbers of events, rates of risk are statistically robust and carry more probative value with the courts. Conversely, for studies of rare events, risk estimates are statistically weak and carry less probative value with the courts. Although epidemiologists and activists have sometimes collaborated in developing health care education, our focus is on social science researchers because of the considerable extent of the literature reporting on tests of the disproportionate risk of certain social groups rather than documenting actual illnesses.
5. Spatial autocorrelation is a problem for researchers who are interested in ascertaining whether environmental risk is distributed randomly or non-randomly across geographic units. If risk is distributed across *like* and *adjacent/neighboring* units, one obtains positive spatial autocorrelation. If neighboring units are *unlike*, one obtains negative spatial autocorrelation. Different models test different assumptions of contiguity and independence. If contiguous areas are alike, assumption of the independence of variables is violated. Thus, while geographers often examine issues of spatial autocorrelation to untangle definitively the effects of race and class across spatial units, sociologists and demographers rarely do so (Cliff and Ord 1973, 1981; Sibert 1975).
6. One might consider judges to comprise yet a fourth voice since, typically, judges do not have the kinds of specialized knowledge that lawyers do and may consequently be as naive as the public. For our purposes in this paper, however, we believe that treating judges as a fourth voice would bring unnecessary complications to the argument without a significant increase in understanding.
7. A few explanations for this sin of omission may be tendered. Researchers ideologically committed to the amelioration of social injustices and who believe that racial inequalities are "bad" may emphasize those theoretical interpretations in which race is "most" or "more important" than other variables, e.g., class. If race and class have significant main effects, rarely do researchers report their relative importance, e.g., standardized beta weights (Mohai and Bryant 1992a, 1992b). Models with main effects only are easier to interpret and calculate than are models with significant interaction terms. Even if fully saturated models were evaluated and interaction terms were found to be significant, the results of such analyses are not reported in the text, an appendix, or a footnote indicating where interested readers may obtain them. If the journal reviewers tend to favor qualitative over quantitative techniques, or favor less over more sophisticated statistics, researchers may eschew evaluating interaction effects.
8. For review of this claim, see Anderton et al. (1994a); Anderton et al. (1994b); Anderton, Oakes, and Egan (1997); Been (1994a, 1994b, 1995); Been and Gupta (1997); Boer et al. (1997); Centner, Kriesel and Keeler (1996); Daniels and Friedman (1999); Downey (1998); Goldman and Fitton (1994); Hamilton (1995); Kelsall et al. (1997); Mohai (1995); Reddic and Cuyenkendall (1995); and Zimmerman (1993).

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Economic and Toxic Chemical Influences on Rates of Gynecological Cancer Mortality in Texas

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Abstract

The influences of economic factors, agricultural pesticides, and industrial carcinogenic wastes on rates of cervical and ovarian cancer mortality were examined for 254 Texas counties. Regressor variables included: median family income, county proportion of state female employment in agriculture, county proportion of state female employment in the chemical/petrochemical industries, percentage of pesticide-treated acres in county land area, and accumulated pounds per acre of known carcinogenic wastes released by manufacturing industries in a county. Data for most of the variables were averaged for the period 1980 to 1990 to stabilize values for rural, sparsely populated counties. Levels of carcinogenic wastes reported by the Toxics Release Inventory were summed for the years 1988 to 1994. Standardized age and race-adjusted mortality rates were based on the average number deaths due to each of the two gynecological cancers for the period 1986 to 1994 and the 1990 size of population subgroups in Texas. Bivariate correlations were computed and ordinary least squares regression (OLS) was conducted. The OLS model explained 83 and 77 percent of the variation in cervical cancer and ovarian cancer mortality rates. Regression findings indicated that cervical and ovarian cancer mortality rates were positively influenced by both of the employment measures and by median family income. Contrary to the research hypotheses, these rates were negatively influenced by pesticide coverage and the per acre volume of accumulated toxic wastes.

Keywords: cervical cancer, ovarian cancer, mortality rates, Toxic Release Inventory, Texas

Introduction

Carcinogen and other health effects due to exposure to toxic chemicals in the workplace and environment are important societal issues garnering much attention from many segments of the socio-political spectrum (Szasz 1994). Concerned lay and professional groups claim that little is known and understood about the effects of most chemicals, especially those in the national waste stream, on human health and safety (Thomas et al. 1999). For example, of the 658 million to 786 million pounds of pesticides applied annually since 1980 in the United States (US Environmental Protection Agency 1997), only 70 among 2,800 pesticide products have been tested and are known to cause cancer in people (Bullard and Wright 1993). In their battle cry for environmental justice, these groups contend that people of color, children, the elderly, and women are more vulnerable to exposure and particular health risks than others in our society (Bullard and Wright 1993; Goldman 1991).

Epidemiologists and social scientists have devoted considerable attention to unraveling the complex relationship between toxic chemicals and cancers among women (Hartge and Stewart 1994; Shen et al. 1998; Vasama-Neuvonen et al. 1999). Their evidence shows that incidence and mortality trends of gynecological cancers, for example, have varied over time and by race, age, and geographical region (Devesa et al. 1989; Oriel et al. 1999; Wingo et al. 1999). Scientists have investigated only recently the occupational and environmental factors that may cause these female cancers in the United States (Wolff et al. 1996). Much of this work is hampered by the lack of longitudinal datasets on women's employment and health histories and an incomplete understanding of which and how environmental factors affect female health (Wolff and Weston 1997).

Although the incidence of gynecological cancers lags far behind the incidence of breast cancer and has shown a downward trend since the 1970s, they are among the leading cancers among U.S. women (Devesa et al. 1989, Wingo et al. 1999). For all races, cancer of the corpus uteri (endometrial cancer) had an age-adjusted incidence rate of 21.1 per hundred thousand (expressed as 10^5) population, which ranked it 4th in the top ten disease sites among women during the period 1990 to 1996. The incidence of ovarian cancer was 14.8 per 10^5 population with a rank of 5th, followed by cancer of the cervix uteri with an incidence of 9.0 per 10^5 population and a rank of 8th (Wingo et al. 1999). Age-adjusted mortality rates due to these cancers were over the same period: ovarian (7.69, ranked 4th), cervix uteri (2.47, ranked 10th), and corpus uteri (3.37, ranked 8th). Ovarian cancer had the greatest mortality-to-incidence ratio (52%). Cancers of the cervix uteri (19%) and the corpus uteri (16%) had lower ratios, largely possibly because of successful widespread cytologic testing programs (Devesa et al. 1989).

An ecological design was used in this study to determine if mortality rates of cervical and ovarian cancers were influenced by two groups of factors at the county-level of analysis in Texas.² One group included economic factors of median family income, county percentages of all women employed in agriculture and in particular high-risk manufacturing jobs. The other group involved environmental factors such as the proportion of pesticide-treated acres to county land acre, and the per acre volume of chemical carcinogens released by manufacturers in each county.

Texas and Gynecological Cancers

Texas was selected as the study area for several reasons. Its average annual age-adjusted mortality rate for cervical cancer (3.3 per 10^5 population) was significantly greater than the national rate (2.8 per 10^5 population) for the period 1991 to 1995 (Ries et al. 1998). Among ethnic groups, cervical cancer was the third most diagnosed cancer for Hispanic women and the fifth most diagnosed cancer for African American and other ethnic groups in 1995 (Carozza et al. 1999). Although Texas' rate for ovarian cancer (7.0 per 10^5 population) was lower than the national rate (7.7 per 10^5 population), it more than doubled the mortality rates for the combined other gynecological cancers in the state. Moreover, ovarian and cervical cancers were among the top five cancer sites diagnosed for all age groups of women in Texas for 1995; endometrial and cervical cancers were among the top sites diagnosed for race/ethnic groups (Carroza et al. 1999).

Texas was chosen also because it is a leading agricultural state in which 18 of 46 regulated pesticides were detected by the Environmental Protection Agency in groundwater levels that exceeded health advisory levels for 1988 (Kellogg et

al. 1992). The state ranks fifth nationally in the number of acres (6.4 million) which has a high risk of ground water contamination by pesticides (Kellogg et al. 1992). Exposure to particular classes of pesticides over a long period might pose high cancer risks because of their potential to mimic female hormones (Wolff and Weston 1997).

Other reasons for focusing on Texas were that it has ranked annually either first or second since 1988 in the total volume of toxic chemicals released into the environment by approximately 1,200 manufacturers who reported to the Toxic Release Inventory (TRI) (US Environmental Protection Agency 1993, 1996). Further, Texas counties have averaged 1,304 women employed in manufacturing jobs since 1980. Some of the most high-risk jobs are in the chemical and petrochemical industries, which account for the largest volumes of carcinogen releases in Texas. Most of these two industries' facilities are located predominately in metropolitan areas and in counties along the Gulf Coast (Thomas and Harveson 1997). Although these manufacturers have historically employed large numbers of male workers, they have increasingly employed more women in professional and wage-related positions as more women have entered the workforce.

Finally, this study was designed to minimize problems associated with ecological studies of cancer. The focus on counties in a single state avoided regional variations observed by other researchers in analyses of gynecological cancer incidence and mortality (Devesa et al. 1989; Ries et al. 1998; Wingo et al. 1999). Next, calculation of standardized age- and race-adjusted mortality rates controlled variations in the size of population sub-groups among counties. Furthermore, age and race are associated typically with cancer risk as confounders by being related to both exposure and disease outcome (Tsai and Wen 1986). Standardization of rates controls for these confounders and adjusts for unequal sizes of subgroup populations among counties. Finally, cervical and ovarian cancers differ in etiology, morphology, diagnostic approaches, and prognoses (Hulka 1997). These differences necessitated the independent study of the mortality rates of the two cancers. Endometrial cancer was not included in the study because of its lower mortality-to-incidence ratio.

Gynecological Cancers and Risks

Epidemiologists have identified several risks associated with gynecological cancers. Cervical cancer includes a group of diseases that arise from the surface of the cervix. Higher risks are associated with infections by the human papilloma virus or the Herpes Simplex Type 2 virus, multiple sex partners, early age at first intercourse, cigarette smoking, and use of oral contraceptives, particularly high-dose estrogen pills (Devesa et al. 1989; Koutsky et al 1992). When

compared to women afflicted with cervical cancer, ovarian cancer patients have a lower probability of survival after metastases to distant organs in the body. Ovarian cancer typically arises in the layer of epithelial cells that surround an ovary, but can also occur in any of several types of ovarian cells. Women who are 55 to 80 years of age and who have familial history of breast or ovarian cancer are the most at risk groups. Other risk factors include nulliparity (Shen et al. 1998), and high fat, protein, and caloric consumption (Kushi et al. 1999). Findings on the use of talcum powder on the perineal area (Hartge and Stewart 1994; Vasama-Neuvonen et al. 1999) and hormonal replacement therapy (Shen et al. 1998; Schairer et al. 1999) remain inconsistent.

Risks related to exposure to toxic chemicals in the workplace and environment are of increasing interest to scientists and the general public (Wagener et al. 1995). Many of these chemicals and their metabolites behave in vivo and in vitro much like estrogen or other endocrine hormones produced in women (Hulka 1997). Some of these agents bind to estrogen receptors and promote prolific cell growth, increasing the risk of tumorigenesis and carcinoma. Long term exposure to other chemical agents such as the pesticide TCDD (2,3,7,8, -tetrachlorodibenzo-p-dioxin) and some dioxin-like PCBs (polychlorinated biphenyls) act anti-estrogenically thereby causing premature anovulation (Wolff and Weston 1997).

A Human Ecological Framework

Human ecology theory provided the framework for this study. According to a contemporary version of the theory, the "human ecological complex," or model, is composed of population (P), social organization (O), environment (E), and technology (T) components (Duncan and Schnore 1959). The POET model embraces the idea that human ecology and biological ecology are closely related, as shown in recent applications of the model involving toxic waste issues (Thomas et al. 1999).

In the POET model, *population* is an aggregate of people who reside in a county and collectively adapt to environmental conditions. Economic opportunities accrue to a place (county) by virtue of both its size of population and its access to larger and more diverse economies of metropolitan areas. These benefits dissipate as the distance from large economic centers increases. Counties that are contiguous to a large metropolitan area are more likely to benefit economically from metropolitan growth than rural, isolated counties.

The population component also includes demographic processes and outcomes such as mortality that accompany collective human adaptation. Mortality rates of breast cancer victims are an aggregated, long-term response by residents to environmental and workplace conditions in a county (Thomas et al. 1999). Differences in distributions of age and

race in subpopulations can distort rates. Therefore, mortality rates were standardized to control for these differences.

Social organization is the manner in which human populations evolve a system of differentiated, sustainable relations and activities that utilize the environment in terms of providing resource materials, living space, and a repository for wastes (Freese 1988). Human ecologists often regard this component as the industrial and occupational structure of an area (Frisbie and Poston 1975). Median family income and the county percentages (i.e., share) of all women employed in the agriculture and the chemical/petrochemical industries in Texas partially indicated in this study the economic or sustenance structure that supported this group of employed women.

The natural *environment* is a composite of external factors (e.g., climate, soil, water and topography) to which a population is actually or potentially responsive (Hawley 1986). *Technology* includes all techniques, practices, and tools utilized by a population in its social organization as it adapts to the environment (Duncan and Schnore 1959). Greatly diversified economies tend to produce by their nature more environmental pollution and risks of human exposure to toxic hazards (Freese 1988). Although the production of synthetic and natural chemicals has expanded the productive capacity of the environment, volumes of industrially released carcinogens and pesticide use are dangerously toxic to humans. Hawley (1986, 49) termed these conditions of ecosystem disruption and pollution "disturbances" between social and biophysical systems. In the present study, volume of toxic industrial chemical wastes and the number of farm acres treated with pesticides indicated environmental quality (i.e., the greater the volume of the waste stream and the number of pesticide-treated acres, the poorer the environmental quality). It also represented the level of technological development (i.e., the greater the volume of the waste stream, the more economic development or industrialization in a county; conversely, the greater the number of pesticide-treated acres, the less urbanized and economically diversified a county).

Empirical Evidence and Hypotheses

Based upon empirical evidence reported in past research, this study tested five research hypotheses for rates of cervical and ovarian cancer mortality in Texas. Because of the ecological nature of the research design, the terms "affected" and "influenced" were used in lieu of "predicted" in each research hypothesis to avoid implying a causal effect (Morgenstern 1995).

H1a and 1b: Median family income is related (a) negatively to the rate of cervical cancer mortality and (b) positively to the rate of ovarian cancer mortality among women. Median family income is often a proxy for socio-economic

status (SES). Research evidence shows that prior to the 1990s, socio-economic status was linked to gynecological cancer risks. Women who had higher SES were more likely to experience ovarian cancer and possibly endometrial cancer, unlike women with lower SES who were more prone to cervical cancer (Faggiano et al. 1997). Najem and Greer (1985) reported evidence of a positive correlation between ovarian cancer mortality and per capita income and a negative relationship between cervical cancer mortality and per capita income in their study of New Jersey residents. Possible factors that contributed to these rate differences among SES groups were life-style differences such as accessibility to preventative care/treatment (Pukkala and Weiderpass 1999) and diet related behavior (Kushi et al. 1999).

H2a and 2b: Employment in the agricultural industry is related (a) positively to the rate of cervical cancer mortality and (b) negatively to the rate of ovarian cancer mortality among women. Employment in agriculture can occur on the farm as an owner/operator, family worker, or hired worker, or it can occur in companies which process agricultural commodities for consumers. Some research findings have indicated excess cervical cancers among farm workers (Blair et al. 1993; Stubbs et al. 1984), as well as among employees in the agricultural products, processed foods, and farm machinery industries (Sala et al. 1998). While women employed in the farm products (i.e., raw materials, wholesale) and farm supplies industries have higher mortality risks for endometrial cancer, female farm workers have lower risks of ovarian cancer mortality (Sala et al. 1998; Shen et al. 1998).

H3a and 3b: Employment in the chemical and petrochemical industries is positively related to (a) the rate of cervical cancer mortality and (b) to the rate of ovarian cancer mortality among women. Occupational exposure to carcinogens and the effects of exposure are difficult to assess because of the unavailability of these data, particularly for working women who have cervical cancer (Wolff et al. 1996). Moreover, in their comprehensive review of articles published from 1970 to 1997, Shen and colleagues (1998) found considerable variation internationally in the incidence rates for ovarian cancer and concluded that the evidence for ovarian cancer risks associated with job titles, industries, and environmental chemical agents was not convincing. Goldman (1991) provided some marginal evidence when he reported an increased risk of breast cancer mortality due to petrochemical employment in the United States. Breast cancer and ovarian cancer share several risk factors.

H4a and 4b: Agricultural pesticide use is positively related to (a) the rate of cervical cancer mortality and (b) to the rate of ovarian cancer mortality among women. The Occupational Safety and Health Administration (OSHA) recently identified pesticides such as dichlorovos and hep-

tachlor as carcinogenic (Beim et al. 1998). The EPA decertified arsenic compounds and chlorodane for agricultural use in the early 1990s because of their carcinogenicity. Other research evidence indicates triazines (atrazine being the most common) increase the occurrence of uterine adenocarcinoma and lymphatic and hematopoietic tissue cancer in female laboratory mice. No clinical or epidemiological evidence exists, however, that affirms a clear association between these pesticides and gynecological cancers among women (Sathiakumar and Delzell 1997). According to Wolff and her colleagues (1996), most chemical pesticides, except for chlorinated hydrocarbons, that are used today do not persist in the environment. This short-lived characteristic of pesticides makes it difficult to quantify body burden after several months or years following human exposure.

H5a and 5b: Accumulated volume of industrial waste carcinogens in the environment is positively related to (a) the rate of cervical cancer mortality and (b) to the rate of ovarian cancer mortality among women. Chemical wastes reported to the TRI are by their very definition hazardous to human health (US Environmental Protection Agency 1996). Of the 299 toxic chemicals listed in the TRI prior to 1994, 121 chemicals were known carcinogens, according to criteria set forth in the OSHA's Hazard Communication Standards (US Environmental Protection Agency 1996). Fifty of these chemical carcinogens were present in industry releases in Texas during the period 1988 to 1994. Chemical carcinogens released in the largest volumes (> 1 million pounds) were: styrene, benzene, acetaldehyde, acrylonitrile, 1,3-butadiene, formaldehyde, lead, tetrachloroethylene, and chloroform (Thomas and Harveson 1997). In addition to causing cancers, many of these chemicals produce genetic and chromosomal mutations, reproductive and developmental toxicities, and neurological risks (Geschwind et al. 1992; Stockwell et al. 1993). Najem and Greer (1985) found a consistent and significant positive association between breast, cervical, and ovarian cancers and the number of disposal sites for toxic chemical waste in New Jersey.

Methods

Regressor Variables

Data were compiled for this study from several sources and were averaged over approximately a ten-year period to produce stable estimates of frequency for rural, sparsely populated counties. Among the economic variables, *median family income* was obtained from the Bureau of the Census (US Department of Commerce 1983a, 1993a) and was averaged for the 1980 and 1990 census periods (mean = \$21,200). Employment in agriculture (mean = 96 women) and in the chemical and petrochemical industries (mean = 1,304

women) were based on women 16 years of age and older. Data used to calculate the average number of women employed full time in each of these industries were obtained from the 1980 and 1990 Summary Tape File 4 provided by the US Department of Commerce (1983b, 1993b). The chemical and petrochemical industries (hereafter shortened to "chemical industry") had the same standard industrial codes (28 and 29) of industries required to report to the TRI. *County percentages of female employment to total female employment in each industrial sector* were calculated to show the relative distributions across the state. In most cases, employment was less than one percent and skewed toward a few predominant counties. Two counties accounted for 15.2 percent of the total female agricultural employment in Texas. More dramatically, three counties provided 58.8 percent of the female chemical employment; approximately a third (36%) of all women employed in the Texas chemical industry worked in one of these counties.

Agricultural acreage data were obtained for three time periods (1978, 1982, and 1987) from the Census of Agriculture (US Department of Commerce 1980, 1984, and 1992). *Pesticide use/coverage* was measured initially as the average number of acres (mean = 34,244 acres) treated with insecticides and herbicides during the three agricultural census reporting periods. The proportion of treated to total number of land acres was determined next for each county (mean = .056 or 5.6 percent). Fourteen counties had more than 20 percent of land acre treated in pesticides. Overall, 84 percent of the counties had less than one in every 10 land acres treated in pesticides. The measurement of pesticide usage had two limitations. Agricultural chemicals are often repeatedly applied to the same acres thus creating a lack of independence in their measured acreages. Another limitation was that pesticide use did not distinguish specific chemicals (i.e., chlorinated hydrocarbons such as atrazine and methoxychlor) by toxicity and longevity in the environment. Data for the applied pounds of particular agricultural pesticides, though preferred, were unavailable at the county level.

Finally, volume of carcinogenic chemical releases was measured in dry pounds (mean = 943,678 pounds for all counties). A list of 121 known carcinogens, that represented less than one-half of the list of other toxic chemicals monitored by the EPA prior to 1995, was standardized to maintain comparability for the TRI reporting years of 1988 to 1994, and to measure the potential accumulation of these wastes.³ Only 38 percent of Texas' 254 counties had reported carcinogenic wastes (mean = 2,496,815 pounds for 96 counties). *Pounds of carcinogenic wastes per acre* was calculated for each county (mean = 1.3 pounds). Seven counties had greater than 30 pounds of carcinogenic waste releases per acre. None of these counties coincided with the counties that

reported large proportions of pesticide-treated acres. As was the case with agricultural pesticides, limitations of this measure of chemical carcinogens were that toxicities of waste chemicals are not all equal, these chemicals do not cause the same cancers and illnesses in humans, and their environmental longevities vary (Stockwell et al. 1993).

Response Variable

Mortality rates for cervical and ovarian cancers were computed for each county and based on decedents' counties of residence. The National Center of Health Statistics (NCHS) provided mortality data for the years 1986 to 1994. The ninth edition of the International Classification of Diseases (ICD) reported classification codes for cervical (ICD 180) and ovarian (ICD 183) cancers (US Department of Health and Human Services 1988).

Mortality rates were standardized first by totaling and then averaging the numbers of deaths for the years of 1986 to 1994 for each county to stabilize fluctuations that might have occurred annually in the number of deaths (Morgenstern 1995; Shryock and Siegel 1976). Second, the expected number of age- and race-adjusted deaths due to reproductive cancer were calculated (Shryock and Siegel 1976). Sizes of county subgroup populations reported in the 1990 US Census were used to adjust the rates for women 15 years of age and older. Age categories were 15-24, 25-34, 35-44, 45-54, 55-64, and 65 years of age and older. Racial/ethnic categories were Anglo, Black, Hispanic, and Other (i.e., Asians, American Indians, and other groups) (Murdock and Hoque 1992). Finally, use of the direct method and the sizes of age-race subgroup populations standardized adjusted death rates per 10⁵ population in Texas (Shryock and Siegel 1976).

Epidemiologists and demographers are accustomed to substituting a non-zero value when a standardized mortality rate (SMR) is calculated to be zero. They assume that the incidence of death due to a site-specific cancer could be unmeasurable in the presence of cancer illness among a given population at a given point in time. Twenty-eight counties had a standardized cervical cancer mortality rate equal to zero for their total female populations in this study; in other words, no incidence of cervical cancer mortality occurred over a nine-year period. Twenty-one counties had a standardized ovarian cancer mortality equal to zero. These SMRs were converted to a value of .0001. Figure 1 is a histogram of the distribution of cervical and ovarian mortality rates. Figures 2 and 3 show respectively the SMRs for cervical and ovarian cancers among Texas counties. The greatest rates occurred in counties shown in black as having rates larger than one standard deviation above the mean rates. Counties with mortality rates equal to or greater than one standard deviation from the mean rates are of particular interest

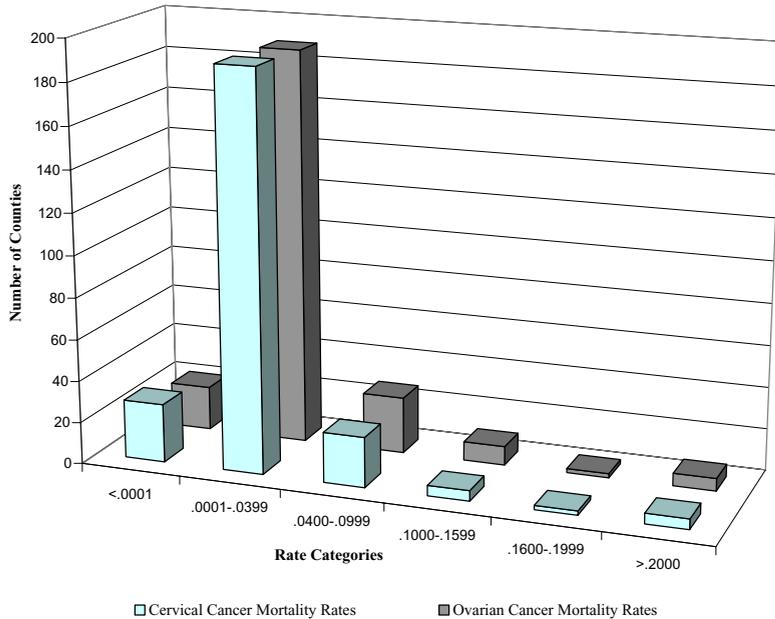


Figure 1. Histogram of Rates of Female Cervical and Ovarian Cancer Mortality in Texas, 1986-1994

Analytical procedures

Bivariate correlation coefficients were calculated and their statistical significance were determined for the hypothesis $\rho = 0$. Ordinary least squares (OLS) regression was conducted next for rates of cervical and ovarian cancer mortality (SAS Institute, Inc. 1990). Computed values for the variance inflation factor (VIF) and tolerance (TOL) determined the occurrence of multicollinearity among the regressor variables (Hamilton 1992). The SPEC option in SAS (1990) assessed whether the residual errors in the OLS models were homoskedastic and independent of the regressor variables, and if the analytical model was correctly specified (White 1980). Heteroskedasticity produces biased and inefficient standard error estimates and undermines the rationale for t- and F-tests (Dietz et al. 1987; Hamilton 1992). OLS procedures assume homoskedastic error terms (see Hamilton 1992 for a discussion of other assumptions of OLS). The SPEC chi square value for the cervical cancer model had a borderline probability value ($p = .0532$).⁴ The chi square value was statistically insignificant ($p = .2999$) in the ovarian cancer model. Both error variances were considered homoskedastic.

