Perceptions of Environmental Quality and Risk in Beach Recreation

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Abstract

This paper explores the associations among three interconnected issues related to beach management in Southern California: characteristics of beach users, perceptions of environmental quality and risk, and recreation behavior. Using telephone survey data collected in Los Angeles during the summer of 1999, this study assesses how the personal characteristics of the people using the beach may affect their perceptions about environmental quality and risk. Survey results indicate that media sources of information and past experience contribute to an individual's perceptions of ocean water quality and the environmental health risks associated with bathing in polluted waters.

KEY WORDS: risk perceptions, marine environmental quality, beach recreation

Running title: Environmental Perceptions

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1. Introduction

In order to develop effective management strategies based on projected demand for coastal recreation, managers must first assess how people use and perceive beaches. In light of the inherent heterogeneity in recreation preferences among users and across sites, one generalized management strategy may not be suitable for all beaches. In addition, perceptions of environmental quality and health risks associated with swimming in polluted water differ among individuals at any particular beach. A person's socio-economic status, cultural ties, and past experiences influence how they perceive environmental quality (Renn et al., 1992). In addition, familiarity with, or exposure to information about, environmental quality can interact with these personal attributes to affect overall perceptions.

Because an individual's perception of environmental quality and risk may affect their behavior, diverse perceptions among beachgoers will result in unique recreation patterns at any particular beach. To properly manage beaches it is necessary to understand people's motivations for using the beach and the ways in which perceptions of risk and the environment influence these motivations. Such an understanding of perceptions is required to accurately predict how people will use the beach in the future.

Maintenance of coastal environmental quality for recreational purposes is an essential element of any beach management plan (Goodhead et al., 1996). In Southern California, stormwater pollution is a critical factor affecting environmental quality along the coast. Increased awareness about the deleterious effects of stormwater pollution on coastal water quality has raised concerns about how this pollution affects peoples' decisions to use the beach. During the summer of 1999, the stormwater pollution problem took the front page of many local newspapers in Southern California. In one particular case, high bacteria counts closed Huntington State Beach, a popular Southern California beach, during July and August including the 4th of July, one of the busiest holiday weekends of the year (Orange County Register, Los Angeles Times, August

1999). Such beach closures make public the devastating impact that water pollution can have both on the health of the marine ecosystem as well as on the local economy. News coverage of beach closures and the associated pollution problem can affect people's perceptions of coastal environmental quality and, consequently, their decisions about how to use such recreation areas in the future.

From the public's perspective, beach closures and hazard signs serve as indicators for water quality and the health risks associated with bathing in polluted waters. However, it is unclear exactly how such signals affect public perceptions of risk (Kahneman et al. 1982, Slovic, 1987). According to one report by the Santa Monica Bay Restoration Project (SMBRP), a significant portion of the public does not visit the Bay because of their concern about water pollution, claiming, "I might get sick if I swim in the water" (SMBRP, 1992). In our own study we found that 5.4% of all respondents refused to go in the water because they thought it was too polluted. More than 16% said that they didn't plan on going to the beach at all for this very reason. Such fears may be well founded. An SMBRP epidemiological study completed in 1996 found that individuals who swim near flowing storm drains are 50 percent more likely to develop a variety of symptoms including fever, nausea, gastroenteritis, and sore throat than those who swim 400 yards away from the same drains (Haile et al. 1996).

Uncertainty about the extent of stormwater diffusion in coastal waters makes it difficult to assess the impact that this pollution source will have on bathing water quality at any one particular beach. In the past, beach managers have focused on keeping people away from pollution "hotspots". However, in many cases, people are unaware of pollution conditions or pollution risks. Consequently, some beachgoers may be at greater risk. Identifying and understanding the way personal characteristics or external factors influence people's perceptions of water quality could help managers develop appropriate strategies to reduce exposure to marine pollution.

Even when experts can effectively assess water quality conditions and quantify bathing health risks, communicating such risks to a diverse user group becomes problematic. Managers are required to protect beachgoers by posting hazard signs near stormdrain outlets and closing beaches if unusually high bacteria levels are detected. SMBRP asserts that as long as swimmers abide by these warnings, entering the water at the beach should not pose a significant health risk. However, this presupposes that all individuals receive the same, complete, level of information about the risks. This may not be an accurate assumption. Furthermore, effective communication of risk may be complicated by personal characteristics that downplay the risk in the minds of particular users (Golden et al., 1996). For example, people may ignore signals such as hazard signs because they do not perceive stormwater pollution as a significant threat to their well-being.

