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Ecological Information Needs for Environmental Justice

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Abstract

The concept that all peoples should have their voices heard on matters that affect their well-being is at the core of environmental justice (EJ). The inability of some people of small towns, rural areas, minority, and low-income communities, to become involved in environmental decisions is sometimes due to a lack of information. We provide a template for the ecological information that is essential to examine environmental risks to EJ populations within average communities, using case studies from South Carolina (Savannah River, a DOE site with minority impacts), Washington (Hanford, a DOE site with Native American impacts), and New Jersey (nonpoint, urbanized community pollution). While the basic ecological and public health information needs for risk evaluations and assessments are well described, less attention has been focused on standardizing information about EJ communities or EJ populations within larger communities. We suggest that information needed about EJ communities and populations includes demographics, consumptive and nonconsumptive uses of their regional environment (for example, maintenance and cosmetic, medicinal/religious/cultural uses), eco-dependency webs, and eco-cultural attributes. A purely demographics approach might not even identify EJ populations or neighborhoods, much less their spatial relation to the impact source or to each other. Using information from three case studies, we illustrate that some information is readily available (e.g., consumption rates for standard items such as fish), but there is less information about medicinal, cultural, religious, eco-cultural dependency webs, and eco-cultural attributes, all of which depend in some way on intact, functioning, and healthy ecosystems.

Keywords

American Indians; eco-cultural; environmental equity; environmental justice; stakeholders

1. INTRODUCTION

The concept that all peoples and communities should have the right to have their opinions and perceptions heard, and where possible, to be part of the decision-making process on matters that affect their well-being was formalized in 1994 by President Clinton in Executive Order 12898. Environmental justice is defined as the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (Table I).^(1,2)

Environmental equity is premised on the notion of the fairness of distribution of environmental risks, particularly technological ones.^(3,4) This means that ethnic, racial, or socioeconomic groups should not bear a disproportionate share of negative environmental consequences resulting from industrial, municipal, agricultural, and commercial operations, or from the execution of federal, state, or local laws, regulations, and policies.⁽²⁾ Federal, state, and local governments are obligated to take into account EJ concerns, and to ensure meaningful involvement of EJ communities in the decision-making process.

Meaningful involvement requires that EJ communities can make informed decisions and take positive actions to produce environmental justice for themselves, and that those communities have effective access to decisionmakers. In many cases, agencies must work with communities to build their capacity to address the issues, acquire environmental and ecological expertise, and participate fully.⁽⁵⁾ Capacity-building can include training interns, students, professionals, and the public through courses, workshops, or technical sessions, providing undergraduate and graduate training, and providing facilities, equipment, and instrumentation for environmental assessment, among other things.⁽⁵⁾

Information and data are at the core of involvement of peoples and communities in decision making concerning environmental issues. While there are several papers and classifications of the environmental information required for valuations of ecosystems functions, goods, and services,⁽⁶⁻⁸⁾ other spatial ecological and eco-cultural information relevant to EJ is clearly required as a separate and recognized data base with maps. Without this information, governmental agencies and decisionmakers cannot identify EJ communities, understand the disproportionate share borne by some peoples and communities, evaluate the relative risks, or design risk management strategies. They cannot even determine if any group bears a disproportionate share of the negative environmental consequences. Similarly, people cannot determine if they themselves bear a disproportionate share of the negative consequences if they do not have sufficient information.

While information alone is not enough to address a broad range of questions dealing with EJ, it forms the basis for a range of evaluations that include exposure assessment, risk assessment,⁽⁹⁻¹⁸⁾ risk management,⁽¹⁹⁻²¹⁾ natural resource damage assessment and

reparations,^(22–24) cultural/religious exposures, eco-cultural dependency web analysis,^(25,26) and eco-cultural attribute analysis.^(6,8,15,27–29) There is now a substantial literature on environmental justice and equity,^(30–36) and this article adds to this paradigm.