Finally, Cook's D values and plots of the residual errors against estimated mortality rates determined case influence

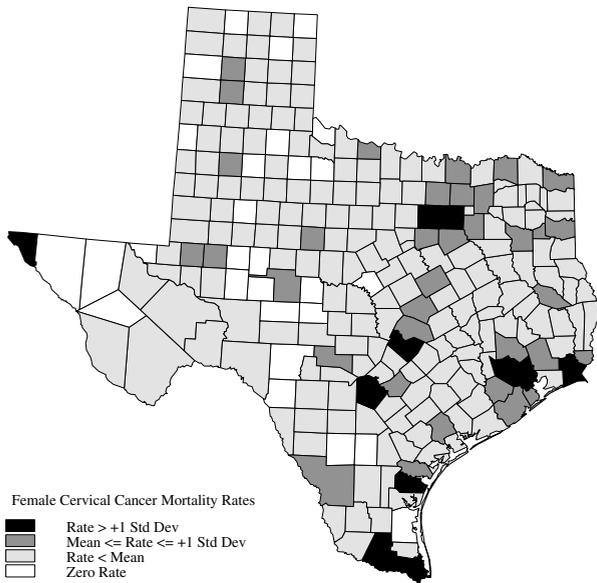


Figure 2. Age- and Race-adjusted Female Cervical Cancer Mortality Rates for Texas, 1986-1994

because they would have the greatest leverage in the regression analysis. Seven of ten counties highlighted in black were the same in both maps. These counties have large industrialized, metropolitan areas and high concentrations of chemical industry employment.

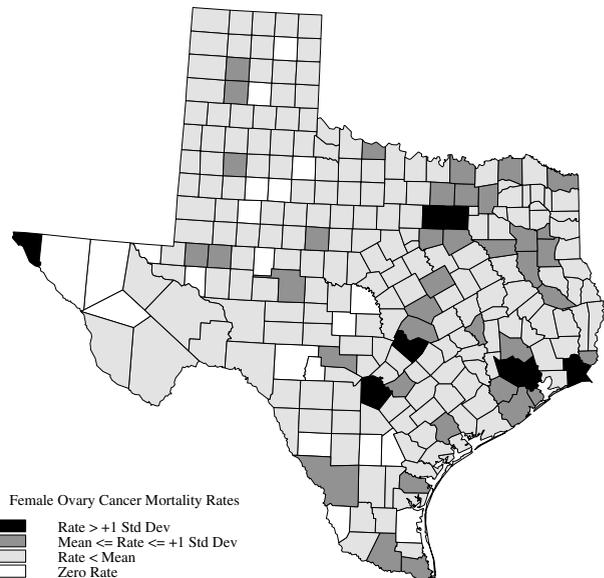


Figure 3. Age- and Race-adjusted Female Ovary Cancer Mortality Rates for Texas, 1986-1994

or leverage conditions (Neter et al. 1985). Cook's D measures the influence of the i th case on all estimated regression coefficients, or equivalently all n predicted cancer mortality rates. Eight counties had values that were greater than one (the absolute cutoff or elimination point), or values greater than .0157 (i.e., $4/N$, where $N = 254$) in both of the OLS models. The latter threshold value is the size-adjusted cutoff point for unusually influential cases (Hamilton 1992). These "outliers" remained in the analysis because they were counties with prominent levels of female employment in the chemical industry and industrial carcinogenic wastes and because no theoretical or methodological reason existed for their exclusion (Dietz et al. 1987).⁵

Several reasons exist for cautiously reporting our findings. Ecological analyses such as the one conducted ignore individual-level data, which include health histories of decedents and exposure vectors, doses, and durations that would affect when, where, and what cancers occur (Wagener et al. 1995). The analytical attention given to aggregate county-level measures warrants that causal inferences be avoided. Relationships among aggregate data used in ecological models can differ radically when observed at other levels of analysis (Morgenstern 1995). Nevertheless, such models and their results may encourage further investigation at the individual-level of analysis. Finally, the examination of only cancer mortality rates in the study ignored incidences of cancer morbidity, that is to say acute and chronic health-related responses to exposure.

Results

Table 1 shows the descriptive statistics and bivariate correlation coefficients of all the study variables. Except for the

negligible relationship with pesticide coverage, rates of cervical and ovarian cancer mortality had statistically significant associations with all other variables, including each other ($r = .993$). Positive relationships were strongest with chemical and agricultural industry employment, followed by the number of accumulated pounds per acre of carcinogenic releases, and median family income. Neither rate had a strong association with pesticide coverage.

Although not addressed in the research hypotheses, intercorrelations among the regressor variables were as expected. Median family income had a weak positive association with the female employment in each industry and per acre level of carcinogenic chemical waste. Agricultural and chemical industry employment of women was moderately related to each other and each of these variables was positively associated with the level of carcinogenic chemical waste. Only agricultural employment had a statistically significant positive association with pesticide use.

Table 2 presents results of the OLS regression analysis for the rates of cervical and ovarian cancer mortality. The model regressed cancer mortality rates against the five independent variables. It explained 83 percent (adjusted multiple correlation coefficient or RSQ) of the variation in cervical cancer mortality rates and 77 percent of the variation in ovarian cancer mortality rates. As hypothesized, all of the economic regressors were statistically significant influences on the rates of cervical cancer mortality. The finding that median family income had a positive effect on ovarian cancer mortality rates differed, however, from results reported elsewhere (Najeem and Greer 1985). Overall, female employment in the chemical and agricultural industries had respectively the strongest effects, which were in line with other empirical results.

Table 1. Simple statistics and bivariate correlations of socio-economic and toxic chemical factors with standardized cervical and ovarian cancer mortality rates for females in Texas counties (N=254).

Variables ^a	INCOM	AGEMP	CHEMP	PEST	CHEM	CERVIX	OVARY
INCOM	1.000						
AGEMP	.145†	1.000					
CHEMP	.276‡	.491‡	1.000				
PEST	.053	.448‡	-.020	1.000			
CHEM	.333‡	.427‡	.672‡	.001	1.000		
CERVIX	.280‡	.748‡	.869‡	-.004	.504‡	1.000	
OVARY	.292‡	.706‡	.835‡	-.015	.470‡	.993‡	1.000
Mean	\$21,200.00	.394	.394	.056	1.310	.032	.038
Stand. Deviation	\$4,400.84	.764	2.472	.064	5.348	.108	.127

^a INCOM = average median family income, 1980-1990; AGEMP = county percentage of the state total number of females employed in agriculture, 1980-1990; CHEMP = county percentage of the state total of females employed in chemical and petrochemical industries, 1980-1990; PEST = proportion of the number of pesticide-treated acres in the total land area of a county, 1978-1992; CHEM = number of the accumulated pounds of carcinogenic chemical waste per acre in a county, 1988-1994; CERVIX = age- and race-adjusted mortality rates for female cervical cancer; and OVARY = age- and race-adjusted mortality rates for female ovarian cancer. Death rates were per 100,000 population for the period 1986 to 1994. Coefficients are statistically significant for rho = 0; p < .05 (*), p < .01 (†), p < .001 (‡).

Results for the environmental variables differed from our hypotheses and supporting literature. The effect by pounds of wastes per acre was statistically significant in both models. However, pesticide coverage had a small influence that was statistically significant only in the model for rates of ovarian cancer mortality. The negative effects by these environmental variables in both models were counter intuitive and contrary to the claims of environmental justice proponents.

Collectively, these findings indicated that cervical and ovarian cancer mortality rates were higher in counties that had greater percentages (shares of the state total) of women employed in the agricultural and chemical/petrochemical industries and higher median family incomes, but fewer pounds of carcinogenic wastes per acres and in the case in the ovarian cancer mortality model, less pesticide usage.⁵

Discussion

The results of this study suggest that rates of cancer mortality were greater in more industrialized counties where

Table 2. Cervical and ovarian cancer mortality rates regressed against economic and toxic chemical factors for Texas counties (N=254), 1990.

Mortality Models and Regressor Variables ^{a, b}	BETA ^c	SE ^c	beta ^c	P > t	Adjusted		
					RSQ	RSQ	P > F
Cervical Cancer Model							
Intercept	-.029	.015	.000	.0044	.832	.828	.0001
INCOM	.000	.000	.075	.0077			
AGEMP	.046	.005	.328	.0001			
CHEMP	.031	.002	.720	.0001			
PEST	-.089	.046	-.053	.0525			
CHEM	-.002	.001	-.113	.0020			
<i>(TOL > .357; VIF < 2.804; SPEC p = .0531)</i>							
Ovarian Cancer Model							
Intercept	-.047	.020	.000	.0187	.774	.770	.0001
INCOM	.000	.000	.102	.0017			
AGEMP	.051	.007	.310	.0001			
CHEMP	.036	.003	.709	.0001			
PEST	-.123	.062	-.062	.0489			
CHEM	-.003	.001	-.144	.0008			
<i>(TOL > .357; VIF < 2.804; SPEC p = .2999)</i>							

^a INCOM = average median family income, 1980-1990; AGEMP = county percentage of the state total number of females employed in agriculture, 1980-1990; CHEMP = county percentage of the state total of females employed in chemical and petrochemical industries, 1980-1990; PEST = proportion of the number of pesticide-treated acres in the total land area of a county, 1978-1992; CHEM = number of the accumulated pounds of carcinogenic chemical waste per acre in a county, 1988-1994.

^b The dependent variables were standardized age- and race-adjusted mortality rates for female cervical and ovarian cancers for the period 1986 to 1994. Death rates were per 100,000 population.

^c Unstandardized (BETA) and standardized betas (beta) and standard errors (SE) were rounded.

female employment and family incomes were greater than in non-industrialized areas. The fact that income is a function of employment could account for the importance of median family income in the model. In other words, regarding gynecological cancer mortality rates, where women work and what they do occupationally were as important as how much they earned. The findings for carcinogenic wastes in the model and pesticide usage's negative effects were contrary to the research hypotheses and to the positive bivariate correlations between carcinogenic waste releases and mortality rates.

Internal dynamics of the regression model (i.e., other regressor variables controlling the effects of the waste variable on mortality) notwithstanding, these findings could be attributable to interesting labor market conditions in the state. For example, women might have lived in a county that had very few carcinogenic wastes per acre and perhaps little agricultural pesticide coverage. Nevertheless, they commuted to jobs in agricultural and chemical industries located in the next county, where the volume of carcinogenic releases was greater. The family incomes of these women would have been above average because of higher paying jobs. Their risks of exposure to hazardous chemicals on the job or during their commuting to work would also have been greater. Consequently, they might have developed cervical or ovarian cancer. As these women died due to their cancers, counties of residence would have experienced above average cancer mortality rates. Although this scenario begs for individual level data on the life-course health/illness experiences of these women, it has some plausibility in Figures 2 and 3. Counties that have above average cancer mortality rates (as shown in dark gray) border and outlie the heavily industrialized metropolitan counties located in the eastern half of the state. Other studies have reported commuting-to-work patterns as just described for these areas (Perkinson 1999; see also Bokemeir, et al. 1983) and that hazardous industrial wastes released in these counties may be more toxic than the releases in more industrialized areas (Ying 2001).

These findings marginally contributed to human ecological theory (i.e., POET model). Researchers have restricted previous applications of the POET model to only selected features of the population and social organization components. More importantly, they have generally ignored framing human health and mortality issues with the model. This study demonstrated a connection between the economic organization (O) of Texas counties and rates of cervical and ovarian cancer mortality (P) through women's possible chemical (T) exposure experiences in *workplace* environments (O or E). It provided some understanding of the interrelationships among employment, chemical exposure, and health circumstances of women. Because of the unexpected negative

behavior of the chemical waste and pesticide variables in the research model, refinement and more explication of the environmental/technological components of the POET model remains, particularly below the county level of analysis and in applications to other highly vulnerable groups such as the elderly and children.

Indeed, identification of complex linkages between exposure to environmental factors and gynecological cancer mortality among women is difficult. Several research issues worsen this situation. The extension of experimental findings based on animal subjects to human subjects has produced inconsistent, unreliable results (Wolff et al. 1996). Also, ecological designs differ greatly from individual levels of analysis, especially in their ability to show causality (Morgenstern 1995). Moreover, use of direct and indirect standardization procedures produce dubious mortality rates when disease incidences are few and sizes of population subgroups are small (Tsai and Chen 1986). These rates may also differ when they are calculated using different geographical units. For example, county-level mortality rates based on population subgroups in a state may differ from rates based on the subgroup sizes for the nation.

Future ecological studies could be improved in several ways. Researchers need to make better distinctions regarding female employment in agricultural and manufacturing industries and specific workplace risks associated with each job type. Also, they should devote more attention to particular racial/ethnic groups who are over-represented in certain jobs. For example, other research has shown that large proportions of Hispanic and foreign-born populations were positively correlated with agricultural pesticide use and high site-specific cancer mortality rates, especially among male farm workers (Hoar et al. 1986; Moses et al. 1993; Stokes and Brace 1988; Thomas et al. 1999). In-depth field studies of women, who are employed in these occupations and are distinguished by ethnic group membership and life-course age groups, would fill a critical gap in the literature on women's workplace risks. Such studies are, however, expensive to conduct and require data on health history, vector and duration of exposure, and other potentially cancer-causing factors.

Next, the measurement of toxic chemicals should be improved by including over-the-counter pesticides, which accounted nationally for 21 percent (or 202 million pounds) of the total pesticide consumption in 1995 (Aspelin 1997). These products contain known or probable carcinogens, whose regular use by consumers prolongs exposure and perhaps accumulation in consumers over a long time period. A related refinement would distinguish among the broad categories of pesticides (i.e., herbicides, insecticides, fungicides, rodenticides, and nematocides). Direct measures of the

active agents in these chemicals and their pounds of applications are not readily available at the county-level.

Finally, this study addressed only on-site carcinogenic releases by manufacturers. Toxic wastes that were transferred off-site by in-state and out-of-state manufacturers to Texas counties were not examined (Thomas et al. 1999). Counties that had no TRI wastes reported as on-site releases may have received wastes transferred from elsewhere for recycling, energy recovery, treatment, or disposal. Consequently, counties' volumes of toxic chemical wastes were likely understated.

The risks and outcomes of human exposure to toxic chemicals and their wastes are controversial in several ways. Although this study explained much of the variation in cervical and ovarian cancer mortality, its focus was on rates, not incidence, of mortality. Therefore, it was unable because of its ecologic design to investigate known and other possible causal factors at the individual level. Controversy is also at the center of the jobs versus environment debate. The employment benefits derived from economic development and diversification are counter-balanced by industrial impacts on the environment and human health and safety in both the workplace and community at large. Environmental and social justice advocates have narrowly argued about the presence of these wastes in local communities and neighborhoods giving too little attention to workplace risks. At the heart of these issues is the citizen/worker's right to know about such risks, right to participate in regulatory reforms that protect against unsafe toxic chemical conditions, and arguably their right to sue for remediation of these conditions, as well as for negative health consequences they might experience (Grant 1997).

Endnotes

1. Address correspondence to John K. Thomas, Department of Rural Sociology, Texas A&M University, College Station, Texas, 77843-2125. E-mail: jthomas@rsocsun.tamu.edu.
2. An ecological study has several advantages. It is less costly than other epidemiological designs given its use of secondary data that are readily available at the county level of analysis. Because it provides a logical first step to identify specific counties with high incidences of specific female cancer mortality, it does not require *a priori* knowledge of an area's morbidity and mortality patterns (Morgenstern 1995). Among its disadvantages are: lack of control of confounding factors and their effects on the observed exposure-outcome relationship, migration changes in the population at risk prior to and during the study period, and a potential of multicollinearity and higher correlations among predictor variables than would occur at the individual level (Morgenstern 1995). While these problems can not be ignored or eliminated, researchers can mitigate such effects to some degree by: (1) use of as many risk factors as possible in an ecological regression model, (2) use of data grouped

- into the smallest geographic units of analysis as possible, subject to the constraints of inter-group migration and unstable rate estimation, and (3) determination of how groups were formed and use of all factors thought to influence the grouping process (Morgenstern 1995).
3. The list of TRI chemicals varies from year to year. It had 343 chemicals listed in 1994. The EPA expanded the list to include about 600 chemicals in 1995. It has modified the list by adding chemicals because of public and interest groups' requests and because recent research found particular chemicals to be toxic. Other chemicals were removed from the list because they were produced in insignificant quantities (i.e., less than 500 pounds) or they were no longer considered to be dangerous to humans and the environment according to scientific studies. Some manufacturers have retroactively amended their Form R reports which produced other changes in the list (US Environmental Protection Agency 1996).
 4. Because of the marginal probability value, the cervical cancer model was rerun after all of the regressor variables, except median family income (which was normally distributed), were transformed using log and square root power procedures. The adjusted multiple correlation coefficient decreased to .304, but the SPEC chi square probability value improved to $p = .5874$. Employment and pesticide usage findings were consistent with those reported for the original cervical cancer model. However, median family income and number of pounds of carcinogenic wastes per acre were statistically insignificant.
 5. The models were rerun after prominent outliers were omitted to determine what effects, if any, the deletion of outliers would produce on cervical and ovarian cancer mortality rates. Seven of the eight outliers were the same counties in both models. These outliers were large metropolitan counties that coincided for the most part with the counties shown in black (highest mortality rates) in Figures 2 and 3. The adjusted multiple correlation coefficient decreased to 69.9 percent in the model for cervical cancer and to 64.1 percent in the model for ovarian cancer. Levels of female employment in the chemical and agricultural industries were again the most important influences on cancer mortality rates. Median family income had a statistically significant, small positive influence in both models. The negative influence by county percentage of pesticide-treated acres became statistically significant in the cervical cancer model but was statistically insignificant ($p = .0529$) in the ovarian cancer model. Finally, negative influences by number of pounds of chemical toxic wastes per acre became statistically insignificant in both models. More importantly, the two models failed the SPEC test, which indicated heteroskedastic error variances.

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The Relationship of General Life Values to Attitudes Toward Large Carnivores

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Abstract

Like a number of western countries, Norway is experiencing severe conflicts over predator control and loss of livestock. Conflict resolution is at least partly dependent upon understanding the underlying values and attitudes of the key actors. This study examines fundamental values and attitudes toward predators among sheep farmers, wildlife biologists, and research biologists in Norway. Attitudes toward the large carnivores are relatively negative among sheep farmers, and more positive among other groups involved in the livestock vs. carnivore conflict, like wildlife managers and biologists. We evaluated the assertion that the contrasting attitudes are related to differences in values between sheep farmers and the other two groups. Generally, the value structure showed large similarities across the three groups; six identical factors appeared in each of the groups. One separate and coherent factor, "Nature" (consisting of the five ecocentric value items), appeared in each group. "Nature" was the most important value dimension among wildlife managers and biologists, while a "Security" dimension was most important for sheep farmers. Negative attitudes toward carnivores were positively associated with items related to "Security" and "Tradition." Positive attitudes toward carnivores were positively correlated with "Openness to change" and "Nature" dimensions.

Keywords: predator control, life values, attitudes, resource conflicts, livestock loss

Introduction

Several studies have demonstrated that attitudes toward animals differ across groups delineated by demographic and socioeconomic variables like age, gender, education, and occupation (see review by Kellert 1996). Attitudes toward particular groups of animals, or even toward a single species, often function as an element in relatively intense and complex conflicts between human groups over natural resource issues, like the livestock vs. large carnivore conflicts (Bath 1989; Bjerke, Reitan and Kellert 1998; Kellert 1991). Such

attitudes are believed to be moderately associated with actual behavior that occurs during conflicts, and have been shown to be affected by psychological factors like personal importance (Vittersø, Bjerke and Kaltenborn 1999; Bright and Manfredo 1996), and attachment to livestock (Vittersø, Kaltenborn and Bjerke 1998).

There are both theoretical and empirical reasons to believe that more fundamental values may serve as "prototypes from which attitudes and behaviors are manufactured" (Homer and Kahle 1988). Defined "as desirable transsituational goals, varying in importance, that serve as guiding principles in the life of a person or other social entity" (Schwartz 1994, 21), values may influence attitudes toward external objects and events, which again may predict behaviors toward those external events or objects. Schwartz (1994) expressed that values serve the interest of a social group, motivate action, serve as moral standards for conduct, and are acquired through socialization.

Thus, when studying marked differences in attitude structure between sheep farmers and groups which seek to protect large carnivores (Kaltenborn, Bjerke and Vittersø 1999), we would at the outset also expect to find significant differences regarding fundamental values expressed by the same groups. However, attitudinal diversity need not necessarily imply large differences in values. Like most conflicts over natural resources, controversies over predators are complex phenomena involving more than competing social values. Economic issues and interest conflicts obviously play a part, and socialization has also been shown to be influential, since people who have grown up on a farm with livestock production express negative attitudes toward large carnivores, irrespective of their present occupation (Bjerke et al. 1998). Previously, it has been hypothesized that the disagreement about the management of the large carnivores reflects conflicts between groups regarding deep, enduring values, and that we are witnessing a collision between different cultures when we listen to the arguments of sheep farmers and wildlife managers (Mysterud 1992a, 1992b). Similar views have been presented by Wilson (1997) concerning the reintroduction of wolves in the USA.

If we want to identify potential differences in the value basis that is thought to contribute to differences between groups in attitudes toward a natural resource issue, we need to be relatively specific about how we conceptualise and operationalize values. We use a cognitive hierarchy model as the conceptual framework for the design and analysis of this study. The cognitive hierarchy is a structure where basic values, beliefs, attitudes, norms, behavioural intentions, and behaviours are thought to build upon one another (see for example Homer and Kahle 1988; Rokeach 1973, 1979) and is well suited for analysing wildlife value orientations (Fulton et al. 1996). Within this framework it is theorised that there are connections between the various levels in the hierarchy, much like a pyramid with general life values at the base and overt behaviour at the top (Fulton et al. 1993). In a previous study we have shown for the same sample we use in this paper, that there are relationships between environmental beliefs and attitudes toward carnivores (Kaltenborn et al. 1998). In the present study, we are concerned with potential relationships between general (basic) life values and attitudes toward carnivores. Here then, we consider general life values to be more fundamental psychological constructs than environmental beliefs. With regard to the rationale of the conceptual framework and previous empirical findings, we should also expect to find associations between general life values and attitudes toward wildlife, and furthermore that environmental beliefs mediate this relationship (although we do not test that assumption here).

A widely used theory of values was presented by Schwartz (1992, 1994). He identified ten types of values that could be ordered within a circular structure built around two dimensions. One dimension contrasts openness to change (self-direction, stimulation) with conservation (conformity, tradition, security). The second dimension contrasts self-enhancement to self-transcendence; this dimension reflects the distinction between self-interest (power, achievement), and concern for the welfare for others and nature (universalism, benevolence). A similar value structure was constructed by Stern and Dietz (1994). They identified one egoistic and one social-altruistic value orientation, corresponding to the Schwartz' self-enhancement and self-transcendence values, respectively. Stern's third value orientation (biospheric or ecocentric values) includes concern for subjects of life, like animals, ecosystems, and the biosphere. Such concern was also included in Schwartz's self-transcendence cluster, as statements like "unity with nature" and "a world of beauty." Past research has shown these value models to be useful in studies of recycling behavior (Vining and Ebreo 1992), ecological dilemmas (Axelrod 1994), and actions to protect the environment (Stern and Dietz 1994; Karp 1996). However, Stern and Dietz (1994) failed to identify one coherent set of

ecocentric values in a representative sample of the U.S. population. Instead, they found one factor that included both social-altruistic (Schwartz's self-transcendence) and ecocentric (biocentric) values. Gardner and Stern (1996, 65) hypothesized that, though not yet examined, a separate ecocentric value orientation could emerge in certain groups, such as environmental activists.