Often it is difficult to provide information about environmental risk without over-sensitizing people to the very same risks. Depending on how people interpret information about bathing risks, communication efforts may unduly deter people from beach recreation altogether (SMBRP, 1992). It is easy to see how people with incomplete information about water quality might believe that all coastal water in the region is hazardous. In addition to the negative impact this has on commercial beach businesses, public misperceptions of risk may translate into a loss of a popular recreation amenity for many users.

Coastal managers must seek a better understanding of how beachgoers form their perceptions of risk and how these perceptions affect user behavior, especially beach choice and the likelihood of exposure to marine pollutants. Such insight can have particularly important implications for beach management if we can identify particular personal and demographic characteristics that affect patterns of perception and recreation activities. This information could be combined with projected demographic changes for Southern California in extrapolating beach recreation levels and patterns for the future.

2. Theoretical Background

Risk Perception and Recreation Research

We approach our examination of water quality perceptions by drawing on two distinct, but relevant, literatures: namely; risk perception and recreation/leisure studies. The following sections summarize relevant arguments from each of these fields. We draw from these findings in order to create a model that explains factors influencing the formation of environmental risk and quality perceptions for Southern California beach users.

Risk Perception

The bulk of risk perception research traditionally has focused on exploring public perceptions about risk (Jackson et al., 1989*)*. Such information is useful to managers and policy analysts in predicting how the public will react to new technologies such as nuclear power or potentially hazardous management decisions such as the construction of a new landfill. Coastal managers also can use this type of information in predicting how beachgoers will respond to information about particular health risks associated with bathing in water polluted by stormwater runoff. In order to effectively communicate risks to the public, managers must first recognize the interconnectedness of how the public forms their perceptions about risk and their effective responses (Slovic, 1987).

One significant complication in effective risk communication is the divergence in risk perceptions between the layperson (or public) and the expert (Margolis, 1996). The layperson interprets risks via complicated psychological processes (Kahneman et al., 1982). Their "quantification" of risk often is independent of technical risk assessment factors used by experts. It is suggested that an individual's values, attitudes, social influences, and cultural identity influence how they perceive risk (Renn et al., 1992). Individuals within the public sphere will necessarily vary in how important they view the same risk issues (Marris et al., 1996). Consequently, managers cannot view the "public" as a homogeneous group in terms of the way people perceive and react to risky technologies or situations.

Two theories that dominate risk perception research are the Psychometric Paradigm and the Cultural Theory of risk perception. Psychologists Slovic, Fischoff and Lichtenstein first proposed the Psychometric Paradigm in 1978 (Fischoff et al., 1978). The "psychometric paradigm" prescribes the use of multivariate analysis techniques to produce quantitative representations or "cognitive maps" of risk attitudes and perceptions (Slovic 1987). They argue that the layperson uses a number of qualitative characteristics such as "voluntariness," "immediacy of effect," and "catastrophic potential" in characterizing risk. By exploring such qualitative variables in individual risk formation, the theory seeks to establish a "taxonomy for hazards" that can be used to understand and predict public responses to risk (Slovic, 1987).

The Cultural Theory of risk perception examines the individual's perception of risk in terms of cultural influences affecting that individual's worldview (Douglas and Wildavsky, 1982). This theory challenges the psychometric paradigm in that it looks beyond the individual to the cultural context in which risk perception takes place. First proposed by Mary Douglas, this theory holds that an individual identifies themselves with certain organizations and that these associations will remain constant in all areas of their life. In terms of risk perception, an individual's perception will be rooted in social and cultural groups that they identify with, regardless of the setting. In effect, their formation of risk perception cannot be removed from cultural influences. The Cultural Theory was tested empirically by Dake in 1991 using a 'Cultural Biases Questionnaire'. Dake argues that while it is the individual who perceives risk in a particular situation, culture provides "socially constructed myths" or beliefs that are internalized by the individual and necessarily affect how they interpret hazardous situations (Dake, 1992).