In some cases the inequities are clear, but remain unaddressed. In other cases, the inequities are not fully described or understood, even though it has long been noted that racial and ethnic communities suffer the most severe environmental pollution.⁽³⁰⁾ In this article we provide a template for the kinds of information that are essential to begin to identify potential EJ inequities that will be useful to scientists, managers, and the public itself. Three case studies are provided to illustrate a range of informational needs. Two of the cases involve primarily fish/shellfish consumption, with primary concern for minority and low-income peoples (the USDOE Savannah River Site in South Carolina; nonpoint, urbanized, and industrialized contamination in Newark Bay and vicinity in New Jersey), and one involves Native Americans (the USDOE Hanford Site in Washington). It is not the intent of the article to argue that environmental inequities exist, but rather to provide a template for the kinds of information that managers, scientists, public policymakers, and the public itself should consider when examining the risks of anthropogenic environmental hazards.

2. NEGATIVE ENVIRONMENTAL CONSEQUENCES AND ENVIRONMENTAL JUSTICE

The environmental movement of the 1960s and 1970s that followed the publication of Rachael Carson's *Silent Spring* resulted in the creation of the Environmental Protection Agency, and a range of laws including the Clean Water Act and the Clean Air Act that were aimed at improving human health and the environment. Cleaning up the environment required methods to evaluate the success and efficacy of cleanup methods, as well as assessing the risk to humans and the environment from environmental pollution. The need for consistency in such risk assessments led the federal government to codify a human health risk paradigm, which was soon expanded to include ecological risk assessment.^(9–11) Because many communities need additional information, the Environmental Protection Agency also developed a comparative risk method for adding a community welfare or quality of life component.^(37–39) This concept has been modified to reflect traditional tribal cultural values, as well as secular or social community aspects, that apply to suburban as well as to tribal communities.^(26,40)

The human risk assessment paradigm is a four-part process that includes hazard identification, dose-response assessment, exposure assessment, and risk characterization. For ecological risk assessment the problem formulation phase is critical. The kinds of information that are required for ecological and human health risk assessment are summarized in Table II, and for sociocultural aspects are included in Tables III and IV.

While it has long been recognized that some individuals and classes of individuals are more at risk than others from environmental contamination (e.g., sensitive populations, such as pregnant women and children, people with certain genetic polymorphisms or underlying diseases), the United States and other nations were late in recognizing and addressing inequalities that had to do with the disproportionate exposure burdens often faced by Native

Americans, minorities, rural residents, and low-income communities. Carol Browner, former administrator of EPA, first confirmed that some communities bear a disproportionate share of contamination problems,⁽⁴¹⁾ prompting President Clinton to issue the Executive Order on Environmental Justice (EO 12898) in 1994. It should be pointed out that this Executive Order pertains to federal agencies, and not to industrial facilities or state governments,⁽⁴⁾ although federal regulatory agencies must act on these EJ concepts. EPA focused on promoting alternatives to the usual top-down approach to regulation, and has developed a community-based EJ protection (CBEP) approach that emphasizes the inclusion of diverse stakeholders, including minority, low-income, and EJ communities.⁽⁴²⁾

Advocates of EJ have noted two key failings of risk assessment: (1) traditional risk assessment sometimes focuses on one contaminant at a time, and sometimes then only on carcinogenesis while ignoring mixtures and other stressors, and (2) it has systematically ignored local, nonexpert knowledge by creating barriers between scientists and others.⁽⁴³⁾ Facing increased risks of cancers and other diseases (health disparities) was one of the first areas where examinations of the disproportionate burden borne by EJ communities occurred.

A number of research papers, reports, books, and panels/workshops examined the cancer and noncancer rates in minority, Native American, and low-income communities. A study conducted by the National Cancer Institute, the National Institutes of Health, and the U.S. Department of Health and Human Services, for example, indicated that cancer incidence among Native Americans is lower than the national average, but that their mortality from cancer is higher than average.⁽⁴⁴⁾ However, further data from tribal organizations of the Yakama Nation and other Pacific Northwest tribes suggest that cancer incidence is actually higher than the national average, and that the higher mortality may be due to late-stage diagnosis and limited access to health care.⁽⁴⁴⁾ These findings suggest that the EJ issues include health care disparities as well as health disparities (exposure, incidence, mortality).^(12,45) That is, once a disproportionate environmental burden is identified, the potential for a disproportionately delayed or lower quality health care response also needs to be examined and managed. Disproportionate environmental burdens have particularly been noted for nuclear risk management.⁽⁴⁶⁾