This paper reports part of the findings from a larger study on human-carnivore interactions focusing on farmers, wildlife managers and research biologists. In other outlets we have reported attitudinal structure (Kaltenborn et al. 1999), relationships between attitudes and environmental beliefs (Kaltenborn et al. 1998), the role of attachment to livestock (Vittersø et al. 1998), the effects of different degrees of depredation on attitudes (Vittersø et al. 1999) and associations between locus of control and attitudes (Bjerke et al. 2000). In this study, we report on the relationship between basic life values and attitudes toward large carnivores.

To illuminate the assertion that sheep farmers hold different general values than the other groups involved (Mysterud 1992a, 1992b) we performed a survey among sheep farmers, wildlife managers, and research biologists in Norway by measuring general values. Regarding attitude conceptualisations and constructs we build extensively on Kellert's work as it has developed over several years (Kellert 1996, 1991, 1985). Previously it has been shown (Kaltenborn et al. 1999) that wildlife managers and research biologists in Norway endorse ecologicistic and naturalistic aspects of the large carnivores, that they have low scores on the dominionistic, negativistic and utilitarian subscales of Kellert's attitude instrument, and that sheep farmers express the opposite attitude profile.

With regard to the structure of values, we first hypothesized that sheep farmers more than the other two groups emphasize values in the tradition and security groups (Schwartz 1994), based upon the previous finding that the farmers' concern about the future economic prospects of their farm predicts negative attitudes toward large carnivores (Vittersø, Bjerke and Kaltenborn 1999). It appears that individuals in this group, more than researchers and managers, feel that their future is threatened, and they are generally slower in adapting to modernity processes. However, we emphasize that this is an assumption that needs further empirical verification.

Thus, we also expected to find a positive relationship between the importance assigned by farmers to tradition and security type values, and negative attitudes toward large carnivores. Due to their interests and close occupational association with natural processes, we hypothesized that the ecocentric values would constitute one separate factor for all three occupational groups, and that a positive relationship

exists between this value dimension and positive attitudes toward large carnivores.

Methods

Sampling and Data Collection

The sampling frame for this study comprised 1) all sheep farmers in eleven municipalities in the counties of Hedmark in Eastern Norway, and of Rogaland in Southwestern Norway, 2) all research biologists at Norwegian universities, colleges, and research institutes, and 3) all wildlife managers in Norway working at the municipality and county level. We mailed the questionnaire to 853 sheep farmers, 379 research biologists, and 551 wildlife managers (in total 1783 respondents). The initial questionnaire was followed up by a first reminder 14 days after the initial mailing and a final reminder including the questionnaire 30 days after the initial mailing. The final response rates were 57.6% for sheep farmers, 70.4% for the research biologists, and 77.7% for the wildlife managers.

Survey Instruments

To measure attitudes we used 35 items representing statements about carnivores where the respondent had five options for each item (ranging from strongly agree to strongly disagree). The statements that were included in this study have been adopted from similar studies conducted in the USA by Kellert (1991) and translated into Norwegian. This required some modifications due to differences between the species which exist in USA and Norway. The statements that we included in this study are the same ones as those used in Kaltenborn et al. (1998), as well as the items used in another study by Bjerke et al. (1998). In the latter study, the term *wolves* was used instead of *large carnivores* (defined in the questionnaire as wolves, bear, wolverine, and lynx). The 35 items can be classified into the six scales briefly defined by Kellert (1991): *Ecologistic*: interest in the ecological value of the species, and its relationship to the environment; *Moralistic*: opposition to cruelty and harm toward the species; *Naturalistic*: interest in direct outdoor recreational contact with the species; *Utilitarian*: interest in utilization of the species, or subordination of their habitat for the practical benefit of humans; *Negativistic*: fear, dislike or indifference toward the species; *Dominionistic*: interest in the mastery, control and dominance of the animals. Previous analyses have shown (Vittersø et al. 1999) that the first three scales constitute one coherent factor of positive attitudes toward large carnivores, and that the next three scales form one negative attitude factor.

In order to look for associations between the general values and attitudes toward the large carnivores, we chose 26

value items from the following nine of Schwartz' (1992, 1994) value groups (number of items in parentheses): Tradition (2), Achievement (2), Self-direction (3), Hedonism (1), Benevolence (3), Security (4), Universalism (6), Power (3), and Stimulation (2). We added two items that we felt were of importance to the conflict about the presence of large carnivores: *Closeness to nature* (spend much time out-of-doors in contact with nature), and *Biological diversity* (protect all animal species). The respondents were asked to rate the importance of each item "as guiding principles in my life," on a five-point scale from "very important" to "very unimportant."

Analysis

Analysis of variance (ONEWAY) was conducted to identify differences in scores across the three sub-samples (sheep farmers, environmental managers and researchers) for the individual value items. The factor structure of the list of value items was explored through principal component analysis with varimax rotation. Factor scores were saved as variables representing value domains for the final solutions for the three groups of respondents. Reliability analysis was performed for each of the value dimensions for all three groups. For the six wildlife attitude scales, sum scores were calculated according to the procedure recommended by Kellert (see Bjerke et al. 1998). The factor scores of the value profiles of sheep farmers, environmental managers, and researchers were then correlated with the sum scores of the attitude scales. The principal component analysis with a varimax rotation assumes that the factors are not correlated. Thus, a regression analysis testing the effect of the value dimensions on the attitude scales should essentially produce beta values similar to the bivariate correlations between value and attitude scales. A regression analysis of all three groups confirmed this, but only the correlation table is reported here.

Results

Value Structure

There is considerable variance in the value structure, i.e., in the ranking of importance of the individual items making up the value domains.² Generally, the 28 items included here elicit positive responses. The mean scores range from 3.0 to 4.9, that is, they are considered to belong in the positive half of the scale. The exception is the item social power, which is viewed as relatively unimportant by all three groups (sheep farmers = 2.3, managers = 2.2, researchers = 2.1). In contrast, the values of family security, peace, honesty, and health received the highest rankings in all three groups. Statistically significant differences among the groups (at $p < 0.05$) are

found for 23 out of the 28 items. The items equality, family security, a world of beauty, enjoy life, and wealth, do not elicit statistically significant differences across the three groups. *Sheep farmers* score highest of the three groups on several items: social power, national security, peace, family security, authority, loyalty, respect for elders, respect for traditions, health, honesty, and helpful. *Environmental managers* score highest on protect the environment, influence, closeness to nature, and biological diversity. *Researchers* score the highest on freedom, excitement, variation in life, and curiosity. Although statistically significant differences among the three groups are found for a majority of the value items, it should be noted that in most cases the conceptual differences among the groups are not great. Yet, the pattern of responses clearly indicates somewhat different value orientations among the sheep farmers, environmental managers, and researchers. The largest differences were found for biological diversity (farmers lowest), natural security (farmers highest), respect for elders (farmers highest), and curiosity (researchers highest).

A series of exploratory factor analyses yielded a general structure of six value domains for the sheep farmers, environmental managers, and researchers. Separate analysis was performed for each of the three groups to determine whether the structure was similar. The amount of explained variance and internal structure of values varies somewhat across the three groups, but generally the factor solutions are quite comparable among the three sub-samples. The six value domains have been labeled "Nature," "Openness to change," "Security," "Tradition," "Self-enhancement," and "Altruism." Collectively, these factors or domains explain from 49.2 per cent to 51.2 per cent of the total variance. The reliability of the scales varies with Cronbach alphas from .47 to .74. None of the scales shows very high reliability, but the internal consistency is reasonably good. "Altruism" and "Self-enhancement" are the least reliable scales.

Among sheep farmers, the "Security" domain is the single most important value domain (alpha = 0.68). Combined with "Openness to change" (alpha = 0.74) they explain more than half of the explained variance in this solution. "Nature" (alpha = 0.70), "Tradition" (alpha = 0.72), "Self-enhancement" (alpha = 0.59), and "Altruism" (alpha = 0.57) collectively explain 20.2 per cent of the variance.

For managers, the "Nature" value domain (alpha = 0.73) explains far more variance than the other factors (18.4 %). Among these respondents, "Openness to change" (alpha = 0.65) also ranks as the second most important value domain in terms of explained variance (8.4%). The domains "Security" (alpha = 0.63), "Altruism" (alpha = 0.58), "Tradition" (alpha = 0.64), and "Self-enhancement" (alpha = 0.56) together explain 22.4 per cent of the variance.

We find much the same picture for the researchers.

"Nature" (alpha = 0.74) and "Openness to change" (alpha = 0.71) explain 28.4 per cent of the variance in this factor solution. "Tradition" (alpha = 0.66), "Security" (alpha = 0.64), "Altruism" (alpha = 0.60), and "Self-enhancement" (alpha = 0.47) explain 23.1 per cent of the variance.

Looking at the factor structure of the value domains for sheep farmers, environmental managers, and researchers, the similarities among the three groups are more striking than the differences, although there are some interesting variations. The "Nature" domain is quite homogenous across the groups. Researchers interestingly associate influence as a characteristic of this domain. Sheep farmers associate influence with "Openness to change," whereas managers see it as an aspect of "Self-enhancement." Otherwise "Openness to change" is quite similar in structure and importance to the three groups. Security is more dominating for the sheep farmers than the other two groups, and also in this case includes independence. In contrasting the other groups, for managers the national security falls into the tradition group of values. The "Tradition" domain includes respect for elders and traditions, as well as loyalty and helpfulness. Sheep farmers also group justice in this domain, while researchers include community. Some variations are also found for the "Self-enhancement" and "Altruism domains." Self-enhancement is generally associated with wealth, social power, and authority. Managers also include influence and independence, while researchers associate honesty with this domain. Altruism taps values associated with equality, freedom, and justice. Researchers group independence in this domain, while managers include community.

Relationships between General Values and Attitudes

The items constituting the general value domains were saved as variables and correlated with the Kellert scales for each of the three groups (Table 1). Significant correlations were identified for several of the interactions, although none of the correlations is particularly strong. For *sheep farmers*, the "Security" value domain correlates somewhat with dominionistic, negativistic and utilitarian attitude scales. "Openness to change" correlates moderately with the more positive attitude scales: ecologicistic, moralistic and naturalistic. The strongest correlations for this group are found between the "Nature" value domain and the naturalistic attitude scale (0.27), and between the "Tradition" value domain and the dominionistic (0.26) and negativistic (0.29) attitude scales. Self-enhancement correlates moderately (0.19) with the dominionistic and utilitarian attitude scales, while "Altruism" is almost uncorrelated with any of the attitude scales.

For the *environmental managers*, the strongest correlation (0.35) is found between the "Nature" value domain and

Table 1. Correlations between value domains and attitude scales.

SHEEP FARMERS						
	Dominionistic	Ecologistic	Moralistic	Naturalistic	Negativistic	Utilitarian
Security	0.16	-0.08	0.04	-0.08	0.12	0.15
Openness to change	-0.13	0.13	0.16	0.18	-0.18	-0.13
Nature	-0.15	0.20	0.14	0.268	-0.001	-0.07
Tradition	0.26	-0.11	0.12	-0.04	0.29	0.23
Self-enhancement	0.19	-0.12	0.08	-0.12	0.25	0.19
Altruism	-0.04	0.06	-0.09	-0.03	0.01	-0.02
N	415	414	415	414	415	412
ENVIRONMENTAL MANAGERS						
	Dominionistic	Ecologistic	Moralistic	Naturalistic	Negativistic	Utilitarian
Nature	-0.05	0.27	0.18	0.35	-0.16	-0.21
Openness to change	-0.03	0.21	0.14	0.21	-0.12	-0.09
Security	0.16	-0.05	-0.08	-0.08	0.13	0.14
Altruism	-0.08	0.21	0.19	0.07	0.02	-0.08
Tradition	0.21	-0.06	-0.06	-0.09	0.17	0.18
Self-enhancement	0.11	-0.04	0.04	-0.04	0.09	0.03
N	374	375	374	374	375	375
RESEARCHERS						
	Dominionistic	Ecologistic	Moralistic	Naturalistic	Negativistic	Utilitarian
Nature	-0.10	0.31	0.30	0.40	0.01	-0.24
Openness to change	0.11	0.09	0.03	0.16	-0.09	-0.05
Tradition	0.29	-0.16	-0.12	-0.08	0.20	0.23
Security	0.08	0.03	-0.01	-0.20	0.17	-0.01
Altruism	0.06	0.03	0.08	0.08	0.03	-0.09
Self-enhancement	0.23	0.06	-0.08	0.06	0.17	0.18
N	197	197	197	197	197	197

Correlations above .18 are significant at $p < .01$

the naturalistic attitude scale. Correlations are also found for the ecologistic (0.27) and moralistic (0.18) attitude scales. The "Nature" value domain is slightly negatively correlated with the negative attitude scales: dominionistic, negativistic and utilitarian sub-scales. "Openness to change" shows roughly the same pattern as the "Nature" value domain, but the correlations are weaker. "Altruism" is somewhat correlated with the ecologistic attitude, and "Tradition" with the dominionistic scale for this group, but other than that, "Altruism," "Self-enhancement" and "Tradition" show only weak associations with the attitude scales.

Like the other two groups, *researchers* report a distinct correlation (0.40) between the "Nature" value domain and the naturalistic attitude scale. The ecologistic attitude scale also correlates with the "Nature" value (0.31). Generally, "Openness to change" and "Nature" correlate positively with the positive attitude scales (ecologistic, moralistic and naturalistic), and negatively with the negative attitude scales (dominionistic, negativistic, and utilitarian attitudes). "Tradition" correlates positively with the negative scales. Correlations between "Tradition" and the positive attitude

scales are negative, but fairly weak. Security is somewhat correlated with the naturalistic and negativistic scales, while "Altruism" is almost uncorrelated with any of the scales. "Self-enhancement" correlates primarily with the negative scales (dominionistic, negativistic, and utilitarian attitudes), but like most of the correlations these are also quite moderate.

Discussion

The assertion that the conflicting groups in the livestock vs. large carnivore debate express distinctly different values receives limited support from the present study. Although several differences between the three occupational groups appeared at the single-item level, the general value structure showed only minor differences across the three groups. The six factors found to characterize the value clusters in the groups also corresponded well with previous analyses of values. The most important difference is that this study clearly distinguishes a biocentric or ecocentric value orientation that in earlier studies have tended to cluster with other value domains.

The "Openness to change" factor included the same value items as were identified by Stern and Dietz (1994), and by Schwartz's (1994) "Stimulation" and "Self-direction" categories. The "Self-enhancement" factor of the present study (authority, social power, wealth, influence) corresponds with the "Egoistic" value orientation identified by Stern and Dietz, and the Power/achievement motivational type in Schwartz's model. In accordance with Schwartz, we found evidence for at least two value types in the "Conservation" category (Security and Tradition), while Stern and Dietz identified one factor (Tradition) that contained these values.

As hypothesized, the present analysis revealed one separate factor (Nature) consisting of the ecocentric items (closeness to nature, unity with nature, biological diversity, protect the environment, a world of beauty). In Stern and Dietz's (1994) study these values grouped with altruistic value items to form a biospheric-altruistic factor, more in accordance with Schwartz's Self-transcendence value cluster. (In the present study, altruistic values (community, equality, freedom, justice) grouped together in a separate factor). A separate ecocentric value orientation has previously been hypothesized to be a potential, future result in particular populations "if radical environmentalists can succeed in socializing youth in a new value structure" (Gardner and Stern 1996, 65). Thus, it is of some interest that we identified this type of value orientation among farmers, wildlife managers, and research biologists in Norway. To some extent, it can be argued that these groups represent special interests, and a special type of interaction with the natural environment. They are not similar to the general population, yet they represent a wide diversity of backgrounds, geography, educational backgrounds and professional activities. Still, the study would certainly have been strengthened by similar measures among a sample of the general population.

Some differences among the three groups appeared on this common background of six value dimensions. It has been shown that an important predictor of attitudes toward large carnivores among sheep farmers is the farmers' personal anticipated consequence for future sheep farming if depredation continues (Vittersø et al. 1999b). Farmers have traditionally met the legal and cultural expectations to stay in their home area and maintain the family responsibility for the farm. That the "Security" value type is the single most important factor among the sheep farmers makes sense in this perspective. As shown in Table 1, sheep farmers have the highest scores on almost all single "Security" and "Tradition" items. Simultaneously, the ecocentric factor (Nature) is more important among the wildlife managers and the research biologists than among sheep farmers. On average, farmers express the same level of agreement as the other two groups on three of the Nature items (unity with nature, a world of beauty, close-

ness to nature), but a lower degree of agreement on two items (biological diversity, and protect the environment).

The importance of the "Security" and "Tradition" value items among sheep farmers, and of the "Nature" (ecocentric) value items among wildlife managers and research biologists is also reflected in the pattern of correlations between value factor scores and attitude toward large carnivores. Sheep farmers hold relatively negative attitudes (dominionistic, utilitarian, negativistic) toward large carnivores, while the attitudes among the two other groups are more positive (ecological, naturalistic, moralistic) (Kaltenborn et al. 1999). These previous findings make the associations between value factors and types of attitudes toward carnivores intelligible. We have shown that negative attitudes toward the large carnivores are positively associated with "Security" and "Tradition" values, and negatively associated with "Openness to change" (farmers only) and with "Nature" values (wildlife managers only). Positive attitudes toward the large carnivores are positively correlated with "Openness to change" and "Nature," and negatively correlated with "Self-enhancement" (farmers only).

However, attitudes are complex phenomena. Although the cognitive hierarchy framework posits a logic and connections between levels of psychological constructs, it does not defy the complex influence of diverse socio-demographic conditions. While we can identify relationships between general life values and attitudes toward carnivores, other factors may also be important for determining attitudes. We also explored the effect of age, education, gender and level of occupation on attitudes through a series of regression analyses. When all of these factors are entered as independent variables, we find a significant relationship with each of the six attitude scales. When considered separately, gender does not yield a significant effect on the moralistic, naturalistic, dominionistic, and utilitarian attitude scales. Age does not provide a significant contribution to the moralistic attitude scale. Hence, education and occupation are more salient factors than gender in the formation of the attitudes toward carnivores. However, when we assess the relative importance of occupation on the collective contribution of these socio-demographic conditions on attitudes, the effect of occupation does not alter the picture much. So, education, occupation, and age have an influence on attitudes, but they "act" in conjunction with one another.

Generally, this pattern of results indicate that negative attitudes toward large carnivores have as their value basis a concern for personal and family security, health, respect and loyalty for elders and traditions, and for economic income and social power. In contrast, positive attitudes toward carnivores seem to be related primarily to concern for the ecocentric values, but also to values like curiosity, excitement, and

variation in life. Aside from the few differences noted here, the three groups were remarkably similar.

Endnote

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2. Tables of distributions of mean scores, factor solutions and reliability tests are available from the authors upon request.

Acknowledgement

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Democracy and Participation in Environmental Decision-Making

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Our Nation's environmental knowledge base and our skills at using what we have are not now sufficiently well-developed to permit us to formulate the coupled environmental and economic strategies that will be needed in the 21st Century.

(PCAST 1998)

More and more the decision makers and affected parties engaged in solving environmental problems are recognizing that traditional [decision making] strategies are insufficient... they suffer from a lack of popular acceptance ... and they slight the local knowledge of people most familiar with the problem.

(Renn et al. 1995)

Introduction

The central theme of SHE XI was Democracy and Participation. This theme prompted informative, substantive and engaging discussions on a wide range of subjects. Environmental decision-making (EDM) is certainly amongst the subject areas where the issues of democracy and participation are most exposed (q.v. Sexton et al. 1999). Our environment anchors and shapes facets of our lives from basic health to our sense of aesthetics and spirituality. We shape and are shaped by our environment, and we are increasingly aware of the need for both a science that describes the interconnections between humans and the environment, and an art that allows us to improve these interconnections or at least to steer away from making them worse. This is the core issue of research in human ecology.

What we have learned so far includes at least two disparate elements. First, the human-environment interconnection is immensely complex. It is, in fact, the subject of the natural sciences and the social sciences, and as these sciences advance, so do increases in the amount of data and information that we are required to marshal if EDM is to be informed. Second, the art of managing human-environment interconnections is enmeshed in human values. No technocratic fiat will ever solve the "environmental management" problem. Democracy and participation are essential to EDM.

The challenge posed by the juxtaposition of these two elements was the subject of a series of papers at SHE XI:

How can we ensure democracy and participation at the same time as we make use of the best available science and technology in environmental decision-making? The papers that follow arose from those sessions.

An exciting research agenda derives from the recognition that we have entered both an environmental crisis and an information revolution. The former is largely a social crisis, the later is largely a technology driven event. Geographic information systems bring the power of the latter to the battlefield of the former at a critical time. Because of the urgency of the environmental crisis, it is imperative that every effort be made to scrutinize, develop, and refine the power of geographic information management and analysis (Kellogg 1999; Craig et al. in press). But because of the social nature of the environmental crisis, it is equally critical that the social implications of GIS be included as part of the refinement.

This Human Ecology Forum addresses the challenge of matching the wealth of scientific and technical data with the recognition that the general public should be involved in environmental decision-making if the decisions are to be locally relevant, gain local acceptance and have lasting impact. This raises two specific questions:

1) *How do we make the benefits of accumulated scientific research available to the public in a way that it can be incorporated by the public in environmental decision-making?*

2) *What is it that natural and social science have so far failed to grasp about the complexities of local human ecologies, and can these missing aspects of human ecology be factored into structured, institutionalized, EDM by enhancing public participation?*

For these papers, authors were asked to address four points arising from their experiences with decision-support: 1) *The context*: What is the perspective that is driving the initiative to be described? What is the problem that the initiative is attempting to solve? 2) *The program of action*: What has been done? This should give a clear picture of a process or approach and allow interested readers to determine if they should be approaching authors for further details (this is not the place for full technical reports on research). 3) *The experiences*: What are the successes and/or failures? What practical lessons have been learned? 4) *Next steps*: What plans or approaches have arisen from the research? What does this imply for democracy and participation in local environmental decision-making?

Although many papers presented at SHE XI made contributions to this theme (and readers are urged to examine the abstracts of the sessions on EDM for details on other initiatives), four papers, representing five from the conference, are presented here. The first, by Thomas Gunther (U.S. Department of the Interior), describes the unique attributes of “place-based” decisions and provides a theoretical framework for defining optimal environmental decision on a surface subtended by ecological, economic and human value parameters. He goes on to describe elements of a place-based decision-support system.

Herman Karl and Christine Turner (U.S.G.S.) describe a particular process of place-based decision-making. In their application (called INCLUDE), the main challenge is to reconcile the wealth of scientific expertise with the need to have local decisions reflect local values. They argue this requires new ways of making data and information available to the public but also, and perhaps more significantly, a new class of professional and a new commitment from institutions. The case they describe deals with local watershed management, and so their experience will have wide applicability.

In the third paper, Thomas Meredith (McGill University) describes an application of a collaborative GIS-based decision-support process. The case involves an expert workshop on biodiversity conservation and, because all participants were senior researchers, managers or administrators, it provided an excellent opportunity to test the robustness of a GIS-based mechanism for managing environmental information through a multi-stakeholder decision making process. This paper discusses what was learned about decision-support procedure from that expert workshop. This workshop was in marked contrast to the situation described in the final paper.

Meredith and Gisela Frias describe a collaborative environmental decision-support initiative that rests on a partnership between citizens in a Mexican rural community and researchers from Mexican and Canadian universities. In this case, the process of building the partnership was the most important and instructive element of the decision-support initiative. But here as in the preceding case, the major lesson is

that a decision-support initiative has to be flexible enough to evolve in response to the input of the participants. If this does not happen, participation is, at best, superficial; at worst, illusory. If participation is not effective, the notion of democracy in the most essential of human endeavors — living adaptively and sustainably in a community, in an environment — is fiction.

These papers are part of a decentralized and multi-faceted initiative to improve human ecology by improving the capacity for human beings to understand the land that supports them, and to exercise their care and concern for those life-support systems through better local environmental decision making. The Society for Human Ecology and the readers of *Human Ecology Review* have a role to play in this. It is hoped that these four papers help stimulate dialogue and action concerning environmental decision-making.

Endnote

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Place-Based Decision Support Systems: A Bridge Between Democracy and Sustainability

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The Context

The management of places — whether National Parks and Forests, cities and towns, or small communities and watersheds — is becoming more complicated and more contentious. There is an increase in concern with both the aesthetic and functional aspects of our environments, more people are living in or utilizing any one place, and the demand to participate in decisions is growing. We want our places to retain those features that we value (many of them environmental), while improving in other, mostly social and economic ways. At the same time, access to the scientific data, information, expertise, and analytical tools that should help us plan for sustainable development has grown enormously. Yet, there is still considerable frustration in the search for science-based, participatory decision making. Two reasons for this frustration are the different perspectives of science and decision-making (whether by elected leaders or stakeholders), and the quantity of information available. It is suggested that the emerging technology of place-based decision support systems has the potential to help with both.