While not explicitly testing either of the two dominant paradigms of risk perception, our study draws on various components of each in the attempt to understand factors contributing to environmental quality and risk perception formation in southern California beachgoers. For example we will explore associations between education, ethnicity, and income in relation to an individual's perception of risk. These various influences may provide an individual with

"socially constructed myths" or risk paradigms, which will necessarily affect their perceptions of marine environmental quality and risk.

Leisure and Recreation Patterns

People using the beach differ in many ways, including the types of recreation activities they undertake as well as their personal characteristics and perceptions about their recreation environment (Bird, 1996). Furthermore, combinations of individual leisure patterns dictate how certain recreation areas will be managed (Jackson et al., 1989). Preferences for particular activities such as biking or picnicking will require investment in such managed amenities as bike paths or tables. Likewise, a greater number of swimmers in a particular area may require greater investment in lifeguards or hazard signs (Siderelis et al., 1998).

Differences in recreation patterns necessitate a greater understanding of how individuals within each user group participate in beach use. Sociologists often explain such differences in "style", or bundles of activities, using demographic variables such as age, income, and gender (Kelly, 1989). In 1962, the Outdoor Recreation Resources Review Commission (ORRRC) completed several studies on socioeconomic patterns of outdoor recreation. General findings included correlations between participation and various socioeconomic indices; outdoor recreation participation generally increased with an individual's level of education and income and decreased with age (Lindsay et al, 1971).

Subsequent research suggests a more complex relationship between individual characteristics and recreation patterns. In addition to looking beyond simple socio-economic explanations for participation patterns, leisure research has examined style and behavior rather than just participation levels (Jackson et al., 1989). Field et al (1974) argue that by focusing solely on participation at recreation sites, early studies ignored the human behavior that determines how this participation will take place. The authors argue for a broader "socio-cultural" understanding of the recreation experience. Other studies examine how social

interaction patterns among participants occur (Dottavio et al, 1980, Field et al., 1974, Field et al., 1973, Christensen et al., 1973, Burch et al., 1969).

More recent leisure studies focus on socio-cultural explanations for recreation participation and style (Jackson et al., 1989). Social psychologists, for example, describe differences in user patterns based on individual preferences and value structures (Kelly, 1989). A number of leisure studies investigate cultural differences among recreation participants (Carr et al, 1993, Irwin et al., 1990, and Floyd et al., 1993). This research suggests that cultural beliefs and norms affect the way in which an individual experiences and perceives recreation areas. Site choice is one aspect of recreation behavior that might be influenced by cultural factors (Carr et al., 1993). People may choose recreation sites based on a sense of cultural unity or familiarity (Burch et al., 1969). Information about recreation use among ethnic groups could be used to enhance recreational amenities in a way that could reinforce cultural norms and values, if that is a decided management goal (Irwin et al. 1990).

Others have examined how increases in minority populations will affect future recreation patterns (Murdock et al., 1990, Murdock et al., 1991). In the case of coastal and beach management, information about a particular group of participants, say Mexican-Americans, has management implications in terms of assuring effective risk communication in Spanish. This is particularly applicable to coastal management in Southern California.

The Link Between Environmental Quality Perceptions and Recreation Decisions

Niepoth and others provide a theoretical framework for considering recreation behavior called "the opportunity framework". (Niepoth, 1973, McClaskie et al., 1986). This theory suggests that an individual's "opportunity" to participate in recreation activities is determined or influenced by a combination of personal characteristics and their environment. In the context of beach recreation, one of these personal characteristics is the individual's perception of risk associated with ocean water pollution.

Several factors contribute to the complex interaction between information about environmental quality and risk and an individual's behavior. Sources of information about pollution and the coastal environment may influence the way in which people develop perceptions about beach quality. The media often serves as the primary source of information about environmental risk (Byrd et al., 1996). However, other studies have shown a weaker correlation between public understanding of environmental problems and regional press coverage of the issues (Gooch, 1996). Research by Gooch (1996) reinforces the importance of factors such as personal experience with local environmental problems and interpersonal communication in explaining public perceptions of environmental risks (Gooch, 1996). Golden (1996) suggests that ethnicity can play a significant role in the "information receptivity" of individuals, independent of potential language barriers (Golden et al., 1996).