Two other clear examples relate to exposure to lead, where there is overwhelming evidence that subclinical lead poisoning occurs mainly among minority populations in low-income urban areas, with old housing contaminated with lead paint dust,^(4,47) and exposure of farm workers (often migrant workers) to pesticides.⁽³³⁾ The former group often has to choose a cheap place to live over environmental safety, and the latter group has to choose jobs over health and safety.⁽⁴⁾ Similarly, air pollution levels in the Washington, D.C. metropolitan area were found to be higher in the poorer areas of the city where the African-American populations live,⁽⁴⁾ a situation that exists in other large cities such as Chicago, Denver, Los Angeles, San Francisco, and New York.⁽⁴⁸⁾ In these cases, the environmental injustice is due to increased environmental exposures and risks borne by the EJ communities.

It is not the intent of this article to provide or discuss in detail human health risk assessments that focus on EJ,⁽⁴³⁾ or the many exposure scenarios designed to examine exposure of tribal nations,^(14,18,49–52) or other environmental justice communities.^(26,53–56) While this aspect

of environmental justice is clearly very important, and plays into the information provided in the following sections, it is only part of the issue with environmental inequities. It is rather an issue of the total relationship of local residents and their local environment in all its complexity.^(57,58)

3. INFORMATION NEEDS FOR ENVIRONMENTAL JUSTICE

Since the early 1990s federal agencies have been required to ensure the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.^(1,2) This definition, then, has two clear aspects: (1) fair treatment regardless of race, color, national origin, or income and (2) meaningful involvement. Both aspects require in-depth information about resource usage patterns, community demographics, and information about the nature of the environmental costs and burdens. While the collection of demographic information is more straightforward (although more difficult for minority populations), collecting information on the nature of environmental costs and burdens is not, mainly because it depends not on data on health risks (traditional risk assessment paradigms), but on information on medicinal, cultural, and religious aspects of the communities (and range of communities) present on and around the site of interest.

There are clear informational needs for ecological and human health that apply to all situations and populations (Table II). These information needs are basic to determining whether there is a risk to humans or ecological receptors. While information on demographics and income can relate to Native American, minority, and low-income populations, such information is not always gathered.

There are additional information needs that are required to examine the risks (both exposure and health risks) to American Indians, other ethnic groups, and low-income Americans (Table III). While this table includes some information generally gathered for all communities while examining risk, there are other specific needs that include more cultural, medicinal, and religious activities that might otherwise be ignored. It is this group of activities and exposure pathways that are sometimes ignored when examining disparities in exposure, risk, and health outcomes. Many of these activities and exposure pathways require healthy and uncontaminated ecosystems, but they may not be directly considered when examining ecological or human health risk.

It must be emphasized that EJ communities must participate, and where possible, collaborate with scientists and managers to derive the information needs for their own communities.^(8,13,15,19) That is, the informational needs must derive from the communities themselves, and be constantly updated and modified with collaboration with EJ communities. Some communities, particularly in areas with recent immigrants, require periodic identification of new cultural, religious, and nutritional patterns.

The identification of rural EJ populations, particularly Native Americans, is not always obvious if an impacted area is not directly on a reservation. The homelands and natural resources important to Native Americans often include off-reservation resources unknown to the regulators or risk assessors, so demographics and resources may need extra consideration

in combination in order for a regulatory agency to identify if government-to-government consultation may be needed.

4. ISSUES UNIQUE TO NATIVE AMERICAN COMMUNITIES

Native American and Alaskan Native communities provide a unique situation because they frequently face environmental exposures that are greater than those faced by other EJ communities because of their greater contact with the environment. Additionally, the disparities in sociocultural or ecocultural impacts is often greater in Native American communities than in suburban communities. Tensions may occur between different cultures over the uses of the same resources, although the use is not always consumptive. For example, the dispute between the Hopi, the Navajo, and the Peabody Western Coal Company (as well as local white residents) has to do with how water is used. The Hopi use water as a major part of their identity, religious beliefs, rural practices, and daily life. A natural spring that is flowing is absolutely key to their religious ceremonies, especially a sacred spring altar and ceremony.⁽⁵⁹⁾ Yet the coal company used the water to transport coal slurry to the Mohave Generating Station in Nevada, and the local residents use the water for hot tubs, heated pools, and drinking.⁽⁴⁾ In this, case, the environmental inequality in the resource use (water) was well established. The problem was not one of lack of knowledge, but of the inequities themselves.