The Program of Action: Technical Performance and Value Decisions

People want *scientific solutions* for the problems of where to store nuclear waste, how to manage watersheds, or improve ocean fisheries. However, as is evident from the debates that attend each of these issues, science cannot provide solutions that satisfy all stakeholders. At best, science can objectively analyze the problem, develop and analyze alternative solutions, and anticipate and forecast consequences. The ability of science to provide solutions becomes more limited as issues become more complex, (the management of Chesapeake Bay), uncertainty more extreme (global climate forecasts), or goals more poorly defined (habitat restoration). But whether science provides extensive assistance or limited insight, its contribution is in understanding how alternatives will “score” on various measures of performance, not in the importance of these measures to society. Science provides a basis for a technical comparison of alternatives, and is the result of logical analyses; society’s selec-

tion of a specific alternative reflects the *values* of elected leaders or stakeholders, and is the result of a political process.

The difference in these two perspectives is crucial, and is illustrated graphically for a hypothetical issue in Figure 1, using concepts from economics. In the first panel, a series of alternative solutions are placed on the graph in a position reflecting their environmental (the y axis) and economic (the x axis) performance. Each is evaluated and developed using science, scientists, engineers, analysts and other sources of objective information. The farther an alternative is from the origin, the better its performance. In some cases, we can conclude that one alternative is better than another because it performs better on both measures. For example, the alternative enclosed in a square is better environmentally and economically than the one enclosed in a circle. In other cases, (e.g. the two enclosed in triangles), there is no clear “winner.” Each alternative is preferable on one measure but worse on the other. If we weed out all alternatives that are clearly inferior to others, and keep only those that are not, we can develop the “efficient frontier” shown in the second panel.

The third panel adds a representation of the values of decision-makers and stakeholders using a “preference function.” It shows the different mixes of environmental and economic performance that would yield the same level of satisfaction, without regard to their feasibility. Higher levels of satisfaction would be shown by preference functions further from the origin, and lower levels by functions closer to the origin (dotted lines). A theoretically best solution would be one that is on the efficient frontier (that is, it is technically among the best we can devise using good science), and on the higher preference function (that is it gives decision-makers the highest level of satisfaction possible). This would occur where the preference function and the efficient frontier are tangent to each other. But the point of Figure 1 is not the search for a best solution: rather it is the distinction between the search for alternatives that are technically good, and the application of society’s values to those alternatives. Science can and should help in the former; the latter is a social process.¹

Information and Problem Overload

A second major source of frustration is the wealth of data, information, and expertise available, and the complexi-

ty of place-based management problems. Information is available on elevation, soils, water, roads, economic conditions and development plans, utilities, vegetation, climate, wildlife and wildlife habitat, home ownership, commuting patterns, retail sales and growth, schools, and mineral resources. Increasingly, there are also models that relate elevation and climate to flooding, development to habitat, home ownership and employment to energy consumption, and so on. Each of the types of information can be important to technically good alternatives, and can provide important insights into the consequences of decisions. But the number of sources and the volume of information can easily be overwhelming. Our ability to generate, archive, and serve data has grown rapidly; our ability to integrate it in ways useful to understanding and managing places lags behind.

At the same time, there is increasing awareness of the potential secondary consequences of decisions, from the impacts of building waste facilities on nearby property values, to the impacts of Midwestern agricultural practices on hypoxia in the Gulf of Mexico, to the impacts of urban development on air quality and wildlife. The characteristics of decisions about places are changing from single objective, single decision maker, with limited scope to multi-objective, multiple decision makers, with potential impacts in other places and after many years. Place-based decisions are becoming more complex, both technically and politically.

The Experiences: Place-Based Decision Support Systems

Decision support systems (DSS) are combinations of data, hardware, software, and models, along with tools to analyze, visualize, and communicate results. They have been developed for a range of purposes, typically limited in scope to a single type of problem or a narrow part of an organization (diagnosis of automobile problems, income tax calculations and reporting, facility management, etc.). In the last decade, scientists and software developers in the government, universities, and the private sector have begun adding these capabilities to geographic information systems, providing a new avenue to deliver scientific information and analysis to managers of public lands or communities. These new capabilities, in combination with a new emphasis on involving citizens in the decision making process, are resulting in both the creation of, and the demand for place-based decision support systems (PBDSS).²

Figure 2 presents a generalized framework for PBDSS. It can be used to express several points that have emerged from both formal and informal groups collaborating in the

development of PBDSS: 1) The architecture of PBDSS's should be open, modular, and extensible. Modules should be interoperable, and users should be able to add, replace, or upgrade specific capabilities without affecting others. 2) Analytical models, databases, GIS, scientific capabilities and other tools are not substitutes for the decision process. They support it. PBDSS should be a bridge between the two. 3) A PBDSS should include tools to help elicit and assess stakeholder goals and values, and incorporate them in the decision process. Other guidelines and recommendations have been developed (Case et al.; Lessard 1999), but these three are sufficient to suggest that a PBDSS can be a mechanism to:

- Deliver and manage the explosion of data, information, and knowledge. This includes not only traditional, and often inaccessible, technical reports and journal articles, but also new forms (e.g. dynamic models that relate water quality to land use, transportation, and agriculture, or habitat to urban sprawl);
- Help decision makers and other stakeholders better understand problems, alternatives, and consequences — both intended and unintended; and
- Express and reflect the values of stakeholders in the development decisions.

There are other, related benefits as well, including a better understanding of the relationship between local and regional concerns, an improved ability to track outcomes and practice adaptive management; and better returns on investments in science, data collection, and geographic information systems.

Next Steps

The evolution of PBDSS is providing an important mechanism to combine science and democratic principles in the management of geographically defined places. Certainly, not all science can be packaged and delivered through such systems, and their existence does not guarantee more participation in decision-making. But the combination of data, models, tools and other components can result in better decisions, with more citizen involvement, in more places, at lower costs. There are currently a variety of PBDSS activities underway, addressing cities, small watersheds, large tracts of Federal lands, or large river systems. There are also efforts aimed at creating guidelines and standards for software developers, helping users learn about the range of capabilities currently available, or addressing the way science components can be developed. It seems likely that these efforts will help enable science-based participatory decision-making.

Endnotes

1. This is not to say that science has nothing to contribute to social or political processes. For example, social science can provide assistance in understanding, measuring, and expressing values. But it is still social values, rather than physical, chemical, or other objective qualities that determine the outcome.
2. For information on current activities regarding PBDSS contact the Federal Geographic Data Committee (<http://www.fgdc.gov>), the Open Geographic Information Systems Consortium (<http://www.opengis.org>), or the Aurora Partnership (<http://www.aurorapartnership.org>).

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Figure 1a. Societal Choices.

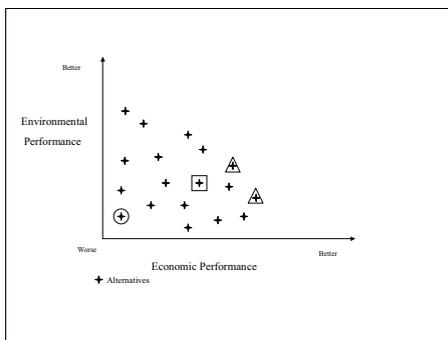


Figure 1b. Societal Choice and the Efficient Frontier.

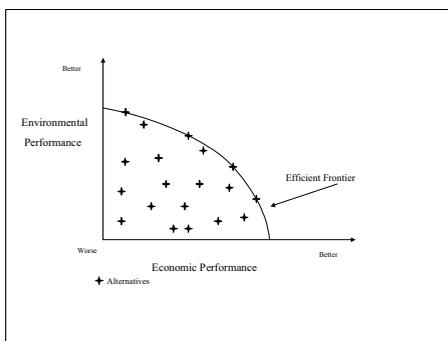


Figure 1c. Societal Choices and Societal Values.

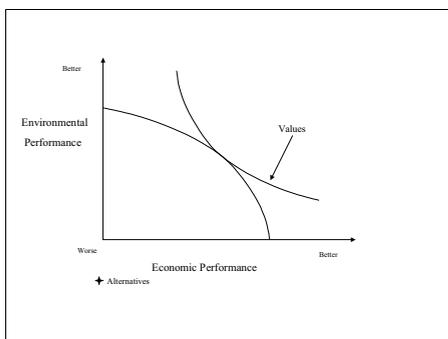
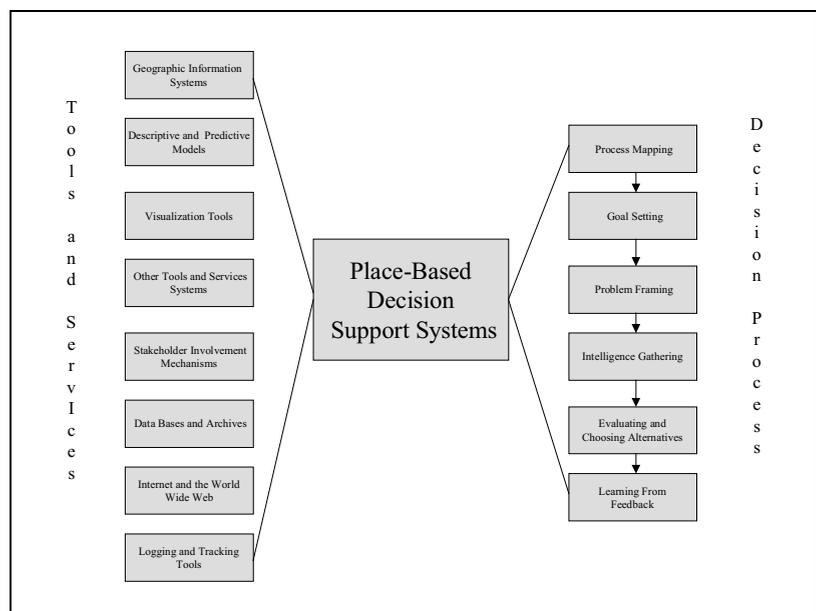


Figure 2. A Framework for Place-Based Decision Support Systems.



A Model Project for Exploring the Role of Sustainability Science in a Citizen-Centered, Collaborative Decision-Making Process

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The Context

The role of science in society is evolving as we enter the 21st century. The report, *Science — The Endless Frontier* (Bush 1990[1945]), outlined a model of national scientific research that served the country for 50 years. The contract between science and society established in that report stipulated that science is essential and that basic research meets national needs (Pielke and Byerly 1998). This stipulation and the abundant — seemingly unlimited and unquestioned — funding for research during the Cold War caused many scientists to come to believe that funding for science was an entitlement independent of societal needs. Implicit in this belief is that science alone can solve society's problems. We now are learning that many policy issues that involve science involve diverse economic, political, social, and aesthetic values as well, and rarely, if ever, is scientific information alone the basis of public policy (e.g., see Sarewitz 1996a, 1996b; Frodeman 1997). Moreover, resources are increasingly more limited and many in society are questioning the value of public-supported science.

This reality challenges the scientific community to define a new social contract that is in accord with the social and political conditions that characterize the dawn of the 21st century (e.g., Lubchenco 1998). Under the terms of the new contract, science is still essential. However, national needs now dictate that much of the research undertaken, and funding for science, will not be an entitlement independent of societal issues and concerns. As populations continue to expand, tensions between environmental preservation and economic development will exacerbate land-use conflicts. Quality of life for the 8-10 billion people who will inhabit the planet by the end of the 21st century will depend on how well we as a society resolve these conflicts. This paper addresses one way that a Federal government science agency can engage citizens in a partnership to develop a community-based decision making process grounded in sound science.

The Need for Community-based Projects Grounded in Sound Science

There is a growing sense of stewardship nationally in that local citizens want to be empowered to make the decisions about ecosystems, watersheds, and land use in their communities (see for example, Turner and Karl 2001). The President wants to empower states, cities, and citizens to make decisions, and his first priority to reform Government is to make Government "citizen-centered" (A Blueprint for New Beginnings-Government Reform 2001). The Department of the Interior recognizes that citizen involvement is a key to the successful achievement of its strategic goals and encourages development of a process of community-based decision making grounded in sound science (U.S. Department of the Interior 1997). Customer involvement and development of robust decision support systems are principal goals of the U.S. Geological Survey Strategic Plan as well.

The real world is complicated and there are no simple solutions. Natural ecosystems and human social systems are complex and interdependent. Tensions between environmental preservation and economic development are exacerbated at the interface between the natural areas and urbanizing areas where these systems adjoin one another. Choices and tradeoffs need to be made in that space where these systems come together. To gain a better understanding of these complex systems, it is necessary to take an interdisciplinary approach and consider a full range of values and interests that include scientific, economic, political, social, cultural, ethical, and aesthetic. Citizens and decision makers are finding themselves having to weigh both sound science and community values in making choices about land use and environmental resource management. To assist citizens and decision makers in understanding the consequences of these choices, we aim to develop an approach that incorporates the full range of natural and social science data within a collaborative problem solving framework to provide a basis for efforts to

develop consensus on solutions to land-use planning and environmental policy concerns.

In light of the above, science is not a panacea, but it can help people illuminate the potential consequences of different choices and thus can inform decisions. Scientists and scientific institutions such as the U.S. Geological Survey (USGS) in isolation cannot determine the science needed to address the complex environmental, resource, and land use decisions that confront society; it must be determined in partnership with our constituents the people who use the science.

However, scientists and decision-makers have increasingly faced a range of problems in using scientific knowledge within decision-making processes that are often driven by a variety of non-scientific, adversarial, and stakeholder dynamics. For example, scientific information can be poorly understood by decision-makers and ignored. Or uncertainty in the data and conflicting interpretations among scientists can lead to confusion. Or scientists might construe the issue at hand as a solution for the purpose of promoting their own research interest (see Adler et al. 2000, for many more examples.) Increasingly both scientists and decision-makers have been realizing that the current ways of dealing with these problems, particularly in complex public projects, do not work well.

The Program of Action: INCLUDE — An Approach to Use Collaborative Problem Solving Techniques for Science-Intensive Environmental Resource Management Issues

The USGS, most notably within the Water Resources Discipline district offices, has made efforts to work with constituent groups to identify issues of concern and to design projects to help address those issues. In an endeavor to increase integration of diverse disciplines and build upon traditional and ongoing USGS efforts to work with constituent groups, the USGS launched an experimental activity, INCLUDE — Integrated-science and Community-based Values in Land Use Decision-making, in late 1998. Since January 1999, INCLUDE has been headquartered at the Western Geographic Science Center as a core element of an interdivisional research agenda. INCLUDE engages citizens as partners with discipline experts in a collaborative problem-solving process. The cornerstones of the INCLUDE effort are to: 1) identify the regional scientific issues of concern through a dialogue with the communities of place and publics of interest, 2) design the scientific investigations to address these concerns, and 3) effectively communicate the scientific concepts and findings to stakeholders. These cornerstones are laid upon a foundation of taking a problem-focused, rather than a discipline-focused, approach to contributing scientific

information toward the resolution of environmental and land use issues.

The INCLUDE approach, conceptualized three years ago, is at the vanguard of sustainability science, an emerging field that explores the interactions between nature and society (Kates et al. 2001). This approach offers a way to implement an idea embraced by the proponents of sustainability science, that is that “participatory procedures involving scientists, stakeholders, advocates, active citizens, and users of knowledge are critically needed” (Kates et al. 2001, 641) to achieve wise and durable solutions to vexing environmental problems.

An Example of a Citizen-centered Project: The Creek Project

The Creek Project is an effort to engage citizens as active partners in the design and implementation of a project to address environmental issues of concern within the San Francisquito Creek watershed in Menlo Park, California. The project is transdisciplinary in nature in that it is situating scientific research in its social and political context (Rofougaran 2001, written communication). It aims to develop approaches and tools to assist local decision makers and citizens in incorporating both sound science and community values in land use and environmental resource management decisions. The communities in the San Francisquito Creek watershed hold different values and cannot agree on land use planning and environmental policy within the watershed. Messages on a community list server established after the creek flooded in 1998 reveal an angry public that is in disagreement as to solutions to flooding and habitat restoration. We propose to use collaborative problem solving techniques that incorporate the full range of natural and social science data to involve the public in the design of research about the issues and to provide a basis for efforts to seek consensus on solutions to land-use planning and environmental policy concerns. Methods developed in the San Francisquito watershed will form a guide for developing other USGS citizen-centered partnership projects for managing other watersheds across the country.

As stated by the Executive Director of the San Francisquito Creek Joint Powers Authority, “The [Creek] project is a consummate model of the complexities facing urban watersheds across the nation, involving issues that often overwhelm decision-makers and the public. Too often this leads to decisions that are driven by a single interest or overriding concern. We are interested in devising a true comprehensive watershed solution that involves voices from all constituents of the community for the San Francisquito Creek and its environs. [I]t is easy to envision empowering this community in such a way as to spark a new method of doing business. This community in particular is poised to receive

presentations of the science in such a way as to allow them to make informed decisions, and rightfully become part of the process. We are delighted to have the opportunity to work with USGS on these issues” (Cynthia DiAgosta 2001, written communication).

The active participation of the community in the San Francisquito Creek watershed is coming from both the formal (government) and informal (citizen) structures. The San Francisquito Creek Joint Powers Authority (JPA) was formed in May 1999 to make decisions that pertain to management of the San Francisquito Creek and environs. Its Board of Directors is comprised of elected officials from the City of Menlo Park, City of Palo Alto, City of East Palo Alto, the Santa Clara Valley Water District, and the San Mateo County Flood Control District. The JPA represents the formal community structure. The San Francisquito Watershed Council (formerly known as San Francisquito Creek Watershed Coordinated Resource and Management Planning) represents the informal community (citizen) structure, although representatives of regulatory agencies, land management agencies, and local governments are members of the Watershed Council as well. The essential function of the Watershed Council process is to provide a forum where all stakeholders of the watershed can share information. Representatives of 30 stakeholder groups work together on the Watershed Council Steering Committee and Task Forces to address six areas of interest: natural resources, pollution prevention, flooding/erosion, land use/development, social issues, and education.

Statement of Problem and Objective

Thousands of communities in small watersheds across the nation are or will be facing issues of flooding, water supply, habitat restoration, aging dams, and stream impairment by sediment and pollutants from non-point sources. There is an immediate need to develop a decision support system based on sound science that incorporates community values that will help to provide for informed decisions on these issues. These issues are vexing decision makers in the San Francisquito Watershed, California.

Background

This watershed encompasses 45 square miles and includes a wide diversity of natural habitats and land use types. San Francisquito Creek is the last riparian unchanneled urban creek on the southern Peninsula of San Francisco Bay. It begins as overflow from the Searsville Lake dam built in 1892 in Stanford University’s Jasper Ridge Biological Preserve. The creek flows for 14 miles from its source to its terminus in San Francisco Bay. Rural areas and open space characterize the upper watershed. In its lower reaches the

creek courses through densely populated cities. San Francisquito Creek is the boundary between two counties (Santa Clara and San Mateo) and flows through parts of five municipalities (Menlo Park, Palo Alto, East Palo Alto, Portola Valley, and Woodside). It empties into San Francisco Bay at the city of East Palo Alto. The towns and cities in the watershed vary greatly in wealth from tremendous affluence to significant poverty.

The reservoir behind the dam, Searsville Lake, is projected to fill completely with sediment in 15 to 40 years depending upon future weather patterns. The consequence of the reservoir filling on riparian habitat and flooding is unknown. In 1998, San Francisquito Creek flooded along its downstream reaches, causing \$28 million in damage. The creek is the last remaining run of steelhead trout (a federally listed threatened species) in the southern part of the San Francisco Bay. It has been listed under section 303(d) of the Clean Water Act as impaired with regard to Total Maximum Daily Load (TMDL). These four issues, flooding, aquatic habitat restoration, dam removal, and TMDL impairment, are of concern to the communities in the San Francisquito Creek watershed. A committee, composed of a subgroup of citizens from the Watershed Council and USGS scientists, decided that a sediment budget needed to be established for the watershed to aid in decisions concerning the four issues.

The following questions must be answered to evaluate the impact of sediment and to make informed choices about the management of the creek. What has been the effect of land use change in contributing sediment to the reservoir and on landscape change? Is the watershed impaired with regard to sediment? What impact will this sediment have on the carrying capacity of the creek and aquatic habitat? How can the multiple uses of an urbanized watershed be managed to minimize impact to the ecological habitat? Overarching questions to these are: How do we connect people and science so that science becomes an integral part of decisions? How can the scientific findings be effectively communicated to decision-makers? How can the competing interests be examined and reconciled to achieve balanced solutions to land use and environmental policy?

The Experiences: Approach and Plan

The Creek Project was designed by a group of citizens in dialogue with scientists. Four citizens and one scientist comprise the project steering committee. To address the questions above and the full range of issues defined by the community, the project takes a problem-focused in contrast to discipline-focused approach. The project began in fall of 2000 and has a planned duration of 4 years to coordinate with the decision timing and framework of the JPA. The Creek

Table 1. The three major components of the Creek Project.*Biophysical and Geographic Scientific Studies*

- Overland sediment transport flow/upper watershed
- Tidal-influenced lower watershed
- Land cover model
- Native/invasive species (steelhead trout/Chinese mitten crab)

Social Dynamics Studies

- Information Technology and decision-making
- Role of science in environmental resource management/consensus building
- Role of community values vs. science and economics
- Role of informal and formal community structures
- Economic policy/risk assessment

Communication and Learning

- GIS/web site development
- Teacher training and school curriculum
- Community education
- Game and simulation development to assist in stakeholder decision-making
- Communication about risk and uncertainty

Project consists of three major components derived from deliberations of the steering committee (Table 1). Owing to funding realities the amount of research allocated to each component will vary, and consequently, the project plan will be adaptive for the duration of the project.

A multidisciplinary team of scientists, educators, practitioners and theorists of consensus building and environmental negotiation, urban and land use planners, and local community leaders and decision-makers has been assembled to accomplish the project objectives. Each of the components above is linked through a series of feedback loops. The purpose of the project is more than just to help solve specific issues in the San Francisquito Creek watershed. An overarching goal of the entire team is to explore the role of science, scientists, and scientific analysis in negotiations regarding the management of environmental resources. As part of this goal, an educational component will focus on working with school groups to test, evaluate, and learn from communities' experiences with using science in collaborative processes to resolve environmental issues

A goal of the of the Biophysical and Geographic Science Studies component is development of a computer-based decision support system (DSS) that will be of use for long-term land use planning to communities in the San Francisquito Creek watershed. At the heart of an effective DSS are models that can show the probable range of outcomes of different policy options. The particular focus of the current effort is investigation of erosion and sediment transport processes within the headwater areas of the watershed, and development of a model linking changes in land use to changes in sediment supply. This is being done to help with decisions with respect to Total Maximum Daily Load compliance.

The Social Dynamics Studies focus on the character of human system/natural system interactions, and ways to educate the public about the interdependence of these systems, so that they will gain an appreciation for a holistic and sustainable approach to watershed management. The natural sciences, the social sciences, economics, and the humanities each play a role in INCLUDE. All these provide useful tools, including computer simulations and cost-benefit analysis. Maps are another effective way to communicate information, and so INCLUDE exercises will also use geographic information systems (GIS). Quantitative techniques like these can allow stakeholders to examine and evaluate resource allocation more effectively. Quality-of-life choices, however, also depend on non-quantifiable, even intangible, cultural and political values. Environmental philosophers and political scientists will therefore contribute as well.

The Communication and Learning component is designed to: 1) raise community awareness of environmental problems within the watershed and 2) actively engage the community in the decision-making process. Two different strategies are being pursued: bringing information to the community through eye-catching and information-rich interactive displays in public places, and involving school students in data collection, data analysis, and decision-making activities. The use of games and simulations is yet another educational tool (see e.g., Barrett 2000; Karl 2000). One of the most useful hypotheses INCLUDE has developed, although we have yet to test this, is that games and simulations can help to build public understanding of the multiple dimensions of complex public issues and thus public support for whatever choice is eventually made. They can also preview possible options for resolution that individuals may be reluctant to advocate in a charged political atmosphere.

Next Steps

The collaborative problem solving approach requires a new class of professional problem solvers who have a breadth of skills and who want to work with citizen groups to solve society's problems. These professionals will have to listen to citizens and incorporate local knowledge and wisdom into the project design and implementation. A discipline approach will continue to be necessary to make fundamental advances in a specific field and to answer specific questions (e.g. water quality). The new professional will have to be able to synthesize diverse and complex information to help identify the problem and then assemble the proper team of discipline experts and citizens to address the problem. The complicated scientific and technical data collected by discipline experts will have to be translated into forms that are

amenable to policy analysis and understandable to non-discipline experts. These data need to be communicated effectively and in a timely manner to contribute toward a decision. Synthesis, translation, and communication will be done at various levels, and will need to take into account complexity, risk, and uncertainty in a manner that lay stakeholders can understand and use. The problem solvers will not make decisions; they play an important role as scientific advisors in the negotiating process that helps resolve land use and environmental policy conflicts (see for example, Susskind 1994). This negotiation process should take place in a collaborative problem-solving framework to help achieve a mutual-gains solution to vexing issues (see for example, Susskind and Field 1996; Susskind et al. 1999).