Past experiences may affect an individual's recreational behavior by influencing how they perceive risk or other aspects of the particular experience. Schreyer et al (1984) use the "Experience Use History (EUH)" framework to describe the linkage between an individual's internal psychological processes and their external, or recreational experiences. This linkage is important because it is an indicator both of the types and the extent of information obtained by an individual during an activity. The framework also gives insight into the motivation behind people's recreation behavior. Schreyer et al. (1984) found that past recreation experiences had a significant effect on a) an individual's behavior at a recreation site, b) motives for participation, and c) perceptions of the environment (Schreyer et al., 1984).

3. Environmental Risk, Environmental Perceptions, and Beach Use in Southern California

Factors Influencing Environmental Perceptions

This study looks explicitly at Southern California residents and how their personal characteristics may affect perceptions of environmental quality and risk. As discussed earlier, multiple factors affect the ways in which an individual both perceives the quality of a particular

recreation site and how they use this area. Our study focuses on four potential determinants of risk and quality perceptions in Southern California residents: 1) information, 2) past experience, 3) culture, and 4) socio-economic characteristics. These four categories of proposed perception determinants are described below and in Table 1:

(1) Information Factors

The Information Factors capture an individual's exposure to news stories about water quality and "signals" such as hazard signs and beach closures. It is hypothesized that the quantity and types of information received will affect how individuals perceive risk and environmental quality.

Local newspapers such as the Malibu Surfside News and the Daily Breeze disseminate information about environmental quality in the area. Larger regional papers (e.g. the Los Angeles Times) also cover water quality conditions, especially when there has been acute water quality impairment. Additionally, the television provides a substantial portion of an individual's understanding of many local issues. Byrd et al (1996) show that in El Paso communities, television was the primary source of environmental information followed by newspapers. To the extent that the media wants to "sell" the story to the public, it may be that "bad news" is more likely to make the front page than "good" news. While the accuracy of the information about environmental quality may not be compromised by this "media agenda," the amounts and types of information that the public receives will be affected. People may have an unwarranted fear of swimming in the ocean if they only hear about the major pollution problems that make the news, and nothing of the improvements over the years.

Slovic (1987) writes that certain "signals" may alert individuals to pollution problems. Reading about beach closures or seeing "No Swimming" signs could increase one's perception of risk associated with swimming at the beach. These same factors may also

influence how they perceive environmental quality today relative to the past (i.e. before they learned of the problem).

We attempt to capture the most significant Information Factors relevant to beach water quality using the following variables:

(a): stories: *"Do you recall seeing or hearing any news stories about water quality at the beach?"*

(b): read np: Indicates whether or not respondent reads the newspaper.

(c): tv: Indicates whether or not the respondent watches television news programs.

(d) closure: *"In the last year, do you recall hearing about any beach closures in Southern California?"*

(e) sign: *"Have you ever gone to the beach and seen a sign warning "No Swimming?"*

(f) env: Indicates whether or not an individual belongs to any environmental groups that may supply the individual with information about environmental problems and pollution.

(2) Experience Factors

The Experience Factors capture past experiences and "familiarity" with the pollution problem. Gooch (1996) demonstrates that personal experience of environmental problems may have a greater effect on public concern for the environment and their perception of associated risks than media sources. Gooch suggests that while information can influence how one perceives such risks, personal experience can modify such perceptions. For beachgoers in our study, we suggest that if an individual has gotten sick after swimming in polluted coastal waters, this experience will modify their perception of risk and environmental quality. It is hypothesized that if an individual has gotten sick after exposure in the past, they are more likely to perceive the ocean water pollution problem as significant. Such a negative, physical connection to the pollution problem will amplify the problem in the individual's mind. In terms of the "Psychometric Paradigm", the risks associated with

swimming in polluted waters will possess the characteristic of "observability" and can be described as "involuntary". These characteristics contribute to the "moral outrage" associated with the model's description of risk amplification (Slovic 1987).

In addition, greater familiarity with the problem, attained through more frequent visits to the beach and/or more years as a resident of Southern California, will contribute significantly to the individual's perception of quality. They can assess, first hand through personal observation how environmental quality may be changing over time. An individual's familiarity with an area, and the beach in particular, will affect their perception of risk and environmental quality. Someone who has lived in an area for a long time ought to be more aware of environmental quality there. Similarly, one who visits beaches may know more about beaches. Frequent visitation also should make knowledge of environmental quality more salient to an individual; the problem should be more important to them because they are more directly affected by it.