Many Native American peoples and other environmental justice communities do not draw a clear line between environmental, cultural, historical, and spiritual aspects of their world: all matters are connected,^(35,60) and it is this interconnection that has often been ignored in data gathering and information provision. Native American ties to the environment are much more complex and intense than is generally understood by risk assessors.⁽⁶⁰⁾ Many tribal cultures are essentially synonymous with and inseparable from the land and its resources. The quality of the sociocultural and eco-cultural landscapes is very important, as is the quality of individual natural resources or ecosystem integrity. To many Native Americans, individual and collective well-being is derived from membership in a healthy community that has access to, and utilization of, ancestral lands and traditional resources. This wellness stems from and is enhanced by having the opportunity and ability to live within traditional community activities and values. Tribal elders draw upon an ancient storehouse of environmental knowledge that has been built over thousands of years using environmental observation and teaching younger generations how to live and behave. This lifestyle is resilient and has persisted through floods, droughts, cataclysms, upheavals, and warfare. This environmental management science has long been codified into traditional tribal laws for daily living and for religious practice.

The traditional environmental management science, which guided this eco-cultural system, was eminently practical. Language and ethics were highly developed, laws were codified, governmental structures were strong yet flexible, crime and disease were low, and food was adequate. The lifestyle evolved with a confidence that through wise environmental management there would always be enough resources and food for the community over time, even if there were lean years. Generosity to the community was held in the highest esteem. A person's failure to take care of the people and the environment was considered

wrong, and the accumulation of excess resources was seen as antisocial, especially if it was at the expense of others through waste, displacement, theft of property, or rights of ownership, access, or use. These traditions, each of which is unique to a particular tribe and its homeland, are woven into complex tapestries that extend from far in the past to long into the future. All of the foods and implements gathered and manufactured by the traditional American Indians are interconnected in at least one way, but more often in many ways. Therefore, if the link between a person and his/her environment is severed through the introduction of contamination or physical or administrative disruption, the person's health suffers, and the well-being of the entire community is affected.⁽⁶⁰⁾

For American Indian tribes, therefore, the existing environmental justice approach may sometimes be unsuitable, primarily because the disproportionate impacts to tribes is more often a question of natural resource use rather than demographics. A framework for evaluating cumulative tribal risk has been proposed.^(6,16) The rating includes three factors for eco-cultural risk, as follows (Table IV).⁽⁴⁰⁾

- *Resource Identification.* The resource identification description of a site or area is defined as the probability of a resource of importance being present or being impacted. This includes sacred sites, historical/archaeological sites, burial sites, and sites containing important traditional cultural materials or with associated cultural uses or history, or general community importance (values, recreational areas, physical features by which the community identifies itself, etc.).
- *Damage Potential.* This parameter describes the existing condition, existing stressors, and potential for damage due to physical disturbance, contamination, desecration, or aesthetic degradation. Predicted peak concentrations, time to impact, and resiliency of the affected system are also estimated. This metric is also termed "Degree of Vulnerability."^(37,61)
- *Consequence Potential.* This parameter represents the combination of the first two parameters (the probability of a resource being present and the probability of damage). One consequence might be restricted access or loss of future use options, and associated impacts such as loss of place names or a cultural skill associated with loss of access.

5. ISSUES DERIVING FROM EXCESSIVE HUNTING OR FISHING

While Native Americans and Alaskan Natives face great environmental exposures because of their dependence on the land for cultural and religious life ways, other low-income and minority groups may face excessive environmental exposures because of their culture and nutritional needs. While many Native Americans do not draw a line between environmental, cultural, historical, and spiritual aspects of their world,^(36,60) others that fish or hunt extensively also may not draw a line between their hunting and fishing traditions (or needs) and environmental contamination of media, fish, and game.^(8,73)

Often, low-income and minority communities in rural areas rely heavily on fish or game to provide protein, and fishing and hunting have become integral to their culture. In much of the southern United States, blacks and other low-income or minority communities depend

upon fishing for protein, and fish has been incorporated into church socials and other gatherings, such as fish fries.^(8,56) Giving fish to those less fortunate, or to family or friends (a cultural tradition in many rural areas), increases the risk of exposure to contaminants while cementing social relationships and networks.⁽⁵³⁾