The interdisciplinary approach and the new professional problem solver require institutional changes in government agencies and colleges and universities to be effective. Government agencies must be willing to empower citizens to work as partners to decide together land use and environmental policy. The Bureau of Land Management Partnership Series that teaches shared land stewardship between citizens and government is an existing example of this concept; it captures the essence of the citizen-centered approach toward sustainability. Institutions, such as USGS, must build the capacity to train and support the new class of professional. Colleges and universities must develop curricula to educate the future professionals in interdisciplinary approaches, and develop environmental research programs that integrate the natural and social sciences.

An ultimate goal of the Creek Project is to apply the models and approaches developed here to other watersheds across the nation that can serve as test cases to expand and refine the community-based interdisciplinary and collaborative-problem solving approach developed in the San Francisquito Creek watershed. It is by undertaking case studies in watersheds regionally and nationally that we can find ways to link people and science in a process of community-based decision making, and to foster decision making that is grounded in sound science.

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Using Spatial Decision Support Systems in Expert Workshops

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The Context

A McGill University team, working with environmental community groups, is conducting research on what sort of decision-making procedures lead to fairer, more efficient and more effective environmental choices. We believe there are two very promising, closely linked, avenues of research. One is to learn to make better use of existing information resources (both scientific and traditional). The other is to find ways to increase the potential for local environmental stewardship by making local participation in environmental decision-making (EDM) more effective. This brings "people most familiar with" and affected by local environmental problems into decision-making.

A central element in the work of the McGill University Project on Community Based Environmental Decision Support (CBED) is the "marginalization/empowerment" debate (Craig et al. In press) about information technology: does new technology assist in making public participation more effective or does it merely create a barrier that shelters technocrats and causes non-specialists to be excluded from decision-making processes?

One tool developed by CBED to explore these questions is Consensus Mapper. This a Geographic Information System (GIS) that allows collaborative exploration of spatial data, discussion of decision priorities, and mapping of environmental values or concerns. The Consensus Mapper is used in a *Round Table* meeting. The meetings permit stakeholders to participate in an open discussion about spatial understandings or priorities, but also to have independent means of expressing their own views. This allows groups with shared interests to clarify their common understandings and groups with divergent interests to clarify points of disagreement and perhaps work toward compromise. Round tables are about person-to-person communication of ideas; networked computers with an interactive GIS are intended to support this communication, but only as and when it is appropriate to facilitate inclusive communication and clarity in spatial decisions. This requires that the GIS be transparent to the users, not an obstacle or a force that dominates proceedings. This, in turn, requires strong technical support and open and adaptive facilitation.

This paper describes the use of this system in an expert workshop on defining North American priorities for biodiversity conservation. The workshop was sponsored by the Commission for Environmental Conservation (CEC), which is a creation of the North American Free Trade Agreement, and is intended to oversee continental scale environmental protection issues. Canada, the US and Mexico represent "frontline" questions in the global environment/sustainable development dialogue, and biodiversity protection is, amongst all environmental issues, perhaps the most irreversible, and the one with the strongest social dimension. For these reasons, researchers at CBED were anxious to engage with the CEC to explore questions of information management in North American biodiversity conservation decision making. A strong and clear consensus would support policy development and priority setting at the CEC. The CEC's interest was therefore in achieving a specific end "product" (a consensus statement on priority area) within a two day workshop, CBED's interest was in exploring the methodology in a time-constrained, "product-driven" setting.

The Program of Action

The proposal put forward by the CEC (discussed in Meredith 2000) was to bring experts in various fields of biodiversity conservation from the three different countries of NAFTA together for a two day consultation. While this is not "community-based" in the sense that CBED conventionally adopts, the CEC opportunity provided a unique opportunity for experimenting with methodology: the stakeholder group was clearly defined (academics, the non-governmental community and government representatives), the array of interests was diverse, the specific objectives were precisely stated and understood by all, the time frame was clearly bounded and, since all of the participants were professionals, we did not have to be as cautious about reticence as we would have been dealing with lay participants in a community-based EDM situation.

Three questions were identified that structured the workshop and allowed both objectives to be met:

- 1) From your experience, outline the top 10 *regions of high ecological priority* in North America (comparable to level 2 Ecoregion in scale).

- 2) From your experience, outline the top 10 *regions of high actual & potential threat to biodiversity* in North America (comparable to level 2 Ecoregion in scale).
- 3) From your experience, outline the top 10 *regions that offer actual & potential opportunities for biodiversity conservation* in North America (comparable to level 2 Ecoregion in scale).

The intent was not to provide new data to workshop participants that would inform them about how to identify or select regions. Rather we were attempting to solicit, sort and record local or traditional knowledge and value. The procedure was intended to:

- 1) allow experts with prior opinions to interact with one another
- 2) solicit a range of opinions and perhaps reach consensus on criteria to be used making priority designations
- 3) solicit a range of opinions and perhaps reach consensus on priority regions
- 4) derive both textual and spatial information supporting these opinions
- 5) verify the effectiveness of the decision support mechanism used.

Six laptop Pentium III computers were used, each with at least 32MB RAM, and each linked in a local network to a server. The speed of the computers was considered to be important so that processing time would not become a frustration if large or complex data bases were used. Each of the computers had an external mouse to facilitate drawing and a 17" monitor to improve visibility and allow groups to work together. The server was connected to a data projector capable of showing an image 1.5 X 2 m (approx.) that could be viewed by everyone in the room. In addition, each work station had a stand-alone word processing computer with Word and WordPad. These computers had been pre-loaded with forms that were available to structure group responses to specific events in the meeting. The forms were intended to simplify information entry and users understood that their use was not required.

The laptops were each loaded with a simple GIS, called Consensus Mapper, that was engineered by George Dias using ESRI Map Objects. The GIS was designed for non-GIS users and, consequently, had a simple yet robust design that allowed zooming on and panning over a base map, display of various map layers, the drawing and editing of polygons, the calculation of polygon areas, and the submission of finished maps, as Shape files, to the server.

The server ran ArcView III. The operator would receive the Shape files from the six workstations and overlay them to produce a map that reflected the degree of overlap of polygons. Results were scored with integer values indicating the number of overlapping polygons (hence, ranging from 0 to 6).

Participants were shown slides that repeated the questions (shown above) and added:

The answers should reflect your global knowledge of biodiversity, including, but not limited to, your own field of expertise. They should be reflected in mapped units "at the scale of level 2 ecoregions" (polygons should not be bigger than 500,000 km).

The process: Clear and sound ideas are the ends, group discussion is the means and maps and computers are the aids. The process should balance free and open discussion of ideas with the need to capture and record some of those ideas.

The entire group was divided into groups of three or four people (by theme/area of expertise, country or a combination of both, depending on the question being asked). These sub-groups worked together, either in a break-out room or in the main conference room, to respond to each of the questions.

Each of these questions was discussed in plenary first so that the meaning and intention of the questions, and distinctions between the questions, were clear. For each question, groups were asked first to discuss the criteria that they would use to establish each of these maps and then to select — by tracing on a base map — the areas they propose. We requested that participants specify up to ten areas, approximately "at the scale of the Level 2 Ecoregions," (which were shown on the bases map over which the polygons would be drawn) such that no more than 20% of the continent be covered. Each set of polygons was considered a data layer that captured the sub-group's priorities. Areas inside polygons were given a value of 1, while areas outside the region were given a value of 0. These maps were submitted to the server and the operator produced the overlay map which was, first, projected on the main screen so that all could see it, consider it, correct errors and comment on their own or other contributions. They were also invited at this time to add comments on the word processors.

The overlay map was then returned to each of the workstations and groups were asked to "change hats" and assume that they have been assigned the task of editing this map for final site designation. They then redrew polygons — with the same constraint on scale, number and total area — to produce what they envisioned as a final map.

The second iteration maps were resubmitted and the same overlay procedure was conducted. This procedure was repeated for each of the three questions and then a final overlay, showing all three sets of polygons, was produced and projected. This map was used for a discussion on priority areas for CEC action.

Participants were asked to comment on procedure for-

mally or informally during the meeting and, at the end, to complete a formal procedural evaluation. The results were intended to reveal both the extent to which technical or procedural barriers might have impeded (and hence distorted) group output and the degree to which participants thought that the process captured the “sense” of the group. Some of the results are discussed below.

The Experiences

From the standpoint of the CEC, the exercise was successful: it was possible to define priority areas based on the expert opinion attending the workshop. While this outcome might have been achievable without the Consensus Mapper format, the procedure ensured that each participant had the opportunity to discuss, reflect and contribute; it provided a record of the sequence of discussions leading to the nominated sites; and it provided a very clear perspective on areas of disagreement and barriers to precision in reaching consensus. The resultant priority areas are noted in Meredith et al. (2000) and include transboundary habitats such as, Baja to Bering, Yellowstone to Yukon, Yucatan to the Florida Keys and the Greater Gulf of Maine. There were several procedural lessons that emerged from the exercise. These are discussed below.

Decisions on Meeting Format and Participants

The procedure could be conducted over a web-based system with a very wide (essentially unlimited) list of participants. The Consensus Mapper Round Table format encourages dialogue and requires people to meet face-to-face. This limits possible participation and can thereby skew meeting outcome. Despite the expense of moving people, it was determined that a face-to-face meeting was required in this case because of the complexity of the issues involved, the differences in political settings, the differences in disciplinary and sectoral perspectives, and likely variation in selection criteria. Care had to be taken in building the participant base. We agreed to these criteria:

- national representation (ensuring that the three countries were effectively represented)
- sectoral representation (ensuring that government, ENGO and scientific interests were reflected)
- systematic representation (ensuring that expert views on conservation priorities for a broad array of taxa were included)

The outcome of the meeting is a partial function of these choices, and so in reporting results, the participation criteria and list must be included. In a community-based situation, if the results are to have credibility and wide acceptance, the selection of the criteria, participants and the format of the meeting must be itself a part of the process.

Advance Preparation

There are trade-offs associated with asking participants to prepare for the meeting in one way or another. At one extreme is the risk that no prior preparation will lead to too much of the limited meeting time being spent clarifying the goals and procedures, but at the other extreme is the risk that too much time spent in preparation will lead to marked differences in the preparedness of participants with the possibility that some might develop strategies to advance specific outcomes. In this case, we decided to create a web-based list-serve that would connect all invited participants, make general requests for “recommended” datasets or information, and provide participants with the opportunity to make comments regarding the procedure or to distribute information. This did not work as well as we had hoped for two major reasons: first, electronic communication facilities are still far from seamless, so that some of what was posted was not available to everybody; second, people had different amounts of time, inclination and/or opportunity for accessing and reflecting on the information. We concluded that the degree of uniformity in preparedness would be inversely proportional to the complexity of the preparation material provided. The temptation to try to maximize productivity at a meeting by setting steep pre-meeting expectations can be counterproductive: material will need to be repeated meaning that some participants are bored while others are getting hasty (and perhaps unclear) summaries of essential preparatory material; some participants may have clearly defined prior strategies, while others may only be turning their attention to the issues of the meeting.

Data Availability

We distinguished two basic approaches to collaborative decision-making exercises: “information driven” (seeking individual response to a fixed information set) and “actor driven” (capturing opinions based on prior knowledge and/or access to distinct information sets of participants). This determines the approach taken to providing information during consultation. We adopted the latter approach and presented only orientation data (Level 2 Ecoregions Map of North America with overlays of political boundaries to state/province level, water bodies and watersheds, major roads and principal cities). Participants were asked to bring their personal expert knowledge to bear on prioritizing conservation areas for the CEC based on the CEC’s unique continental mandate. This worked well (taking note of point one, above), but it was clear that those who had well-presented data (for example, published thematic maps) were much better able to influence the direction of discussion than were those with what might have been better scientific insight but less impressive documentation. Providing reference material does not overcome this bias unless long periods are available for

perusal. In this case, all the participants were professionals and were alert to the problems of data access and presentation; if a broader array of stakeholders were involved, these differences could be very significant and facilitators would have to try to minimize the resulting bias.

Flexibility of Agenda Vs. Product Delivery

A strict agenda, requiring lock-step movement through previously determined activities, can limit discussion and frustrate participants. On the other hand, very specific objectives require some degree of closure. In this case, we decided to begin with a clear, sequential, agenda but to be flexible enough to promote any particularly rich interchanges that evolved. This inevitably leads to awkward, on-the-fly judgments by a chair or facilitator and these judgments can influence the outcome of the process. For example, in plenary, questions arose about procedure. The intent was that within subgroups people could comment at will (so that all voices could be heard), but that heated dialogues (or monologues) that appeared not to hold the interest of the majority in plenary should be contained. What was lost by limiting these interventions cannot be known. However, in cases where productive and inclusive discussions in plenary indicated that rigid adherence to the proposed agenda would lead to a loss of information (or of goodwill), we did change the agenda. The ability to find and adopt alternative routes to the specified end-point is sometimes essential. Rigidity will alienate participants and undermine the principle of participation, but a lack of structure may simply lead to a progressive blurring of focus as the clock runs out (potentially a strategy for stakeholders whose interests are served by indecision).

Technology Support

We configured the room with six computer pairs: each was comprised of one networked GIS computer and one stand alone word processor. Participants were reminded at several points that the computer technology was not intended to drive the agenda but rather to serve as convenient and accessible tools for gathering information. However, we did want people to leave a "paper trail" of map evolution and comments. There is a learning curve for any procedure, and a cost in time required for people to break the conventional pattern of discussion and make notes on a computer. We began with one support person per group. The support person performed three tasks: one was to ensure that all the equipment worked and that its use was easy for participants; the second was to encourage or remind people that salient ideas should be recorded; the final was to watch the clock and attempt to ensure that maps and comments were available for the plenary. The importance of the support person diminished as

participants acclimatized to the procedure. It was clear that a heavy investment in support at the beginning yielded benefits that enriched the entire process. This was a key element in making the technological aspect of the workshop successful.

Mapping, Precision and Accuracy

As noted, questions arose with respect to recording responses: should respondents give a binary response (priority=1, non-priority=0), an ordinal response (high=3, mid=2 ... etc.), or a ranked response (10 = most, 9=next ... etc.)? The approach taken affects both the mechanics of the meeting, and the clarity and precision of the result. We selected a simple binary system and placed an arbitrary upper limit on total number of sites and total area to be selected. Some of the participants felt that this limited the accuracy of the results they could give, although all recognized that some steps need to be taken to harmonize inputs from the different groups. At the stage of the merging maps in plenary sessions, the question of precision arose: areas of overlap were recognized as accurately reflecting core areas of concern, but any attempt to make boundaries precise led to disagreements that often reverted to the underlying assumptions (e.g. should areas be homogeneous or eclectic, should boundaries be administrative or natural). Any precise lines would have been somewhat arbitrary and controversial, general areas lacked precision but accurately reflected the group position. Depending on goals, the relative ease of getting accuracy probably makes it a more efficient objective than precision.

Opinion Leaders

It was our intent to monitor each of the above issues. Two "lessons" emerged spontaneously from the event. The first was the extent to which the success of the workshop depended on the goodwill of the participants which, in turn, depended in part of the signals from opinion leaders within the group. The rigors of a full agenda, a novel and somewhat complex procedure, and an overall goal to which not all participants necessarily subscribed fully could derail a procedure. If this is confounded with any physical discomfort (meeting rooms that are less than comfortable, missed meals, residual effects of travel) the potential for a lost meeting is increased. It was evident at this meeting that "participating in the spirit of the invitation" (i.e. agreeing to work hard over two full days to cover a lot of material and reach an end-point that would meet the needs of the organizer) was partly dependent on a small group of participants who remained very "upbeat" even when other participants voiced frustration. While it was not done at this meeting, organizers might consider prior requests to some participants to "lead from within" if potentially crippling attitude shifts appear to be emerging.

Follow-Up

The most surprising procedural finding was the follow-up e-mail exchange. As noted in point 2, above, it was difficult to get busy people to invest preparatory time in a meeting whose significance they might not have grasped or supported fully. In light of that, our intention was to be sure to terminate the process at the actual meeting; that is, we would not make the outcome of the meeting contingent on anything that participants had to do after the meeting ended (like sending in summary sheets). Nonetheless, we agreed to post preliminary results by e-mail. The draft press release and the accompanying draft map produced almost two months of intense, analytic and constructive e-mail. Although, of course, participants were self-selecting, the amount of thought and reason that went into the follow-up e-mail suggested that once people have subscribed to a process and an objective, despite being busy, they are willing and able to continue to contribute. This may not be easy or even possible to orchestrate in any given case, but the possibility of “run-on” benefits should not be foreclosed. It may be that the period of reflection after the meeting, and the requirement of ordering thoughts that written e-mail imposes, create conditions for some of the most insightful contributions.

Next Steps

One goal of CBED is to have a simple computer-based spatial decision support system that can be deployed quickly and reliably in any community where collaborative EDM is necessary. The opportunity to work in a situation where tri-

national experts were meeting over a limited time period with agreed objectives allowed us to experiment with almost a SWAT team approach to Consensus Mapper. The experience of using high-technology tools to get “community” involvement is in marked contrast to the example in the next paper. But the lessons learned are valuable and will help make the application of the tool in less well-structured circumstances much more effective. A solution, for example, might be to invite stakeholders who are engaged in a complex real-world situation where conflicts are deep rooted and rates of progress are expected to be slow, to treat participation in a short term Consensus Mapper exercise as a “game” designed to clarify issues and pinpoint areas for further research. Under those circumstances, stakeholders may be willing to commit, in good faith, to an exercise that would build understanding and perhaps an agenda for further action. Under such circumstances, the cost of procedural failure of the workshop would be high. By drawing on the lessons learned in the CEC exercise, the probability of succeeding with the workshop is higher.

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Cross Cultural Participation in Sustainable Development: Canadian Academic Involvement with Mexican ENGOS

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In sustainable development, everyone is a user and provider of information considered in the broad sense. That includes data, information, appropriately packaged experience and knowledge. The need for information arises at all levels, from that of senior decision makers at the national and international levels to the grass-roots and individual levels. The following two programme areas need to be implemented to ensure that decisions are based increasingly on sound information: (a) Bridging the data gap; (b) Improving information availability.

(UNCED 1992, 40)

The Context

Since the Brundtland Commission reported (World Commission on Environment and Development 1987), there has been wide acceptance of their view; that is, the view that the world's environmental problems are inextricably linked across national borders and across the intangible divide between the affluent, high-consumption, industrial "North" and the materially poorer, low-consumption, largely agrarian "South". The assumption was that, once this interdependency had been identified, significant efforts would go into addressing common solutions.

There are barriers to moving in this direction, not the least of which is the simple fact that the North may not yet be politically mature enough to take the actions that a reasonable diagnosis of global environmental problems dictates. The recent volleys into the side of the Kyoto Accord demonstrate the challenges of mobilizing those comfortably isolated (physically and mentally) from the real challenges of acting on CO₂ emissions. Other barriers include the cost and complexity of action. But perhaps the most telling barrier is the simple fact that, even when the political will, economic resources, and scientific insight are there, we still do not know how to accomplish the environmental goals that we set. It is a new area of human experience and we still need to develop tools for action.

One approach is to examine questions of democracy and participation and the close correlates of access to and use of information. Agenda 21 notes that conventional definitions of information may be inadequate and advocates initiatives to

enhance the distribution of relevant information. This paper describes an initiative undertaken under this rubric.

A Partnership

The premise of the work is that for any environmental problem (in which humans play a significant role), there are two critically important data sets: one is the best that science has to offer on the issue, the second is the best that the humans involved in the problem have to offer. The value of the scientific information rarely needs to be justified. The value of the local information is important for many reasons ranging from its inherent accuracy to the fact that it describes the perception of the local human communities and is therefore a part of the human ecology of those communities. Understanding local perception is necessary for any effective action.

These two sets of information imply a partnership; that is, a collaboration between the holders of complementary information sets. Of course, it is not unusual for scientists to work amongst non-scientists, and so there is a legacy of interaction. But these interactions, by and large, have been either exploitative (the research community is simply extracting information from or about the local community) or patronizing (the research community is actually there to disseminate rather than gather information). The reality of partnerships is new and still awkward. It must provide for the truth that "everyone is a user and provider of information" and make sure that the flows of information are at least two-way. How, given different cultural backgrounds and unequal power relationships, can representatives of two groups learn from each other?

The information technology revolution has many profound implications. Spatial decision-support (SDS), including remote sensing, GIS and data management capabilities, has radically altered EDM. Access to the tools of SDS has affected, and will continue to affect, the capacity of different stakeholder groups to influence the outcome of environmental decisions. Establishing equity may require a more uniform access to these tools, but the problem of inter-cultural technology transfer arises. The essence of this problem is the question of the extent to which the "medium is the message." Is it possible to engage people in using SDS without requir-

ing that their procedures of analysis and their data needs conform to the SDS system? If not, then the new tools, rather than being tools of protection or of liberation, become tools of assimilation, and the naive (or indifferent) actors who strive to “modernize” local community participation in EDM may merely be new and slightly more subtle techno-evangelists.

The Program of Action

This project was initiated by Northern academics who had a strong commitment to the idea of community participation in EDM. The intent at the initiation of the project was to find a situation where a community group would be interested in forming a partnership to explore information technology, both to gain access to useful, outside sources of local environmental information and to present their own local information in a more compelling way. A decision was taken not to seek a community already engaged in some local environmental “crisis.” There were two reasons for this: the first was that in crisis situations conflict lines are generally clearly drawn and positions have already been defined. We wanted a situation where people were open-minded and prepared to explore options. The second reason was the belief that communities in crisis are communities at a point in planning and environmental management that should ideally be avoidable if effective stewardship mechanisms exist at the community level. Our interest was in helping to reinforce stewardship mechanisms before crisis arose. Communities where conflicts have arisen represent important areas for remedial action; communities where conflicts have not yet arisen, the vast majority of communities, represent the areas for the development of — to use a medical analogy — “preventative” or health preserving strategies.

We attempted to forge a genuine partnership between Northern researchers and members of a Mexican rural community in a mountain forest area about 20 km. south of the edge of Mexico City (Meredith 1997a). We assumed that “genuine” would require at least two things: that we not come with a prior agenda and that we not hijack the interaction by imposing arbitrary timelines. This is some of what we have learned about procedures so far.

The Experiences

Intermediary group

In attempting to define an appropriate community partner, it was necessary to enlist the support of people who were aware of the local setting. We contacted GEMA, a group with a record of popular environmental education at the grassroots community level. The interest of GEMA in our project was

very muted, for three reasons at least. The first was the simple clash of the academic and NGO cultures. Academics are seen to be driven by research agendas and institutional structures, while NGO members are action and results oriented. There was little expectation that the research agenda and the pragmatic local agenda would be compatible. The second reason was an issue of marginalization and empowerment. Experience had demonstrated to the GEMA executive two things: the first, that outside researchers tended to want to dominate planning and decision-making processes and could be patronizing in their dealings with local people; the second, that even if a partnership led to useful end products, it is possible that the products would not be sustainable in the local environment (for reasons such as cost, technical complexity, or equipment dependency). The last reason for hesitancy was researchers’ record of desertion. The feeling was that researchers often “mine” a situation for results and then leave without delivering on any of the implicit expectations and often without returning any of the results to the community from which they were generated.

These concerns were very clearly and forcefully expressed. It demonstrated the importance of having some “gatekeeper” advisors at the local level (and the sad legacy of academic research). Our commitment to the idea of partnership made it easy to understand these concerns and possible, after considerable discussion, to arrange a working structure that would prevent some of what was feared. The solution was to relinquish control of decision-making within the project to a group that included GEMA, the community members and the researchers. The consequences of this are evident in the following points.

Local self-administered “diagnostico”

Defining the questions we would investigate was the first step in our process. The area we selected is a forested area that is conspicuously affected by various outside forces ranging from road development and land value increases to the imposition of a set of restrictive conservation measures. We expected forest issues to be paramount locally. They were not. In approaching the community, the implication was that outside researchers would help locals to study and perhaps solve some of their local environmental concerns. Of course, it was vital that we listened to, rather than told about, what those concerns were. The process used was a locally designed and administered survey. This had several beneficial consequences: it got local people interested and involved at the initial stage of the process; it generated a picture of the local environment as seen through residents’ eyes; and it ensured that the work done by the outside partners was relevant, and seen to be relevant, to local concerns.