Similarly, low-income and minority communities in urban environments are often exposed to contaminants through fish and shellfish consumption due either to economic need for the protein or to cultural practices, often due to their recent immigrant status. That is, there is an influx of immigrants in many urban environments, and some of these bring a culture that includes extensive resource use through much or all of the year. For example, in metropolitan New York and New Jersey, there have been recent increases in immigrants from Asia who consume bird eggs, shellfish, and fish in excess of consumption rates of the majority population.^(54,55,73,74) For these communities, fishing serves both a subsistence function (providing protein), a recreational one, and a cultural one.⁽⁵⁵⁾ These three functions often cannot be separated, and when asked, people within these communities often rate relaxation, to be outdoors, and communing with nature much higher than obtaining fish to consume.⁽⁵⁵⁾

For both urban and rural communities where fishing plays an important role for subsistence, cultural, and recreational needs, all three of the factors listed above for Native Americans (resource identification, damage potential, and consequences) are important and essential to identifying environmental justice issues and concerns. However, we add a fourth for these communities: *Community Identification*. While Native American and Native Alaskan communities are well identified, environmental justice communities that involve low-income and minority communities in urban and rural setting have not always been identified or recognized. Failure to recognize these communities may occur because: (1) they may be scattered among majority communities that are not heavily exposed through fish, shellfish, game, or cultural/religious practices, (2) their populations may be low and not easily identified, (3) they may be invisible because they do not purchase licenses, boats, or other expensive equipment, (4) they may be isolated by language or cultural barriers, or (5) they may be recent immigrants to their communities.

6. CASE STUDIES

We use three case studies (the Hanford Site, Washington; Newark Bay, New Jersey, and the Savannah River Site, South Carolina/Georgia) to examine informational needs.

We first consider a case study from Hanford (Table IV). It is a case study of a constructed scale that provides information about sociocultural impacts that can be considered in combination with human health and ecological risk assessment results. The example in Table IV assumes that the EJ populations are known, by virtue of having identified them using the information previously gathered (Tables II and III) and is tailored to a specific location at the Hanford Site that is known to have tribal resources and uses associated with it. The underlying interview questions would be site-specific and would be different for each different site. In the test case shown in Table IV, a systematic evaluation of data from the interviews could be compared to data from another population such as the local nonnative

community. In this case, the descendants of early settlers might have some historical interest in the area, but the archaeological data, native cemeteries, and sacred sites would clearly show a much greater EJ impact to the native than to the nonnative populations. A purely demographic approach would not reveal this.

The approach shown in Table IV can then be combined with the information provided in Table V to provide sufficient information on environmental justice communities. For example, some of the variables can be quantified (e.g., g/day of fish consumption or game consumption, days on the site), and others require a qualitative or semi-quantitative examination of factors (e.g., loss of habitat, ability to provide unimpaired religious, cultural, or medicinal activities). Further, many Native Americans have high consumption rates of both fish (including shell-fish) and game, and both must be considered. West-coast salmon rivers, for example, supported a well-documented original (or baseline) consumption rate of 500 pounds per person per year (620 gpd), which was affirmed in *United States v. Washington* (the “Boldt decision”). The Hanford example also shows that Native Americans potentially have a significant human health risk through each individual exposure pathway, and there is an even greater disparity when all exposure pathways are considered cumulatively.

The Savannah River example provides an example of exposure through fish consumption where the EJ inequities are typical of both minority and low-income disparities in exposure, coupled with educational differences (Table V). EJ evaluations often examine both racial/ethnic disparities and income disparities, but seldom have information on educational level and its relationship to exposure disparities. There were clear and significant differences in fish consumption rates, with blacks consuming higher levels of highly contaminated fish.⁽⁵³⁾ Blacks had significantly lower incomes than whites. Although the consumption curves for blacks and whites were similar as a function of education, the consumption curve for blacks was higher than for whites. That is, for every educational group, blacks consumed significantly more fish than did whites. This EJ community was not previously identified because they fished along a stretch of the river without marinas, bait shops, or other high-end fishing tackle stores, they used small boats or fished from the shore, and sometimes fished without licenses.

Finally, Newark Bay provides another example of the kinds of information required to adequately evaluate the relationship of ecosystems (and their resources and attributes) to human health (Table V). Consumption rates of fish vary widely from 23 g/day for blacks, to 41 g/day for Hispanics and 52 g/day for Asians.^(54,55) Moreover, these populations are shifting with time as new waves of immigrants come to the New York/New Jersey harbor and begin to use these resources. While consumption provides an important aspect of ecological resource use, there are other risky environmental behaviors such as the cultural and religious use of mercury.^(62,63) For this population, community identification was a critical factor. This example illustrates the importance of considering not only exposure through goods and services that ecosystems provide, but other, often deliberate, environmental exposures.^(75–77)

7. CONCLUSIONS

Understanding the informational needs for evaluation the ecological and human health risk to EJ communities is complicated, and in this article we provide a template for these evaluations and some case studies to illustrate the approach and information required. The information needs include not only the standard information for ecological and human health risk assessments (Table II), but information on a range of other categories, such as consumptive and nonconsumptive uses, maintenance and cosmetic activities, medicinal, religious, and cultural activities, interconnectivity, and eco-cultural attributes (Table III). As we become more aware of the variability in cultural, medicinal, and religious activities of EJ communities, other aspects of each type will emerge that relate directly to exposure and ecological resources. The examples provided in this article will serve as a starting point for expansion to include unusual and unique exposure routes.

Further, there are methods for scoring impacts of contaminants on ecological resources and human health that can be used to examine disproportionate EJ impacts (Table IV). This kind of examination can best be completed after the parameters in Table III are both delineated and described. Such a delineation can then lead to developing an appropriate questionnaire or survey of EJ community members (or of elders or community leaders) to complete a resource identification, harm potential, and consequence potential matrix for each EJ community in question.

The three examples we present lead to several generalizations: (1) each EJ community differs in the importance of each variable, (2) each EJ community requires careful identification of the activities that fall into each major class of activities, (3) many EJ communities are defined by racial/ethnic identity, economics, and educational level, and the interactions among these variables need to be considered, (4) some EJ communities may face unusual, excessive (e.g., fish consumption) and unique exposures (e.g., mercury use for cultural purposes) that have to be considered holistically, (5) Native Americans and Alaskan Natives may face additional exposures because of their unique and excessive use of ecosystems and their resources, and (6) shifting demographics (including immigration) need to be considered, making it essential to periodically review EJ communities and their environmental risks. This article suggests that ecological resources and their attendant ecocultural attributes need to be considered holistically when evaluating the risk to EJ communities. Too often risk assessors consider the risk from one excessive and unique exposure (e.g., high fish consumption) without considering the whole range of unusual exposures the EJ population faces. It is this combination of unusual, unique, and excessive exposures that has the potential to provide even greater environmental inequities than previously considered.

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Table I**Definitions of Environmental Justice, and Its Applications**

The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. ^(1,2)
Racial, ethnic, or socioeconomic groups should not bear a disproportionate share of negative environmental consequences resulting from industrial, municipal, and commercial operations, or from the execution of federal, state, or local laws, regulations, and policies. ⁽²⁾
Meaningful involvement requires effective access to decisionmakers for all communities to make informed decisions and take positive actions to produce environmental justice for themselves. ⁽⁵⁾
A condition of environmental justice exists when the environmental risks and hazards, and investments and benefits, are equally distributed with a lack of discrimination, whether direct or indirect, at any jurisdictional level; when access to information, participation in decision making, and access to justice in environmental-related matters are enjoyed by all. ⁽²⁴⁾

Table II

Overall Needs for Ensuring Protection of Human Health and the Environment Around Contaminated Facilities; These Are the Basic Concepts Needed to Evaluate Human and Ecological Health (After NRC;^(9,11) Harper and Harris;⁽⁶⁾ Burger *et al.*^(64,65))

Ecological
Identification of different population through spatial/ecological analysis
Identification of ethnohabitat attributes (who cares about what resources)
Sources of radionuclides and contaminants, with natural barriers
Transport pathways (hydrological, geologic, and biological)
Species, populations, communities, ecosystems, and landscapes
Habitats and biomes
Threatened and endangered species and habitats
Unique assemblages or unusual phenomena
Relative importance of on-site habitats to local and regional habitats
Chemical/radiological thresholds for effects (by species groups)
Service flows from the affected resources
Human Health
Demographics (age, gender, population numbers, spatial distribution)
Income information for different populations and racial/ethnic groups
Differences in the relation to the local environment among subpopulations
Information systems in place
Population characteristics (expanded demographic information)
Vulnerable populations
Exposure pathways
Exposure assessment
Contaminant/radiological assessment (media, biota)
Hazard identification, thresholds, and effects levels
Dose-response curves and information
Extrapolation to humans from animal studies
Human health risk distributions among subpopulations