Use tools of popular education coupled with tools of science

Scientific information is powerful, and the tools of communication that are commonplace in the research environment are effective. Yet, they are appropriate to a narrow set of communication circumstances. The discipline of popular education has developed an array of tools that are effective in many other circumstances, and it is important to draw on these skills when attempting to reach community members who may vary considerably in age, interest, experience and literacy levels. Communication tools that are alien to academic researchers, such as role playing, educational games and skits, are extremely effective in allowing people to express themselves and to make points about environmental information. The procedures can seem slow, and their information content per unit time low relative to, say, an academic lecture. But the skill of the popular education specialist is to know what breadth, depth and mode of delivery is appropriate. These are sophisticated skills that should be recognized as a required complement to the specialist skills of academic researchers working in communities.

Allow open agenda (where process, not outcome, is the objective)

Conventionally actions are undertaken with specific goals in mind, and an effective strategy for moving toward those goals is to have a well-structured agenda. This is contrary to the principle of participatory community-based environmental research. If the goal is to allow community members to express their own perception of their environment and to establish a firm sense of ownership of the decision-making process, then an agenda must be created by the consultative process and it must be infinitely adaptable as the activities proceed and as knowledge, perception and expectation of participants change.

A commitment to an open agenda does not mean that a researcher must give up all control. The researcher is still a part of the process and can still expect to be able to make contributions that will influence what priorities are established. It may be that period of trust-building and/or finding a common vocabulary are required before the community and the researcher can reach agreement on agenda priorities. In this Mexican case, the site was originally selected because of what appeared to the researchers to be serious forest management issues. This topic did not come out in the initial diagnosis and so the partnership had to address the topics that were cited as being of concern (water quality and waste management). It turned out that forests issues actually are important but it took several months of discussion before they were identified. The reasons for this are varied: a perception of what constituted an "environmental problem" conditioned

somewhat by mass media taking a global or regional perspective (dealing with Mexico City) rather than a local perspective; a question of trust on issues that are vitally important and somewhat divisive locally; a matter of perceiving something as omnipresent as the forest as a distinct environmental asset; even a matter of who had become involved in the environmental discussions (see point 5, below).

Demonstration of dynamism in the procedural aspects of the partnership makes it clear that new ideas are welcomed and new inputs can be significant in determining the direction of the overall process. Thus, the openness in the agenda becomes a tool that encourages contributions and participation. Any process that builds conscientious involvement is a positive step. A partnership with an open agenda can contribute to that.

Recognize unequal promotion of idea

As noted above, a voluntary community-based process will initially recruit a sector of the population that may not reflect the array of perspectives and concerns in the community. If it does not, a problem arises because, clearly, everybody in the community has an integrated perception of his or her environment and each of those individuals has a stake in the future and may have unique knowledge of the factors that will shape that future. Each voice could be important but, clearly, not everyone will be as willing or able to become involved in a planning process and, of those who do, not everyone will be equally vocal, assertive, compelling or tenacious.

The question arises of who actually becomes involved in voluntary "community-based" discussions and how representative they might be of the entire community. Clearly there will be some self selection of people who are already concerned about or active on some issue (in this case, water and waste), while there are others who may be too busy, physically less available (because they work in the forests), less open to the idea of community stewardship, or less willing to be forthcoming about their own activities (especially the case if the legality of some informal-sector activities is imprecisely defined).

This will affect the nature of the partnership program and direction in which activities move. If the process has been "hijacked" by the first arrivals or the most demanding, the partnership may merely create or reinforce divisions within the community and will accelerate fragmenting or destructive interactions within the community. Mechanisms must exist to allow non-dominant voices to be heard. Two methods were used to encourage this in this case. The first was frequent evaluation sessions, at which time the process rather than the content of the process was discussed. The second, and perhaps most important, was to have participants

available for informal discussion. For example, a person who may not have raised an issue in a public meeting (for any of a multitude of reasons) may seek an opportunity to raise it privately, for example in an informal discussion at a social function. If interactions occur only according to norms more-or-less rooted in Roberts Rules of Order, efficiency and predictability may be gained but at the expense of thoroughness and accuracy. Openness to ideas, however they come and whenever they come, will lead to a more complete picture of the issues and priorities. This is the objective of community-based environmental initiatives, and so the mechanisms for capturing ideas, regardless of the promotion skills or intentions of the originator, must be created and maintained.

Adapt information technology

This issue has been discussed at length in Meredith, Yetman and Frias (in press). Three items are important to note. The first is that the amount of data available for outside sources is often overwhelming and, despite efforts by many governments and researchers to ensure unrestricted access to data, the reality is that there are barriers to information flow (Meredith 1997b). What becomes accessible at a given location and time may be as much an accident of the effect of the barriers as it is of the real information needs. The expertise that is required to collect and convert existing data must not be overlooked nor must the fact what is collected and made available at any time may be partial, selective and distorting. For example, in this case a series of maps showing local deforestation was readily available. This was part of a series of national maps, so the scale was not sufficiently detailed for local work. Moreover, assumptions made in the national study masked certain local anomalies (for example, partly wooded pasture land that became more open was represented as deforested land despite the fact that the real transition had been minor; conversely, primary forests that had been cleared but which supported a scrub vegetation were not counted, even though the transition was large). The impact of "random" data needs to be noted just as it must also be noted that it is impossible to wait until all extant information has been collected and made accessible.

The second point is that information management technology, especially perhaps GIS, is inherently complex and requires expert training. The advancing front of new technology and methodology mean that if the "best available" procedures are desired, the dependency on esoteric expertise will increase. This is necessarily marginalizing, since those who community-based initiatives intend to include can become passively dependent on the "black-box" procedures used by the expert. There is no solution to this dilemma except to be aware of it and ensure that a reasonable balance is maintained between credible procedures and stakeholder involvement.

Sincere outreach can help make the start and endpoint of complex procedures clear.

The third point, arising from this, is that in fact, it does not matter if the goal of full local inclusion in decision-support procedures is reached. The process of exploring the procedure and examining the data and technology issues described above is a learning process that helps build inclusion and helps shape the agenda for action. No matter how far along in the learning process people come, if the exploration has helped make the overall process more effective then the exploration has been a valuable part of the process. It is not necessary to succeed in transferring information technology tools to the community; the exploration of the possibilities can be a good popular education tool.

Next Steps

There is a marked contrast between this case and the previous one. Here a real community is involved with real environmental conflicts. Moreover, the community mode of communication and data/information management is distinct from that used in scientific or policy research. The principal finding from this exercise is the organic nature of the growth of real partnerships. Without the intervention of the popular education specialists, the temptation might have been to arrive with the "beads and trinkets" of high-technology decision-support and to proceed to projecting both problems and solutions on the local community. Research undertaken to advance a scientific agenda is not necessarily structured in a way that makes it compatible with the research agenda (implicit or explicit) that is required by a local community attempting to resolve issues in its local ecology.

The tools of data gathering, management and presentation used in science and policy making are becoming essential to effective participation in collaborative decision making. This means that community-based stakeholders will be disadvantaged in any case where they are engaged in collaborative decision-making (or even consultation) in which the outside community establishes the terms-of-reference. This provides a justification for working to make these tools ones of empowerment. But if the experts who control the tools hijack the agenda, local control is lost. The sort of cautious and open building of partnership described here is essential.

The fact that it takes time and risks to build partnerships does not work well within the "instant gratification"/ "short attention span" / "NIMTOO" / "results oriented" value structure of government, corporate or academic culture. This may represent the biggest single "mutual learning" opportunity that will come out working in genuine partnerships at the community level. Whatever academics may be able to teach about data management must be balanced by what we learn

about how human ecological systems evolve in dynamic environments. Acceptance of decisions must be based on participation in decision-making procedures. These increasingly require collaboration. The benefits of science and the information revolution have an undisputed role to play; but that role must articulate with the way communities really work. The challenge is not so much how to make data and information tools available, it is how to make them work in the interest of the community. This can only come from partnership, and, as Karl and Turner have noted above, real progress will require a new class of "problem solver" and significant institutional changes. But the process can begin with experimental partnerships amongst governments, academics, NGOs and communities, partnerships based on the principles of democracy and participation.

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We are the champions. Nothing can hurt us. Really?

A critique of Richard K. Ford's review of Herman Daly's *Ecological Economics and the Ecology of Economics* in *HER 7* (2): 75-76, 2000.

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Nature is Real

Imagine a world in which there are no humans and in which there is great unrest among the large carnivores. They are tired of their welfare being dependent on the population size of the animals they prey upon, which tends to fluctuate for reasons beyond their control. So they get together and decide to develop innovative techniques which guarantee greatly improved efficiency in locating and hunting food resources, particularly in times of scarcity. This becomes a highly successful project; the carnivores steadily increase their numbers and also, because of the greater availability of food per capita, they become fatter. Life is good. And then their prey begins to dwindle in number, and food procurement failures mount because the predators have become grossly overweight. When life takes a turn for the worse, the carnivores become aware of the fact that there are too many of them and their standard of living is too high. But it is too late, as they have become locked into their new habits and are unable to return to a simpler way of life. There are only two options left: either become extinct or start devouring each other.

This gruesome tale is nonsense, of course, as nature does not work this way. But humans, apparently because their behavioral potential is sufficiently detached from natural constraints, seem to believe that a scenario such as the one described here can be attained without the final consequences similar to the fate suffered by the imaginary foolish predators. Herman Daly (1999), in his *Ecological Economics and the Ecology of Economics*, points out that this is a belief in the impossible, that we are indeed headed for disaster if we continue to let our economic system be guided by standard neoclassical thinking and thereby ravage the planet. Richard K. Ford (2000), in a most distressing review of this book, remains untroubled by this. He ridicules Daly's warnings by saying that all through history fortune-tellers and entrail-readers have always claimed that doom is just around the corner. Consequently — this is Ford's amazing logic — nothing can or will happen to us now. True, prophets throughout our

cultural history may not have been very successful in forecasting troublesome events. Under present circumstances, however, we are discussing conclusions drawn from scientific analyses. Consider just two examples that illustrate the severity of our current predicament:

(a) In *Beyond Growth*, Daly (1996, 57) quotes a 1986 study according to which 25% of the global potential net primary production (NPP) is being appropriated by human beings. NPP is "the amount of solar energy captured in photosynthesis by primary producers, less the energy used in their own growth and reproduction." Obviously just two more doublings of the scale of human consumption would bring the percentage up to 100!

(b) Mathis Wackernagel and William Rees (1995, 15), in their book, *Our Ecological Footprint*, convert the human use of resources to land area needed to sustain that level of consumption. They conclude that, if everybody on this globe aspires to the American way of life, we will need two additional earth-type planets for our life-support. "Unfortunately, good planets are hard to find ..." they add.

Are these findings a cause for alarm? Ford, simply ignoring what other disciplines have to say about the present state of the world, does not think so. He detests ground truth and prefers to fly high in the sky of his economic theory. This is reminiscent of John Dryzek's (1987, ix) Titanic metaphor in his *Rational Ecology* (p. ix): "Many ecologists are aware of icebergs in the vicinity, and seek to convince us that the ship of state chart a course to avoid them. Most economists would be more concerned with ensuring a utility-maximizing arrangement of deckchairs. ..." By the way, regardless of the relative success or failure rate of fortune-tellers, there is compelling evidence for previous falls of civilizations due to environmental problems. Karl Butzer (1980), for example, sees such problems as a decisive factor in various periods of decline during the time of the ancient Egyptian empires. So what we are facing is nothing new. What is different about our present situation, however, is that the problems we are confronted with are not just local or regional, but global in scope and therefore all the more dangerous.

Ford recommends that Daly's book be put on "people's secondary reading list as an example of how intelligent and otherwise well-informed, educated people miss the point." True, *Ecological Economics and the Ecology of Economics* is not Daly's best book, but not because it misses any points, but because it consists of a collection of critical responses to other authors mostly published earlier elsewhere. Consequently, it does not have the coherence of a textbook; nevertheless most major aspects of Daly's concept of ecological economics can still be found in this book. In what follows I will briefly describe some of the salient points of the book, not following Daly's exposition slavishly, but indicating, with

the figures in parentheses after the subtitles, the pages in the book where the author discusses the topic in question. The reader interested in a more systematic presentation of the idea of ecological economics is encouraged to read Daly's excellent earlier book, *Beyond Growth* (1996).

Daly Dissects the Wondrous World of Economics ...

1. The missing optimal scale of the economic system (8-12, 47-55, 62, 89). The scale at which the economic system operates can be described as the simple product of population size times the per capita consumption of resources. Obviously, the size of the impact on the environment thus generated determines whether or not the level in question is sustainable, i.e., whether or not it could be maintained without problems for an indefinite period of time. Now, much of the thinking in microeconomics is dedicated to the question of optimal scales of activities. It is shown that an optimum exists when the marginal costs of producing one more unit (supposed to be increasing with an expansion of the production) are equal to the marginal benefit arising from the same additional unit (supposed to be declining with an expansion of the production). If the activity in question were to grow beyond this level, it would be simply uneconomical. Daly wonders why there is no corresponding macroeconomic concept, i.e., for the economy as a whole. In the gross national product (GNP) everything gets lumped together. For example, expenditures for environmental cleanup operations needed in the wake of polluting activities are treated as a benefit, and not as a cost. Or the export of natural capital, for example, of wood out of clear-cut operations in tropical rain forests, is counted as income despite the depletion of the stock that goes with it. Daly therefore suggests that we should use a cost-benefit type of accounting also at the macroeconomic level, meaning that we should determine the point at which the marginal cost of natural capital reduction is equal to the marginal benefit of man-made capital increase.

2. The economic system as a *perpetuum mobile* (9-16). How is it possible that, at the macroeconomic level, the question of an optimal scale or, alternatively, the question of uneconomic growth, is ignored in mainstream economics? This is because nature in economic theory either (1) does not exist at all, or (2) is thought to be infinitely rich so that any dents made by human activities are negligible, or (3) is regarded as a sector of the economic system just like any other sector. Daly illustrates Case 1) using the famous diagram appearing in standard economic textbooks in which there is a closed circle of flows connecting producing firms and consuming households. The economy is pictured as a system totally isolated from the rest of the world, i.e., with-

out any inputs from or outputs to an environment. This is, in Daly's words, the biological version of the idea of a *perpetuum mobile*. In Case 2) the human economic system is, in accordance with reality, correctly seen as a subsystem within a larger ecosystem, yet the acknowledgment of this fact is elegantly avoided by simply assuming that surrounding nature is practically infinite and that, consequently, any damage done by human activities to its life-supporting services are negligible. Daly compares this with the belief that, with respect to the size of human impact on nature, our world is still practically empty, that we still live in the Stone Age, so to speak. In fact, of course, we live today in a very full world — remember the extent of the human NPP appropriation mentioned above! In Case 3) the world is simply stood on its head. Instead of the economy being a subsystem of nature, nature is a subsystem of the economy! It is a sector from which resources can be imported and to which waste products can be exported, both without limits. There is no concern for what happens in this sector in ecological terms. In fact, it looks as if nature needed the human waste in order to be able to produce resources.

3. The hocus-pocus production function (17-20, 48, 77-83, 90-94). As Daly argues, the way one sees the relationship between economy and environment is a matter of what he calls one's preanalytic vision — we could also say one's worldview. Today we need a worldview that acknowledges the fact that humankind with all its activities is just one part of an entire ecosystem, and that this part has reached a size such that we find ourselves in an already full world. This view of the situation is crucial to our survival because otherwise any talk about sustainable development becomes totally meaningless. Nevertheless, the worldview that regards nature to be a negligible quantity is clearly a dominant one and finds its expression also in the definition of economic production functions. As we recall, such a function describes the economic output as depending on a number of production factors. In many instances the only factors considered are (human-made) capital and labor, as if the economy, in material and energetic terms, were capable of producing everything out of nothing. Daly likens this to the belief that we can make a cake without flour, eggs, sugar, etc. and bake it in an oven that does not need to be heated! A prominent long-time advocate of this miraculous kind of production function was Robert M. Solow, a Nobel prize recipient. Later, he actually added natural resources as a factor, but, as the function had a form suggesting that all factors could be substitutes for each other, it did not really solve any problems. In particular, as Daly argues, human-made capital cannot, in principle, be a substitute for natural capital. If a fish population dwindles we certainly cannot rectify the situation by simply using more fishing boats! (Well, for a while we can, of course, but in so

doing we will not contribute to a positive solution of the problem. Instead we put ourselves into the role of the carnivores in our opening fictional story.) Natural and human-made resources are complements rather than substitutes, i.e., if we want more (less) of the one we also need more (less) of the other. In place of such production functions Daly recommends the use of what Nicholas Georgescu-Roegen called the fund-flow model. Much closer to reality, this model shows that production is in fact a transformation of natural resources into useful products and waste. Remembering Aristotle's system of *causae*, we can now say that the resources constitute the *causa materialis* while labor and capital play the part of the *causa efficiens*. Looking at the situation in this fashion it becomes readily apparent that it is not possible to substitute efficient for material causes.

4. The primacy of the economy over the ecology (34-39). Not surprisingly, if nature is not or hardly reckoned with in economic theory, then to the extent that practice follows theory economic activities will cause environmental damages that do not appear as costs within the accounting schemes of those activities. As we know, this phenomenon is discussed in economics under the heading of "external effects". The problem has been recognized, if not really in terms of environmental damages, then in terms of undesirable social effects (polluted air, for example, causes respiratory diseases). To remedy the situation such external effects must be internalized, i.e., become part of the bill we have to pay for carrying out the problem-causing activity in question. Daly reviews the two now classical approaches to internalization: (a) The charging of a tax according to the polluter-pays principle (according to an idea first proposed by Arthur Cecil Pigou), and (b) the redefinition of property rights such that in a conflict between private citizens, external effects will become part of the ensuing problem-solving negotiation (first proposed by Ronald Coase). Both principles, however, pose difficulties: How do we measure the monetary value of external effects, and who will be in a position to define property rights? This is typical for environmental economics, which tries to extend economic thinking to the environment and by so doing reveals itself as simply treating nature as a sector of the economic system — true to the-world-on-its-head vision mentioned earlier. Still, at least it is acknowledged that this sector is not simply a free source of resources and a free sink for waste, but that something negative may happen in it so that the ensuing costs must become part of our bookkeeping. Daly, of course, favors a different approach, one inspired by ecological economics. The type of thinking that goes with it does not like headstands and, consequently, tries to put everything upright again. This means the primacy of the environment over the economy: First, we define a regional or national limit for human activities in biophysical terms, for exam-

ple, tons of carbon dioxide emitted, and second, within this limit, we let the market distribute emission rights in the form of tradeable permits. As we can see, the issue of such a limit refers back to the question of optimal scale discussed above. In determining marginal costs it may not be possible to come up with reliable or meaningful monetary estimates of the value of depleted natural capital, for example. Biophysical limits, on the other hand, can be derived from the results of scientific sustainability research.

5. Globalization through boundless free trade (22, 43-44, 66-67, 119-125, 128-131). Neoclassical economics admires the idea of a totally unfettered competition within a globalized economic world system. Following the principle of comparative advantage, it is argued that everything will be produced in the country where it is most efficient to be produced. And such efficiency will also result in a minimization of the strain on the environment. Consequently, our ecological concerns will be best served by giving free rein to a highly deregulated system of free trade all around the globe. Daly deconstructs such a belief by pointing out that the concept of comparative advantage goes back to David Ricardo (1772-1823) and, at that time, relied on the international immobility of capital as a precondition.¹ Meanwhile, of course, the free mobility of capital across national borders has become part and parcel of the idea of a globalized economic system. This, however, means that economic activities will locate according to the principle of absolute advantage and not comparative advantage, which is a relative kind of advantage. In other words, capital to be invested for the production of some good will simply move to the place on our globe where it is cheapest to produce that good. This, however, as Daly points out, will have severe social and environmental consequences. Concentrating here on the latter: Imagine a country A in which some kind of environmental protection scheme has been introduced, resulting in higher prices for some products of the national economy. And picture a second country B, in which this is not the case and the same products can therefore be manufactured more cheaply. Country A has now three options: (1) it gives up its own production, (2) it turns around and lowers its environmental standards again, or (3) it introduces a compensating customs duty for the imports from country B. This, of course, goes against the principle of free trade. The usual argument for such trade is that tariffs provide protection for inefficient national economies and therefore must be eliminated. In the case at hand, however, we are not dealing with an inefficient economy, but on the contrary, with an economy that is efficient in terms of ecological economics. Consequently, it is of paramount importance that the function of national boundaries does not get totally eroded within a globalized world, meaning that it is still possible to devise sensible frameworks for national economies by politi-

cal decision-making. Unrestricted free trade undermines exactly this possibility and, therefore, Daly speaks up against it and in favor of a nationalistic economic orientation which lets countries develop a high degree of self-sufficiency and minimize the necessity for international exchange. This, by the way, would also solve the present transportation problems with their disastrous consequences.

6. The virtuality of the money system (135 ff.). As Daly explains, Karl Marx, by using a very simple but illustrative symbolism, showed how the historical development of the use of money led to the exponential growth culture of the capitalist system. In a “primitive” culture, in which money is not known yet, economic exchanges take the form of barter, in which a commodity C is directly exchanged for another commodity C^* . This is written as $C - C^*$. As both sides profit from the exchange, the emphasis is on an increase of the use value of both commodities. Of course, the amount and type of goods that can be traded in this way is greatly limited. The restrictions are overcome with the invention of money, which now serves as an intervening means M for the facilitation of exchange. This situation can be described by $C - M - C^*$. Note that the principle involved is still the enlargement of the use value of the goods in question. The fact that money has an exchange value is of instrumental importance only. Now, with the advent of commercial and later industrial capitalism, things have been turned around, totally in line with what we said earlier about the world being stood on its head. The goal is no longer to better the use value, but to enlarge the exchange value represented by the money, i.e., to use the money to buy or produce a good and sell it at a profit. Therefore we have now $M - C - M^*$, with $M^* > M$. The decisive change is that money as a non-natural entity invented by humankind can multiply itself forever, whereas there are limits to the growth of real goods. Actually, this multiplication is speeded up enormously through a further step, which carries the whole system to an extreme. It is characterized symbolically by $M - M^*$, indicating that we can use money to generate more money without any intermediate step. This is, of course, what happens on today’s financial markets. More familiar to most of us is the growth of money through compound interest and through its creation as credit in the form of book money by the banks. Concerning the latter, Daly (1999, 135) comments: “counterfeiters are sent to jail for making it [the money], but the private banking system can create it out of nothing and lend it at interest.” The present money system has a high degree of virtuality. This can be demonstrated by three kinds of impossibilities:

(1) An attempt to convert all book money into cash would not work, because the bank credits given out are always a multiple of the actual reserves in cash.

(2) All existing money could never be transformed into

real wealth, because, as we said, money can grow indefinitely, while real assets cannot. All the same, or precisely because of this fact, this exerts tremendous pressure on the environment because a person holding surplus money will eventually want to do something other with it than just put it in a bank account, if that other is likely to bring higher returns.

(3) To imagine a society in which each and every member can lend money and live happily on the interest paid by others is just a further illusion of the *perpetuum mobile* kind. Conversely, this last kind of impossibility means that there are always winners and losers; the rich get richer and the poor get poorer, and this is a dangerous cause for social unrest.

... and Ford Amuses Himself

What does Ford make out of all this? Not very much, next to nothing actually. He picks out minor points and prudently avoids a careful discussion of the bigger issues that might question the reasonableness of the orthodox economic theory. It looks as if he simply could not understand what it is all about, which is rather hard to believe. More likely Ford does not choose to understand it. His way out is to ridicule Daly’s argumentation, to say that it is “amusing” to read it. Let us now look at the critical points mentioned by Ford.

1. Daly’s idea of a steady state economy with no growth does not hold up, according to Ford, because it is not possible to determine an optimum level of happiness. This is a curious argument because nowhere does Daly talk about happiness as such. If anybody or anything is to be “happy”, it is the environment. Of course, as outlined above, the steady state concept aims at a level of material and energetic throughput that ensures sustainability of the economic system within the framework of the larger ecosystem.

2. Daly metaphorically illustrates the steady state idea with a library that keeps a certain constant size by accepting new books only against a corresponding sorting out of old books. As it reminds him of book burnings, Ford criticizes this on the grounds of fascism. Who will decide which books should get discarded? This critique is, of course, entirely beside the point, as the library example is simply used to establish ideas concerning the steady state concept. And books could be sold or given away, rather than burned, when space becomes crowded. Admittedly, this may not be a very good example, as, in a global system, to keep the economy at a certain constant throughput level, we cannot give things away to somebody else, we simply have to restrict the scale and/or the impact of our activities.

3. Daly’s unsuccessful search for a concept of optimal scale in macroeconomics leads Ford to surmise that he probably did not read the intermediate textbook on microeconomics right to the end, thereby missing the chapter on general

equilibrium. I am somewhat at a loss to make any sense of this highly derisive comment. Of course, an economy could be in equilibrium at any scale and, conversely, an economy in equilibrium can by no means guarantee any degree of sustainability. So of what use is this concept for the issue at hand?

4. Neoclassical economists usually argue — and Ford is no exception — that any environmental problem can be solved elegantly by the price system. If a resource becomes scarce it will simply become more expensive and, as a result, it will be replaced by something else. Ford forgets that prices reflect the scarcity of resources only relative to their availability within the economic system and not in absolute terms with respect to the environment. Even if the use of a resource would, in fact, be price-regulated appropriately, i.e., ecologically speaking in a sensible way, this could work only for a single resource at a time. In pointing this out, Ford implicitly admits that Daly is right in complaining about the lack of a concept of optimal scale for the overall economy.

5. It is nonsensical, says Ford, to distinguish broad categories of inputs as either substitutes or complements. The situation is much more flexible, he maintains, because our increasing knowledge can find substitutes for anything, given time. This argument, which suggests that in the end we do not need nature at all, is, of course, exactly the kind of misguided belief questioned by Daly.

6. In particular Ford attacks Daly's argument that if man-made capital could be a genuine substitute for natural capital, then the reverse would be true as well. Reversibility does not apply, he claims, because substitution is the result of a price advantage and therefore, there is no turning back. This, however, has nothing to do with Daly's intention at all. What he is getting at is the idea of substitutability in principle. Are substitutes created in a vacuum? No, of course not, any substitute of anything always contains some matter and consumes some energy in being produced. This would seem to be simple common sense and does not require much scientific reasoning.

7. To demonstrate what he perceives as the hopelessly backward orientation of Daly, Ford asks us to imagine him living in the Stone Age. He would have advised his fellow humans to use flint stone sparingly so that something would be left for future generations. In so doing he would have hindered progress because a lowered production of arrowheads would have meant a declining hunting success and perhaps hunger and death for the community. Again, Ford is wide of the mark. His example concerns an "empty world" whereas Daly's warnings are appropriate in a "full world." But Ford does not believe in this distinction, he finds it "amusing," in fact. Who can help him? Besides, the number of arrowheads would not have been very decisive anyway. Today's cultural anthropology recognizes that the concept of "man the hunter"

is ill informed: Except under extreme conditions, such as for the Inuit in the Polar region, the livelihood of foraging societies is or has been secured much more by women's gathering than by men's hunting.

Ultimate Confusion²

In conclusion, maybe Ford's admission that he considers *The Ultimate Resource* by Julian Simon (1981) to be one of the most important economic books of our time helps one to better understand his curious frame of mind. Simon, of course, is the wizard who fits the finite earth out with infinite resources, which explains why he believes that the more people living on this planet, the better. If otherwise intelligent economists really think that Simon's book should be today's bible, then this is surely a justification for Daly's (1993, 24) fear "that ... we economists have become dangerous to the earth and its inhabitants." Daly is modest in saying "we." Of course he means the representatives of mainstream economics.

Endnotes

1. "Ricardo showed how free trade could be mutually beneficial for countries even when there were dramatic one-sided differences in how expensive it would be to produce the same goods in each country. Consider his example of England and Portugal in the eighteenth century. It was cheaper to produce both wine and cloth in Portugal, in absolute terms, than in England. But it was also true that England's cloth industry was — relative to its wine industry — significantly more efficient. England's disadvantage relative to Portugal in cloth production was less than its disadvantage relative to Portugal in wine production. England had a comparative advantage in cloth, Portugal a comparative advantage in wine. Ricardo showed that each country would be better off specializing in the product in which it had a comparative advantage and trading for the other, regardless of absolute advantage" (Daly 1996, 152).
2. Wording used by Daly (1999, 27) in the title of a paper that criticizes Simon's writings.

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Misunderstanding economics is more likely to "hurt" us than is nature: A rejoinder to Steiner's critique

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This is a rejoinder to Professor Dieter Steiner's critique of my book review of Ecological Economics and the Ecology of Economics by Professor Herman Daly. Professors Steiner and Daly share many views concerning their predictions and prescriptions for humanity. Their shared views can be determined not only from their works mentioned above, but also from their other writings, many of which I have recently inspected. Consider the following sentences, which I take to be representative of their views:

"The largely unintended consequences of this race beyond any reasonable limits make themselves felt as an ecological crisis which in its scope and intensity is unprecedented and endangers our long-term survival." (Steiner 1987, 47)

"We are living by an ideology of death and accordingly we are destroying our own humanity and killing the planet." (Daly and Cobb 1989, 21)

Contrary to Steiner and Daly, my views align with those of the late (and great) Professor Julian Simon and can be represented with the following excerpt from his writings:

"In the short run, all resources are limited. ... The longer run, however, is a different story. The standard of living has risen along with the size of the world's population since the beginning of recorded time. There is no convincing economic reason why these trends toward a better life should not continue indefinitely." (Simon 1996, 588)

In a nutshell Steiner and Daly are pessimistic about the future while Simon and I share an optimistic prediction of the future.

Lacking a crystal ball, one must accept the inability to predict precisely the future regardless of whether one's prediction is optimistic or pessimistic. Since much of the dis-

cussion within the literature leading to this rejoinder stems from disagreements concerning the future, perhaps understanding these conflicting views of the future is a logical starting point.

Suspecting that the origin of these disagreements originates from different interpretations of today's world, one approach is to examine these differences. Specifically, consider interpreting the world of today in either positive or negative terms. This forced dichotomy dramatically illustrates the divergences of perspective that is at the core of our differences. If one currently views the world from a negative perspective, I would suspect that one's prediction of the future would also be negative, and obviously generalizing, the converse holds.

When assessing one's current view of today's world the question is whether or not the economy and the environment contribute to our well-being. Specifically, and in order to focus on the topics germane to this exchange, four questions can be formulated:

1. Are stocks of natural resources that contribute to human welfare unduly depleted?
2. Is the world's population too large to be fed and cared for?
3. Are plant and animal species becoming extinct at a rate that diminishes our well-being?
4. Is the quality of air and water employed by humanity unacceptable and degenerating?

Notice that each question is cast in terms of human welfare. Also notice that these questions are framed in the present tense because of the lack of a perfectly functioning crystal ball. By using this tense, comparisons can be made between the present and the past in an effort to remove some of the uncertainty in the process of assessing these environmental concerns. Granted we may not have complete data for perfect comparisons between the present and the past. This difficulty however, is much more of a deterministic process than comparing the present with the future. While some historical data exists, no data from the future is available for scrutiny.

Notice also that each of the above questions is anthropically orientated, or is framed relative to humans as opposed to orienting the valuation process to nature or using some other foundation as a basis of comparing well-being. It is possible to cast questions similar to those above in terms of some non-anthropical base; however, that defeats the implicit task at hand, which is formulating a base from which human well-being can be ascertained. In addition to the tense and anthropical qualities of these questions, each one requires value judgments on the part of those that would proffer an answer. How much depletion of natural resources is too much? What level of "caring for people" is acceptable for the

world's population? Should the rate of species extinction be zero even if that necessitates a substantial reduction of human welfare? And what level of air and water quality is to be deemed "acceptable"? Depending on how one chooses to make these obligatory value judgments, some would assign an affirmative answer to all of these questions, while others embracing different value judgments would reach a negative answer for each question.

Most "main-stream economists" would answer these four questions negatively thereby being reasonably positive about humanity's current conditions. In fact, a negative answer to these may be a prerequisite for being considered a "main-stream economist." Why this optimistic outlook about the state of the world by most economists? Primarily, economists look at what exists compared to what had existed in terms of quantifiable factors that affect people's lives, or what can be called their "standard of living." How long people live, how much food they consume, what portion of their life is spent in leisure activities versus working, and the amount of goods and services consumed per person are some of these quantifiable factors. If these measurable indicators have increased, then the conclusion is reached that humanity has enjoyed an increase in its standard of living, or a rise in the overall welfare level has occurred. In a more general (and certainly not an economically technical) sense, if these quantifiable factors have increased, it can be argued that mankind's general level of "happiness" has increased.

When making comparisons between the present and the past, the choice of a particular time to which the present is to be compared is often critical. For the sake of this discussion, let the historical point of reference be 1750, or a time before the industrial revolution began. This point in time is selected because it predates most of what Steiner and Daly would label as the "evils" (my word, not necessarily theirs) of modern society. Such comparisons have been made by Professor Gale Johnson in a recent American Economic Review article:

"People today have more adequate nutrition than ever before and acquire that nutrition at the lowest cost in all human history, while the world has more people than ever before....Throughout history there have been those who believed that food shortages and famine were the fate of humanity and that the world's population was restricted not by human decision on fertility but by limitations imposed by nature. ... In the last two centuries, and especially in the twentieth century, all this has changed to a remarkable degree" (Johnson 2000, 1)

Most of today's populations do not face hunger, and those that suffer from malnutrition do so usually because of political shortcomings as opposed to resource or economic problems. Much of the world's population enjoys a longer

life span, with more education, medical attention and entertainment opportunities than their ancestors of 250 years ago (see Lomborg 2001a, Chapter 1). Although this condition is not true for all of humanity, nowhere does a substantial portion of those living today exist at a welfare level below that of their predecessors, except in those cases directly caused by their own government, as is the case with North Korea. Without a doubt, differences do exist between countries in all measures of human existence today. However, differences between countries also existed a quarter of a millennium ago. Of course, there are differences in welfare levels between countries today as there were in the past. While differences exist among the nations at points in time, it is clear there has been an improving trend in the human condition over time. This is especially true during the twentieth century and even more so for those countries that nurture high levels of individual freedom.

For humanity, the trends are very positive. Generally, and especially for developed nations, in practically all measurable anthropological indicators of human welfare around the world, life is getting better. This statement is also true for most environmental concerns. Consider the following quote concerning water as one indicator or proxy of the environment:

"And while only 30 percent of the people in the developing world had access to clean drinking water in 1970, today about 80 percent have" (Lomborg 2001a, 6)

Now consider a second quote about mankind and forests as a second proxy for the environment:

"In a 1993 article in The Atlantic Monthly, the science journalist Charles Mann wrote about the six Hudson River counties an hour's drive from the World Trade Center in lower Manhattan. Mann noted, 'When New York State surveyed itself in 1875, [those] six counties contained 573,003 acres of timberland, covering about 21 percent of their total area. In 1990, the date of the most recent survey, trees covered almost 1.8 million acres there, more than three times as much.' Back in 1875, Mann continued, the six counties had 345,679 residents; by 1990 that number had risen to 924,075. In other words, while the human population of this heavily developed area near Manhattan was increasing three-fold, its wooded portion - the zone where nature dominates- went up from 21 percent to 65 percent" (Easterbrook 1995, 13)

A similar story is seen with energy:

"When Britain began industrializing, charcoal was used to make steel. This depleted Britain's forests. The human

mind responded to this challenge by mining for coal. This was hugely profitable as charcoal had become scarce. Over time, the woods of Britain re-appeared as coal became the chief source of energy. Yet this coal did not die out. Soon, Man discovered oil. And Britain found it cheaper to import coal and oil than to dig so deep for it. Today, you can take coal to Newcastle. There is no mining, but there is still coal under the ground. It has not been exhausted. Similarly, there will always be oil and natural gas, for the human mind will come up with alternatives. Even these non-renewable sources of energy will not be completely exhausted, ever. The price of energy will prompt the search for substitutes” (Mitra 2000, 72)

Professor Bjorn Lomborg, the author of *The Skeptical Environmentalist*, presents many other statistics indicating that water, air, soil, health, life expectancy, and other factors that make for a more enjoyable (happier) life have similar trends. Parallel examples can also be found in other recently published books such as: *Through Green Colored Glasses*, *Earth Report 2000*, and *It’s Getting Better All the Time* (see References).

With this kind of evidence available for the reading, why do Steiner and Daly believe that at this moment in time, the long-range trends are going to change direction abruptly? Why do they believe that doom is just around the corner? The answer may be in their prescriptions for humanity. Steiner wants a “new kind of society”:

“The notion of control should become replaced by a notion of creative participation in the adventure of evolution on this planet. It means that we should do less, and do everything more cautiously, and this can happen only in a new kind of society. In other words, we should remind ourselves time and time again that the so-called environmental crisis is not really a crisis of the environment. But a crisis of we human beings” (Steiner 1987, 49, emphasis added)

The insistence that past trends will not continue into the future is necessary if one wants to propose a “new kind of society” with any hope of its implementation. Steiner’s fictitious world filled with large carnivores keeps the illusion alive that doom is pending and is avoidable only by adopting a new kind of society. However, even in his imaginary world of large carnivores, the fallacy in Steiner’s logic is apparent. People are not like other living things, we think, and more importantly we trade. The biologically valid concept of carrying capacity is inapplicable to humans because it assumes the subjects cannot change their circumstances. Humans can and do change their environment. Typically they change it for the better through innovations, discovery, specialization, and trade. When incentive systems are properly constructed and

implemented, most rational individuals will endeavor to improve their surroundings and search for solutions to situations that limit their betterment.

“Both the jayhawk and man eat chickens, but the more jayhawks the fewer chickens, while the more men, the more chickens” (Moore and Simon 2000, 17)

It is important to recognize the tremendously positive effects that the past quarter of a century has had on humanity, and especially that portion of humanity living in societies where legal and social institutions promote individual liberty and ingenuity.

“A central message of this book is that the fruits of a free society are prosperity and wealth. All of the evidence in this book documents that in every material way, life in the United States is much better today with 270 million people than it was in 1900 with 70 million people. Moreover, as we documented earlier, the American people are net resource creators, not depleters — protectors of the environment, not destroyers. Each generation leaves the ecological fate of the planet and our continent in better condition for future generations. Thus, the growth of the American population, which is healthy and wealthy, is a trend to celebrate, not to bemoan” (Moore and Simon 2000, 264)

Given these past trends, and with no compelling reason to suspect a dramatic shift in these trends, why would one be searching for a new kind of society? We are capable of providing a better life for more people, but it’s entirely possible that more people may also not be a valid prediction for the future, or at least not indefinitely. Current demographic research has presented the prospect of the challenge of depopulation.

“Indeed, at the end of the twentieth century, almost half of the world’s population is thought to live in countries characterized by subreplacement fertility...in reviewing the particulars of the current world population situation, it would appear only reasonable to begin entertaining the possibility that, contrary to even quite recent expectations, the subreplacement fertility regimen may come to typify not only particular regions of the world, but of the world as a whole. If that were to occur, the twenty-first century could turn out to be a time in which world population peaked, and thereafter diminished” (Bailey 2000, 66-67)

It is reasonable to question the prophecy of population decline because it is looking into the future without a crystal ball. However, this is not the only source of such a prediction:

"... the massive growth in population began around 1950 and will probably end around 2050. The increase in population is mainly due to the dramatic fall in the death rate as a result of improved access to food, medicine, clean water and sanitation. The increase is not on the other hand due to people in developing countries having more and more children. ... as one UN consultant put it, rather bluntly: 'It's not that people suddenly started breeding like rabbits: it's just that they stopped dying like flies'" (Lomborg 2001a, 45-46)

Popular literature often assumes that population growth will continue unless "nature" brings it under control. Usually one or more of the biblical four horseman of the apocalypse is charged with the task of reducing man's numbers. Perhaps this assumption should be challenged more often since birthrates have declined, without exception, as nations develop.

No, Professor Steiner, I do not think nature will hurt us in the sense you imply. I do, however, believe that humanity will continue to help nature provide us with better lives. It is far more likely that mankind's tendencies to improve our lives will be limited by ill-advised policies through various kinds of social engineering and income redistribution schemes that dampen innovation, discovery, and trade. Such schemes hatch from misunderstanding the advantages of our current institutions. One such misunderstanding is displayed in your statement "All existing money could never be transformed into real wealth ..." Dr. Daly and you arrived at this ridiculousness by starting with probably the world's single most discredited author: Karl Marx. His basic ideas have been rejected by most of the world's intellectuals and academicians as well as by the vast majority of the world's political experimenters. With the fall of the Soviet system, I was astonished to see a reference to his writings, which truly belong in the dustbin of history. Incidentally, why would everyone want to convert all money to real wealth? The primary function of money is to facilitate trade, which is the wellspring of wealth. Such a conversion would signal the end of efficient trading, and therefore the cessation of most wealth creation. (A total conversion could of course occur, however, the rate of exchange of the final unit of money for real goods would not be anything like the early exchange rates.) Also, it should be pointed out that real wealth can grow without limit. To cite just one example, what is the value (a measure of wealth) of the Mona Lisa today? What was its value a hundred years ago, and what will its value be a hundred years from now? By the way, do not forget the contributions to the economy from services that, incidentally, use practically no physical resources.

The subject of global potential net primary production (NPP) is a good example of junk science. Is this measure of

"the amount of solar energy captured in photosynthesis" measured before or after the "green revolution" of the 1960's? How will this index be adjusted to account for the forthcoming improvements in plant yields stemming from genetic engineering? It may be advantageous to remember that Norman Borlaug won the 1970 Nobel Prize for his work in agriculture. He developed a variety of wheat that dramatically increased the world's grain harvest while the amount of solar energy landing on the surface of the planet was constant. I suppose that a substantial difference would be detected in NPP if measured before and after Borlaug's contributions.

Professor Steiner accused me of criticizing Daly's library metaphor "on the grounds of fascism." Actually, "book burnings," my phrase to which Steiner responded with political name-calling, have occurred in Imperial Japan, Communist Russia, Nazi Germany, Islamic Afghanistan, as well as in religious zealot communities in the United States. What all these have in common is not fascism, but rather narrow-mindedness. Trying to organize a society where policy limits growth because "throughput" considerations outweigh increases to human welfare is also a facet of narrow-mindedness.

Dr. Steiner either did not understand, or chooses to ignore, the message in my metaphor concerning flint mining in early human history. His response is undoubtedly politically correct and most likely extracted directly from ecofeminist literature when he dismisses the making of arrowheads because: "... the livelihood of foraging societies is or has been secured much more by women's gathering than by men's hunting." Besides the fact that my illustration was stated in gender-free terms, why does Professor Steiner suppose these arrowheads were made? For art objects? I am not an anthropologist. However the fact that arrowheads were made, thereby incurring a cost in terms of alternative uses of time forgone, means that the arrowhead makers attached value to them. These people could have engaged in other activities like food production, defense, social contracting, or the creation of art. The fact that early man made the arrowheads and that their children's children survived is sufficient grounds for my example to stand. If the tribe had not extracted this resource at the rate they did, but had practiced "sustainable resource extraction" would they have survived? And if they did survive with lower levels of flint extraction, would we, their descendents now endowed with larger flint reserves, be better off today? Sustainable development in this case (as in others) would have been ill-advised. The following passage comes from Becherman's American edition, however, his United Kingdom edition of the same book is appropriately titled *Small is Stupid*.

"During the last few years the fashionable concept in environmental discourse has been "sustainable development." It has spawned a vast literature and has strengthened the arm of empire builders in many research institutes, universities, national and international bureaucracies, and statistical offices. Environmental pressure groups present the concept of sustainable development as an important new contribution to the environmental debate. It is claimed that it brings new insights into the way that concern for the environment and the interests of future generations should be taken into account in policy analysis. But in fact it only muddles the issues. As two distinguished authorities in this area, Partha Dasgupta and Karl-Goran Maler point out, "...most writings on sustainable development start from scratch and some proceed to get things hopelessly wrong. It would be difficult to find another field of research endeavor in the social sciences that has displayed such intellectual regress'" (Becherman 1996, 143)

In addition to mystifying their readers with the term sustainable development, Steiner and Daly demonstrated that they do not understand either the microeconomic idea of optimization or the concept of wealth creation through trade. Optimization is a process to reach a specified goal given some limitations such as a firm's production process during a particular time period without changing some fixed input. However, macroeconomic analysis is a different process with different objectives. It usually attempts to understand how society can organize itself in such a way as to increase the total amount of welfare for individuals within society. Some societies with an abundance of "environmentalism" and a dearth of consumer goods will gladly trade that which is in abundance for that which is scarce. Societies in the opposite situation will, not surprisingly, willingly trade in reverse. Such a pattern has been observed as nations develop. They readily trade environmental amenities for consumer goods. However as the standard of living increases, these same countries are more willing (and also able in terms of wealth) to assign higher levels of value to environmental concerns. Such outcomes have been empirically varied as can be seen in the work of Dr. Don Coursey of the University of Chicago (Coursey and Hartwell 2000).

Dr. Daly's arguments against free trade, with which Dr. Steiner seems to agree, overlook the advantages of trade from the consumer's perspective. The main reason consumers in one country will purchase goods from another country is that the price/quality ratio of those goods is superior to those goods produced domestically. By restricting this trade, these benefits that accrue to the consumers are forfeited (thereby becoming costs to consumers) but are easily overlooked since they are dispersed across the buying public. The benefits that

accrue to domestic workers as a result of blocking trade are more readily identified since the beneficiaries (workers and plant owners) are usually concentrated. However, the net result of these benefits and costs is negative. That is, in total the country loses more than it gains from restricting trade. David Ricardo would most likely not agree that advantages in trade in a dynamic setting would produce the negative effects Dr. Daly suggests. Ricardo used "land" but not geography as one of his inputs in his analysis, which in many cases is an important component of the production process and is obviously not free to move. The argument that free trade merely produces a race to the lowest level of environmental standards is also not substantiated by statistical evidence. As Professor Lomborg has empirically verified, countries with high environmental standards are also ones with more active trading records and higher standards of living.

Upon second reflection, I repeat my original statement that Daly's book belongs on secondary reading lists. Most of the references to this rejoinder, and particularly the works of Simon, Beckerman, and Lomborg, would make fine additions to anyone's prime reading list. These works would provide the readers with a clear and accurate view of today's world from which they can predict the future for themselves.

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Sprawl City: Race, Politics, and Planning in Atlanta

Edited by Robert D. Bullard, Glenn S. Johnson and Angel O. Torres
Washington DC: Island Press, 2000
ISBN 1-55963-790-0

Reviewed by Robyn Bateman Driskell
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 Department of Sociology

Sprawl City is a well-edited volume on the growth of the ten county region of Atlanta, Georgia. This easy to read book employs a multidisciplinary approach to the environmental, racial, and educational concerns of unplanned growth. The twelve contributors represent professionals in various fields: the Director of Georgians for Transportation Alternatives, the founder of Southface Energy Institute, a research associate at the Environmental Justice Resource Center, a GIS specialist in environmental analysis, and professors of law, sociology, and educational policy studies. It is refreshing to read non-academic type authors who provide different perspectives and shed new light on some traditional problems from their hands-on experiences. The publisher is the Island Press, a nonprofit organization that publishes books on environmental issues.

The introduction, a few chapters, and the conclusion are written by Robert Bullard adding to the flow of the chapters

and consistency throughout the text. Good illustrations, maps, and tables are provided to support the text. *Sprawl City* begins with a definition of sprawl, (i.e., random, unplanned growth) describing the fastest growing region in the country, Atlanta. With each chapter, many of the problems and unanticipated consequences of sprawl are described. Usually, growth is viewed as a sign of progress and improvement, yet in this book, sprawl becomes the cancer that spreads throughout the counties uncontrollably. For Atlanta, continued growth is to the detriment of those living in the area ... bigger is not better.

The introduction addresses the various problems of sprawl, gives a historical overview, and speculates on the future of continued sprawl. The ten county metropolitan area of Atlanta has over 3 million people and is expected to increase by a million by 2025. In the 1990's, Atlanta grew more than any other metropolitan area in the U.S. and today is the least densely populated region with only 1,370 persons per square mile (L.A. has 5,400 people per square mile). Most of this growth is occurring in the sprawling suburbs as the boundaries of Atlanta's region doubled in the 1990's and continues to expand. Each week, Atlanta sprawl consumes an additional 500 acres of field and farmland. The authors suggest that sprawl is a threat to the quality of life due to traffic congestion, air pollution, health concerns, deforestation, and increasing residential segregation. Bullard provides many interesting facts concerning the car dependent area and consequences of traffic on the citizens in the region. Each chapter of the book is devoted to certain issues related to sprawl including environmental issues, transportation, housing, residential segregation, education, legal reform and energy use.

Chapter 1 begins with the environmental issues of Atlanta's growth. The environmental assaults of land use, air quality, water pollution, toxic releases and sewage treatment plants are described. Emphasis is placed on how these hazards disproportionately affect low-income and minority populations. While much of the literature on sprawl and environmental costs often neglect the issues of race, Bullard and his colleagues focus on racial disparities, residential segregation, and the educational gap between the races throughout the book.

Topics highlighted in chapter 2 include traffic congestion, the lack of public transportation, the use of federal monies, and future transportation systems. It is made clear that the solution is not merely building more highways, but rather public transportation. These authors state that it is also essential to improve the mobility of Atlanta's poor and people of color. For the readers not familiar with the Atlanta region, helpful maps are included with the economic activity centers and transportation lines. Chapter 3 continues with the problems of transportation and the flawed transportation

planning process, focusing on policies, laws, mandates, and subsequent lawsuits. The political groups and agencies such as DOT, GRTA, RTP, and TIP, play a role in the safety, funding, and infrastructure of new developments.