Table III

Environmental Justice (EJ) Informational Needs for Native Americans, Other Ethnic Groups, and Low-Income Americans Exposed Around Contaminated Sites (After Harris and Harper;⁽²⁶⁾ Harper and Harris;⁽¹⁶⁾ Burger *et al.*;^(8,65) Harper *et al.*⁽⁶⁶⁾); This Information Needs to be Integrated with the Usual Human Health Data Taken for Risk Assessments (Such as Cancer and Noncancer Incidence, Morbidity, and Mortality)

Ecological resource usage patterns of region
Identification of EJ populations who use resources from the impacted zone
How important are those resources or places to the EJ population?
Is the affected area linked ecologically, culturally, visually, or hydrologically to tribal or other EJ population resources or uses?
Is a tribe a Natural Resource Trustee of the affected resource or lands?
Is the affected area within a tribal historic area, a traditional cultural property, or a tribally important landscape?
Demographics of region
Types and percent of EJ populations
Proportion of EJ population affected by the stressor
Age distribution of EJ groups (for exposure assessments and risk)
Gender composition
Economic and education of EJ populations (relationship to majority population)
Changes in these populations over the last 10 years
Differences between local/regional EJ population and majority population
Consumptive and nonconsumptive uses
Daily and seasonal consumption patterns by Native American or other EJ group
Daily and seasonal consumption patterns by biota species, parts, and preparation
Unique consumption patterns by group and season
Presence of high one meal/day consumption (feasts, fish fries, socials)
Inadvertent consumption patterns (e.g., children eating dirt)
Daily and seasonal patterns for religious, cultural, recreational, or other activities
Species, types, seasonality, and exposure from commercial foods
Maintenance and cosmetic
Occurrence of tribal sweat baths
Use of sand or soil or plant material for maintenance or cosmetics
Use of unique substances for religious/cultural practices
Medicinal, religious, and cultural
Occurrence of tribal sweat baths
Species, types, seasonality, and exposure from herbs or other medicines
Potential role of commercial medicinals in relation to self-gathered
Types and frequencies of religious events or ceremonies
Types and frequencies of individual religious observances
Types of on-site, nonconsumptive uses, such as Vision Quests or Dream Quests
Other
Interconnectivity
Interrelationships between organisms and their environments that are central to Native American or other cultural entities (resource-central, multiple resource-base)

On-site and off-site dependence resource webs

Eco-cultural attributes

Degree of visual and nonvisual impairment because of anthropogenic activities

Loss of ecological, cultural, and religious resources because of ecosystem degradation

Ability of the habitat to provide cultural/religious lifestyle

Ability of the habitat to provide clean air and water for cultural/religious activities

Ability of a given habitat (or ecosystem) to provide for the cultural/religious needs of Native American, other ethnic groups, and low-income peoples.

Table IV

Ranking Sites for EJ Disproportionate Impacts: Hypothetical Example of Impacts to Resources, Activities, and Values at a Hanford Site (Harper *et al.*⁽⁴⁰⁾)