Chapter 4 details the obstacles of fair housing and residential segregation, as white flight to the sprawling suburbs occurs. According to the authors, the equity of housing is blocked as minorities are discriminated against by real estate agents, mortgage lenders, and insurance companies. Residential segregation and historical patterns of minority housing are further discussed in chapter 5 through a sociological perspective.

While education is usually not addressed as a problem of sprawl, chapter 6 explains the impacts of poverty and loosely connects the effects of sprawl to a widening of the educational gap between the races. The discussion of educational disparities includes several theoretical debates, but also concludes with practical policy recommendations for the Atlanta school systems.

Chapter 7 discusses the legal reforms, reviews relevant court cases, and examines the use of federal monies for anti-sprawl reforms. The limited authority of a single government agency makes it necessary to combine local, state, and federal efforts to establish and enforce growth management laws for Atlanta. The “heat island” created in Atlanta by deforestation, building developments, and the unrestrained urban growth is described in chapter 8. Housing and energy consumption are mitigating factors in the creation of the “heat island.” Like the other chapters, the issues of race and residential segregation are woven into the fabric of the environmental impact of sprawl.

Finally, the last chapter briefly summarizes the consequences, sets a new agenda for the future, and outlines possible reforms. Bullard states that the government has failed low-income and minority people in protecting their quality of life, and by providing transportation, fair housing and employment opportunities. It will take a coordinated effort of multiple groups to attack Atlanta’s problem of sprawl. The effects of sprawl have impacted the infrastructure decline, inner city deterioration, racial segregation, health risks, transportation problems, deforestation and lack of quality public education. However, Bullard discusses possible solutions so that growth can be planned and managed, thus curtailing the severe impacts of sprawl.

As with most edited volumes, since the authors are discussing similar topics, information is repetitive from chapter to chapter. Much of the same statistics on Atlanta’s growth and traffic problems are presented in several chapters. While Bullard and his colleagues address the often neglected issues of race, housing, and education, some issues were left to be explored. These issues include: the effect of sprawl on the

sense of community and neighboring; the impact of immigration on sprawl; practical remedies for the average citizen or small group to combat sprawl; and white, middle-class gentrification of the center city.

Sprawl City is a well-written, multidisciplinary approach analyzing the racial and environmental crisis caused by uneven and unplanned growth. This readable volume will be useful and interesting to government officials, community leaders, policy analysts, and practitioners eager to fight the ills of Atlanta’s sprawling boundaries.

Briefly Noted

Edited and Compiled by William S. Abruzzi
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Notes of a Potato Watcher

by James Lang

Texas A&M University Press: College Station, TX, 2001

ISBN 1-58544-154-6

The potato has a larger story to tell than its humble status suggests. In this fascinating account of the potato and its role in human history — and the human future — James Lang tells that story. Combining biology and social science, he describes the origins of cultivated potatoes and how they spread as a staple throughout the world; the many ways to propagate, store, and harvest potatoes; and the crop’s potential for feeding a hungry planet. Along the way, Lang also reflects on famine and demography, describes village-based, farmer field schools, and looks at the role the potato plays in feeding China.

Native to the New World, the potato was domesticated by Andean farmers, probably in the Lake Titicaca basin, almost as early as grain crops were cultivated in the Near East. Full of essential vitamins and energy-giving starch, the potato has proved a valuable world resource.

Lang’s grasp of the social and technological issues involved is formidable; his revisionist thoughts on the origins of agriculture are convincing. *Notes of a Potato Watcher* explains how “think globally, act locally” can actually be applied. Here is a book that anyone interested in potatoes, development, and small farms will not want to miss, a book that explains why the potato was not the culprit in the Irish famine, a book that shows why solutions must begin at home.

Chimpanzee and Red Colobus: The Ecology of Predator and Prey

by Craig B. Stanford
Harvard University Press: Cambridge, MA, 1998
ISBN 0-674-00722-0

Honorable Mention

Association of American Publishers
1998 Professional/Scholarly Publishing
Annual Award in Biological Science

Our closest living relatives, the chimpanzees, are familiar enough — bright and ornery and promiscuous. But they also kill and eat their kin, in this case the red colobus monkey, which may say something about primate — even hominid — evolution. Based on a six-year investigation in Tanzania's Gombe National Park, this book is the first long-term field study of a predator-prey relationship involving two wild primates. Because chimpanzees are often used as models of how early humans may have lived, Stanford's findings offer insight into the possible role of early hominids as predators, a little understood aspect of human evolution.

Saving Louisiana? The Battle for Coastal Wetlands

by Bill Streever
University Press of Mississippi: Jackson, MS, 2001
ISBN 1-57806-348-5

Wetlands expert Bill Streever spent years struggling with the question: Can Louisiana's wetlands be saved? Salt water is inundating coastal Louisiana, transforming precious wetlands into backwaters of the Gulf of Mexico. Science may hold the key to reversing the problem. But what will the cost be? And will the plan work? These are the quandaries Streever reports in his new book *Saving Louisiana? The Battle for Coastal Wetlands* (University Press of Mississippi).

"For almost every idea I uncovered in the past year, someone out there is ready to disagree," Streever writes.

For what is unquestionably the most ambitious ecosystem management and restoration program ever proposed, calls have been made to save the Louisiana coast, with a price tag of fourteen billion dollars.

From the Mississippi River's Old River Control Structure to the pipeline canals of the Gulf's oil fields to the capitol in Baton Rouge, Streever's new book follows scientists, conservationists, and politicians, as they persistently tackle Streever's question. For some experts, technical uncertainty impedes progress. For others, bureaucracy and

special interests block what they see as the right path. Still others believe that the real challenge lies in determining what society really wants, so that ecosystem restoration becomes a balance of dollars against choices.

Saving Louisiana? Contains on-the-scene reporting, as Streever accompanies scientists and advocates in flights over canals backfilled to promote plant growth, in excursions to measure Mississippi River sediment, in fishing trips on Calcasieu Lake, and in canoe explorations of a cypress swamp contaminated by lead and zinc. As Streever considers the methods and results of science side-by-side with the scientists themselves, he reveals personalities and biases, passions and commitments. Anyone intrigued by the big ecosystem restoration projects underway in the Florida Everglades, the Chesapeake Bay, the Puget Sound, and elsewhere will find this account of Louisiana's morass compelling and cautionary.

Imperial Ecology: Environmental Order in the British Empire, 1845-1945

Peder Anker
Harvard University Press: Cambridge, MA, 2001
ISBN 0-674-00595-3

Winner of The History of Science Society's Forum for History of Human Sciences Prize.

From 1895 to the founding of the United Nations in 1945, the promising new science of ecology flourished in the British Empire. Peder Anker asks why ecology expanded so rapidly and how a handful of influential scientists and politicians established a tripartite ecology of nature, knowledge, and society. Patrons in the northern and southern extremes of the Empire, he argues, urgently needed tools for understanding environmental history as well as human relations to nature and society in order to set policies for the management of natural resources and to effect social control of natives and white settlements. Holists such as Jan Christian Smuts and mechanists such as Arthur George Tansley vied for the right to control and carry out ecological research throughout the British Empire and to lay a foundation of economic and social policy that extended from Spitsbergen to Cape Town. The enlargement of the field from botany to human ecology required a broader methodological base, and ecologists drew especially on psychology and economy. They incorporated those methodologies and created a new ecological order for environmental, economic, and social management of the Empire.

The Environment and Society Reader

Edited by R. Scott Frey
Needham Heights, MA: Allyn & Bacon. 388 pp.
ISBN 0-205-30876-7 Paper, 2001

Reviewed by Andrew K. Jorgenson
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Locating an effective “supplementary reader” for courses in environmental sociology and/or human ecology can be a rather time-consuming, difficult task. This reader attempts to fill that gap. It is a compilation of articles that address “current concerns with environmental problems,” focusing on the following six interrelated questions: (1) What are the actual nature and scope of depletion and pollution problems at the local, national, regional, and global levels? (2) How are threats to humans created by problems of depletion and pollution distributed within and between countries? (3) What are the human causes or driving forces of environmental problems? (4) What kinds of human responses (individual, organizational, cultural, societal, and international) have these environmental problems produced? (5) Because human responses are embedded in a larger social context, how have they been influenced by psychological, economic, political, social and cultural forces? and (6) How can we deal more effectively with environmental problems?

Overall, the reader consists of twenty-one papers in eleven chapters, organized into three thematically driven sections. Part I examines the nature and character of environmental problems. Part II provides an overview of human responses to environmental problems. Part III outlines an “emerging view referred to as sustainable development that not only represents an alternative way of thinking about environmental problems but provides concrete suggestions for action.” The selections vary widely in their level of theoretical abstraction and/or their empirical scope. Some are discussions of general issues in environmental sociology and human ecology while others are case studies or narrowly focused on one particular issue.

Substantively and theoretically, the selections are generally of a high quality. For anyone interested in being brought up to speed on any of the areas covered, this reader is a good place to start. The introductory chapter by Frey is helpful in summarizing the general nature and character of environmental problems. Dunlap’s article on the historical evolution of environmental sociology provides a clear and interesting picture of its emergence, upswings and downswings, and compares the characteristics of American environmental

sociology to European environmental sociology, particularly the UK, where “environmental sociology seems to be flourishing.” Perhaps the most influential article in this reader, which originally appeared in *Human Ecology Review* in 1994, is Dietz and Rosa’s paper, “Rethinking the Environmental Impacts of Population, Affluence, and Technology.” This paper outlines an important effort to modify the original IPAT model using more sophisticated modeling to make better sense of the influence of population, per capita affluence, and technology on the environment. This is a ‘must read’ for all students and researchers in our respective discipline(s).

Chapter three contains two excellent articles on environmental problems embedded in stratification systems that exist within and between countries. First, Bullard’s article examines how exposure to environmental hazards and associated health risks vary by racial/ethnic group status in the United States. Using a world-systems approach, the second article (by Frey) addresses how the export of hazardous wastes to less developed countries by transnational corporations headquartered in core countries contributes to health, safety, and environmental risks in peripheral regions. Chapter six consists of three papers which address different dimensions of the contemporary environmental movement. The first paper, authored by Brulle, examines the ideologies, support bases, motivational dynamics, organizational structures, and political styles of the diverse movement organizations in the United States. The second paper offers a case study of the environmental movement in less developed regions, specifically India (Bandyopadhyay and Shiva), while the chapter concludes with an article by Frank that examines the emerging global-level environmental discourse and associated macro-networked activism. These two chapters illustrate the greatest strength of this reader — the presentation of interrelated issues using different levels of analysis: intranational, national, and world-systemic. This exposes the reader to the overall complex nature of environmental problems, illustrating the wide range of issues to which environmental sociology and human ecology can be applied.

What about students? The main purpose of this reader is pedagogical and it is primarily for that purpose it must be evaluated. With some caveats, I think this book is well worth considering for courses in environmental sociology and/or human ecology. The first few chapters are effective in briefly introducing and summarizing environmental problems and the emergence of environmental sociology, but additional and more in-depth exposure to traditional theoretical frameworks before reading the rest of the selections would make them more accessible to undergraduate and beginning graduate students, especially the more empirical articles.

This book is not the sort of reader that an instructor can assign without discussing. Students are going to need the

feedback and assistance that in-class discussions can provide. Some of the more challenging selections could be incorporated into a course if they are intended to be an integral part of what goes on in class. Clearly, the issues addressed in this book are important and valuable enough to be accompanied by systematic discussion. As with any “supplementary reader” used in a quarter or semester sequence, it may be necessary to be somewhat selective in what articles to assign. To benefit from the organizational and substantive strengths of this reader, I believe that the selections discussed above should be considered first.

The Environment and Society Reader is a welcome addition to the still very short list of effective readers specifically designed for courses in environmental sociology and/or human ecology, and it is well worth considering for courses as well as for personal use.

Earth and You: Tales of the Environment

**Edited by Charles Officer and Jack Page
Portsmouth, NH: Peter E. Randall, 2000**

*Reviewed by Michael M. Welsh
Assistant Professor, Political Science
Albright College, Reading, PA 19612*

Though potentially useful, this is an unusual book, both in style and structure. Structurally, the book is presented as an argument: two hundred-plus years of environmental history, most of that concentrated in the last thirty years or so, has given us a number of stories from which lessons might be learned. In some detail the book recounts a number of these stories (by my count twenty-three). These include the establishment of national parks and forests, the drying of the Aral Sea, the contamination of Love Canal, Times Beach, and the Cuyahoga River, Ozone Depletion and Global Warming. Each of these and others, claim Charles Officer and Jack Page, are environmental problems successfully solved or promisingly confronted by the valiant work of determined people, often single individuals. Their’s is, claim the authors, an optimistic account, full of hope that these problems and our response to them prove our ability to tackle unforeseen others still to come. The account of these problems occupies the bulk of the book and is written at times with an approachable freshness and energy that places this book near the top of the many that put these well-worn and often told ecological “tales” to use. For this alone the book might be recommended to friends with a new interest in ecological history or

to undergraduates in an introductory course in environmental studies.

The argument that underlies the structure of the book then takes an unusual turn. There are two global problems — population growth and a looming energy shortage — that must be tackled systematically, using the decidedly non-individual institution of government and the specialized disciplines of sociology and science (respectively). We start in this book, in other words, with a message about the power of individual human initiative to raise consciousness and effect change. We end with an evaluation of these success stories as heartening but inadequate, “like mowing dandelions instead of uprooting them,” the authors write. Fighting the two root causes of environmental problems, the authors claim, will require that ten to twenty billion dollars per year be reallocated from the nation’s defense budget to environmental research. The Cold War, they remind us, is over, and it is time to direct at least a small portion of the energy and resources thus freed up to saving the environment: “Technology addressed at environmental problems is . . . to the benefit of all of us. It is our right to demand that our tax dollars be used for our benefit” (p. 226).

This, then, is the conclusion of *Earth and You*, oddly prefaced by what the reader comes to understand are nice-but-not-enough environmental case histories. As an argument this might be considered structurally unusual, the presentation of refuting or unsupported evidence prior to the statement of a thesis. That thesis, in addition to the only moderate support it receives from what precedes it, is weakened by a lack of originality. For years analysts have urged that a post-Cold War “Peace Dividend” be directed at environmental and other social problems. Al Gore himself, in his widely-purchased but infrequently read *Earth in the Balance*, thoughtfully recommends that environmental quality become the new “central organizing principle” of society in the waning period of the Cold War. Unlike the authors of the book under review, Gore further can be credited for refusing to succumb to the twin traps of lifeboat ethics (questioning the advisability of developed nation’s assistance to the poor) and technological boosterism (calling not for conservation but for the development and use, among other things, of nuclear breeder reactors and fusion). These features of their analysis weaken Officer and Page’s final message. Asked by someone about a book I would recommend for this work’s target audience I would in fact select *Earth in the Balance*. The main reason I can imagine for picking Officer and Page over Gore would be some knowledge that the recommendation I will be making is to someone ideologically predisposed against receptivity to the recommendations of a Democratic former Vice President. Such people, I hear, exist.

Finally, were I to recommend this book, I would have one final set of reservations about its unusual style. Enormous portions of the book are second- and third-hand restatements of well-known environmental history. Block quotes, always a hazard to reading, sometimes take up pages of text, broken only by the shortest of linking original sentences. Chapters at times seem randomly ordered and confusingly titled as a part of an ongoing description. Chapter 1, for example, is titled “We as a Species have Grown to Dominate the Earth — to Alter its Landscape and to Eliminate Natural Wilderness Areas,” and is followed by Chapter 2 titled “...To Overextend the Limits of Water and Land Use,” and Chapter 3, “...And to Decimate or Drive to Extinction Other Species.” The commentary continues thusly in the titles of Chapters 4, 5, and 6. These faults are not critical but they give the book an odd and rushed-together feel, like one is reading a team-written commission report and not the product of thoughtful collaboration of two experienced writers and teachers.

The book, after all, is the latter. Though not without flaws and ready comparisons to existing works, the book is valuable as an additional call for greater attentiveness and even some hope in the face of the serious environmental problems we face. The past year shows that such works still have an audience within both the public and high-placed policy makers that needs to be reached.

The First Sex: The Natural Talents of Women and How They Are Changing The World

Edited by Helen Fisher

New York: Random House, 1999.

ISBN: 0-679-44909-4 (cloth)

ISBN: 0-449-91260-4 (paper)

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Anthropologist Helen Fisher argues rather convincingly, that the brains of men and women are biologically “hard-wired,” resulting in relationships between the sexes that are naturally “gendered.” She traces these differences to deep history, and the grasslands of Africa. As a result, these traits are cross-culturally uniform, despite concerted efforts of societies to minimize them through socialization and the reframing of social institutions. In addition, evolution favors the natural tendencies of women.

Fisher begins her argument with the assertion that women are the biological “first sex,” because androgens must be added to a fetus to create a male. She dismisses biological determinism by acknowledging the importance of nurture in her argument, and by devising a continuum ranging from hyperfemininity to hypermasculinity. One’s location on this continuum is directly related to both the amount and timing of hormones in the womb, allowing for individual differences on these traits. She then argues that women as the “first sex” has important social repercussions, because as we move through the “information age” and toward a “collaborative society,” industry will need the inborn traits of women to succeed. This makes women the “first sex” not only biological but socially.

Focusing first on thought patterns, Fisher claims that because both the regions of the pre-frontal cortex and the corpus callosum differ in men and women, women are relatively more adept at “web-thinking.” This entails contextual, holistic thought, that is more intuitive, imaginative, mentally flexible, and long-term. Therefore, women are less apt to think linearly, and are more pre-disposed to thinking in terms of interrelated factors. In contrast, men engage in linear “step-thinking,” moving toward an overall solution to a specific problem. Web-thinking is important for globalization where taking a broader, more longer term perspective is important.

In addition, estrogen-levels impact the female tendency to have egalitarian and harmonious relationships. Women are less interested in gaining power, and are more apt to share it in an effort to have win-win relationships with others. Testosterone causes men to be more power-driven, hierarchically oriented, and concerned with their rank within groups. Fisher believes that these female tendencies are important for the success of globally-oriented post-modern organizations, where team-work, minimal hierarchy, and linking people together are important.

These differences in the cerebral cortex and estrogen also give women a verbal-edge. Estrogen allows for the flow of information between neurons, and as estrogen levels heighten in women they are better adept at verbal memory and communication. In addition, a gene or gene cluster on the X chromosome influences proficiency in language skills and reading. These differences also give women superior “executive skills;” they are better at “reading” subtle social cues within context. Fisher claims that because of these innate skills, women will be successful “gold-collar” workers, where knowledge, education, and computer literacy are paramount. These innate skills will also be of great importance globally because women are adept at “reading” business people from other cultures.

Because women are naturally team-oriented, and they

produce more of the brain chemical oxytocin, which is linked to nurturing, women are successful at specific medical specialties that stress hands-on, nurturing treatments. For example, women gravitate towards internal medicine, pediatrics, obstetrics and gynecology, and family practices. In addition, assisted-living facilities and wellness-centers will also need these female capabilities.

Because of these natural differences between men and women, Fisher claims that women will probably not participate in traditional government leadership roles that require strategically maneuvering through rigid, formal, hierarchies. We know that matriarchy has never existed, and women have never held these positions in great numbers in any society, no matter how developed. She believes this pattern will continue because women engage in political activity to improve society, not to gain social status and contacts. Women will impact politics, but they will be leaders in civil society and NGO's, where community concerns override ambition.

Marital relationships are also impacted by biological differences between men and women. As the population ages, relationships will become more egalitarian. As women age they experience decreases in estrogen and increases in androgens, while older men exhibit decreases in testosterone and increases in estrogen. This results in women who are increasingly more independent and assertive in relationships, and men who crave emotional closeness from their wives. This will result in near peer or peer relationships between the sexes.

Fisher also claims that modern changes in family structure really represent a return to ancient patterns found in deep history. With the rising rates of divorce and remarriage today, we are merely resuming the ancient pattern of serial monogamy, and female-headed households. In addition, we are recreating hunting and gathering bands through the current rise of families of choice.

Fisher scolds intellectuals for perpetuating the belief that men and women are more similar. To successfully make this argument, one must ignore the growing scientific evidence for inherited gender differences. Fisher argues that we must distance ourselves from the idea that highlighting these differences would signal further oppression for women. She claims that this is no longer a legitimate concern because societies no longer value having boys over girls. Today girls are now able to care economically for themselves, their families, and their aging parents, so there is an incentive to have girls. Therefore, we must honor these gender differences, which would allow women to flourish in society, and foster further understanding between men and women. In addition, she claims that on every continent, women are moving toward economic parity, and in some sectors of the economy they dominate. In those sectors, they are the "first sex."

Fisher is optimistic about the future and predicts that we are moving towards what she terms a collaborative society. As we move forward in time, we are returning to relationships indicative of the deep past, where men and women can live and work as equals and the merits of both sexes are cherished and employed.

Helen Fisher has written an important book that is ambitious in scope. Oftentimes, social scientists acknowledge the importance of the interplay between biology and society, only to abandon biology in their own work. But there are some crucial problems with this line of research. Fisher often makes very broad generalizations about scientific research that is still hotly contested. For example, while much of her book relies on evidence about the differences between the prefrontal cortex of men and of women, the sciences merely support this "possibility" (p. 10). In addition, the behavioral effects of estrogen and testosterone are also controversial. To further complicate the issue, many of these biological differences that she cites are only apparent in 50% of women.

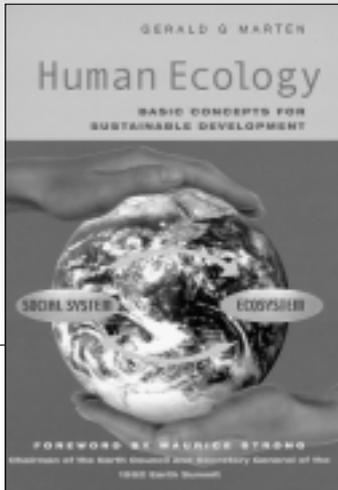
Fisher also makes the error of minimizing social structure, where she merely assumes that the natural tendencies of women will be favored and rewarded. This is clear when she claims that men and women typically seek traditional occupations because of their gendered brain. While she does acknowledge social stratification, she disregards the importance of gendered job queues (Reskin and Roos 1990), where the traditional female occupations today are oftentimes the traditional male occupations of the past; occupations that men have abandoned due to a decrease in status and working conditions.

Last, Fisher occasionally makes statements that appear implausible. For example, she cites the foraging of fruits and vegetables by women in deep history as a forerunner to contemporary shopping (91). She also asserts that women will probably never actively participate in the upper-echelons of the traditional corporate world, because they have more important work to do — having children (48-49).

Caveats aside, I really enjoyed this book and I highly recommend it. Helen Fisher makes a clear, logical argument while citing current evidence from the fields of sociology, biology, anthropology, and sociobiology. This is an enormous undertaking and she does it well.

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"The scope and clarity of this book make it accessible and informative to a wide readership. Its messages should be an essential component of the education for all students from secondary school to university... [It] provides a clear and comprehensible account of concepts that can be applied in our individual and collective lives to pursue the promising and secure future to which we all aspire."

— From the Foreword by **Maurice Strong, Chairman of the Earth Council and former Secretary General of the United Nations Conference on Environment and Development (Earth Summit)**

Human Ecology

Basic Concepts for Sustainable Development

GERALD G. MARTEN

- Clear, accessible and illuminating introduction to the fundamental concepts and issues of sustainable development
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Author's Erratum

Thomas Webler and Seth Tuler's article published in HER 8(2), 29-39, 2001 (Public Participation in Watershed Management Planning: Views on Process from People in the Field) had an error in Table 3 on page 34. The corrected table is reprinted below.

Table 3. Reordered factor matrix.

Name	Factors			
	A	B	C	D
Factor A				
Wigham	.62	.06	-.09	.61
Stacy	.61	.08	.03	.27
Clinton	.61	-.07	.25	.08
Faurague	.48	.08	.40	.37
Listof	.48	.00	.01	.36
Jannson	.46	.16	.15	.08
Hughes	.43	.08	.05	.14
Factor B				
Pickels	.15	.67	.04	.20
Sontag	.13	.67	.14	.31
Austin	-.04	.48	.10	-.01
Reno	-.28	.47	.38	.38
Minau	.22	.49	.26	.21
Factor C				
Kinsey	.05	.18	.62	.00
Garcia	.21	.07	.48	.16
Vaughan	.41	.16	.42	.03
Factor D				
Smith	.15	.26	.19	.59
Christianson	.18	.05	.14	.52
McGough	.32	.39	.01	.46
West	.09	.20	-.08	.45
Moore	.21	.11	.12	.45
Non-loaders				
Stern	.29	.21	.15	.29

All numbers in bold type are significant at $p < 0.001$, two-tailed, critical value = 0.429.

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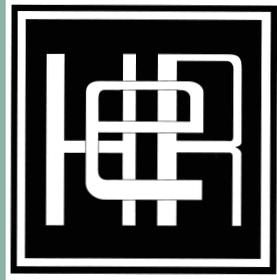
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