Metric	Maximum Possible Score	Actual Score	Comments
Resource Identification			
Likelihood of natural or cultural resource of importance to a tribe being present within the impact zone	50	50	Known village, burial, ceremonial sites, prime habitat
Total area impacted (based on acreage or river miles)	25	25	Entire area river shoreline of the affected zone
Types of sites/resources (e.g., T&E, medicinal, cultural landscape)	150	150	Multiple types, sites; prime ecological area, known traditional cultural property and archaeological district
Existing condition (existing quality and/or potential restoration success)	25	20	Surface largely undisturbed
Harm Potential			
Imminence of harm	50	50	High urgency
Severity of harm	100	100	Varies with the degree of environmental contact, i.e., the human use and exposure scenario
Reversibility/duration	100	100	Would be irreversible
Consequence Potential			
Potential to limit access or use over time	25	25	Full loss of use, depending on scenario for hundreds or thousands of years
Potential resource loss	25	25	Irreplaceable; small potential for natural recovery
Potential impact on recreational quality and use	25	15	Recreational use of the river may be reduced
Proximity to river	25	25	Very close to river make it a higher consequence
Degree of trusteeship responsibility	25	25	Multiple ecological, cultural resources
Potential for multigeneration impacts	25	25	Cumulative health and cultural impacts over many generations.
Potential for limiting future land-use options	25	25	Depending on scenario, could restrict all future uses
Totals	825	755	Extremely high priority to protect and restore safe access and use
<hr/>			
Summary of Threat	Score	Comments	
Resource Presence Probability	245 out of 250	There are known village, burial, ceremonial sites, and prime shoreline and habitat areas; part of the area is disturbed	
Harm Potential	250 out of 250	Damage to cultural factors would be essentially irreversible; high urgency to prevent harm	
Consequence Potential	255 out of 325	High existing and future impacts to access, resources, river, trusteeship, multigeneration impacts, and other site values and principles	
Total	750 out of 825	This site should be a priority to protect, remediate, and/or restore	

Table V

Case Studies to Provide Examples of Key Information Needed; Table Can Be Used to Identify Data Gaps for Specific Environmental Justice Groups; The Examples Below Do Not Have All Compartments Shown in Table II; For a Comparison of the Majority Population, Information Is Given for the Jersey Shore (a White Population Near Newark Bay), and for a White Population Using the Same Resources Along the Savannah River; NA = Not Applicable

Characteristic	Hanford, WA	Newark Bay, NJ	Jersey Shore, NJ	Savannah River, SC	Savannah River
<i>Ecological or Spatial Identification</i>					
<i>Demographics</i>					
EJ group	Native Americans				
Percent of population ^a		Minority (Hispanic, Asian)	White	Black	White
Age distribution					
<i>Consumptive and Nonconsumptive</i>					
Fish consumption (g/day)	620 gpd ^g	37–52 gpd	20–30 gpd	48–70 gpd	26–38 gpd
Game (g/day)	125 gpd				
Unusual patterns	Feasts	Picnics	Fishing tournaments	Fish fries	None
Total days on site	365				
<i>Maintenance^b</i>					
Special events		Use of cosmetics	None	None	None
Cultural/religious ^c					
Religious	Prolonged on site for quests, ceremonies	None	None	None	None
Religious	Sweat baths				
Cultural	Use of medicines	Use of mercury	Fishing clubs and tournaments	Fish fries	Fish fries
<i>Eco-Cultural Dependency Webs^d</i>					
Relationships among biota	Salmon web, food chain webs	Fishing webs	Fishing clubs and fishing webs	Fishing webs	Fishing webs
On-site and off-site webs	Webs for different locations	NA	NA	NA	NA
Resource use	Total resource use	Total fish/shellfish use in estuaries	Total fish/shellfish use in bays and ocean	Total fish use in river	Total fish use in river
<i>Eco-Cultural Attributes^e</i>					

Characteristic	Hanford, WA	Newark Bay, NJ	Jersey Shore, NJ	Savannah River, SC	Savannah River
Visual or nonvisual impairments	Contaminated buildings and habitats	Heavy industrialization	Light industrial, marinas, and residential	Contaminated buildings from SRS ^f	Contaminated buildings from SRS
Loss of habitat	Yes	Yes	Yes	Yes	Yes
Loss of eco value of land	Yes	Yes	Yes	Yes	Yes
Ability to provide clean air or water	Impaired	Impaired	Impaired	Impaired	Impaired
Ability to provide unimpaired religious. or cultural experiences	Impaired	Impaired	Impaired		
Sources	(14, 26–28, 66–70)	(54, 55)	(55, 73)	(53, 71, 72, 75–77)	(53, 71, 72)

^aNeed to define and distinguish between sampled population, and population residing in the region.

^bRequires extensive data on the type, duration, and exposure of each activity.

^cRequires definition of types of ceremonies or events, types of exposures, and types of people involved.

^dRequires extensive mapping of webs.⁽²⁶⁾

^eRequires extensive data to determine attributes.^(8,65)

^fSRS = Savannah River Site.

^gHistoric American Indian consumption.