We attempt to capture the most significant Experience Factors relevant to beach water quality using the following variables:

(a) got_sick: *"Have you or any members of your family ever gotten sick within two weeks after swimming at the beach?*

(b) # of visits: *"During a typical summer, about how often would you go to the beach?"*

(c) years: *"How many years have you lived in Southern Californi*a?"

(3) Cultural Factors

The Cultural Factors provide proxies for culture including race, language and citizenship. There may be implicit factors associated with an individual's culture such as particular world views, language, and citizenship which may affect overall perceptions.

If culture influences perceptions of environmental quality it may explain part of the cultural segregation seen at beaches in Southern California. Several studies have looked at

the role of ethnicity in recreation patterns (Carr; 1993, Floyed; 1998, Stamps;1985). This is particularly important in Southern California where demographic projections reflect a dynamic population, diverse in culture and race . We hypothesize that culture influences perceptions of environmental hazards and qualities, either because of culturally influenced attitudes or differential access to information. These cultural differences could be very important to managers if cultural differences (e.g. language barriers) lead to beach use that places certain people at greater risk than others.

We attempt to capture the most significant Cultural Factors using the following variables:

(a) Description of Ethnicity:

ntv: Native American
blk: Black
mex: Mexican descent
asn: Asian
hisp: Hispanic (non-Mexican descent)
cauc: Caucasian

(b) Language:

language: Choose to complete survey in Spanish (1) or English (0).

(c)Citizenship:

citz: Whether or not respondent is a US citizen

(4) Socio-Economic Factors

The Socio-Economic Factors category includes education level, household income, age and gender. Socio-economic status or class differences will affect lifestyles and beach avidity (Stamps et al., 1985). One study found that certain groups of people, those who are younger, female, and have lower education and income levels tend to have a higher level of dread associated with hazard risks (Savage, 1992). The author argues that these groups have a greater perceived exposure to a hazard and are therefore more fearful. Flynn et al. (1994) argue that socio-political factors such as power and trust may be significant determinants of

risk perceptions. Individuals that feel they have less power, tend to distrust those in authority such as scientists who attempt to convey environmental risks to the public. This suggests that under-represented segments of society, such as women and ethnic minorities, may have a heightened sense of risk associated with environmental hazards such as ocean water pollution.

To the degree that beach-going is a leisure activity, it may be something of a "luxury good." An individual who has greater resources may be more concerned about recreation quality. Individuals with fewer resources (lower income, lower education level), may be more concerned with issues such as crime and air quality because they are more directly affected by these hazards. Education may be associated with the ability to access and interpret information on water quality. Age, gender, income, and education all could influence recreation preferences and beach activity.

We attempt to capture the most significant Socio-economic Factors using the following variables:

(a) Education:
education**:** 3 categories determined by whether or not individual finished high school, college or above

(b) Income: (measured in income quartiles similar to those used by the US Census)

(c) Age

(d) Gender

Perception of Risk Severity For Different Sources of Pollutants:

We assessed environmental risk and quality perceptions of Los Angeles residents by asking respondents if they thought swimming in water polluted by various sources posed a significant health risk. These pollutant sources included sewage, stormwater, trash, and industry and are summarized below. We sought to differentiate perceived risk among different pollutant sources. Previous studies assessed perceived risk by asking respondents directly, how serious they felt the risk of pollution in coastal waters was to people (Langford et al., 1998, Georgiou et

al, 1998.) In this study, we wanted to illicit responses cued indirectly by the idea of whether or not the individual thought they could personally become ill, or very ill after swimming in polluted waters. We used this two-tiered question format in order to establish a relative scale for risk perceptions (i.e. sick, very sick translates into lower risk perception, elevated perception of risk.)

Risk Indicators:

sew (sewage)
= 0, if they think swimming in water polluted by sewage would not make them sick
= 1, if they think swimming in water polluted by sewage would make them sick
= 2, if 1 (above) do they think it would make them very sick.

stm (stormwater)
= 0, if they think swimming in water polluted by stormwater would not make them sick
= 1, if they think swimming in water polluted by stormwater would make them sick
= 2, if 1 (above) they think it would make them very sick.

tra (trash)
= 0, if they think swimming in water polluted by trash would not make them sick
= 1, if they think swimming in water polluted by trash would make them sick
= 2, if 1 (above) they think it would make them very sick.

ind (industry)
= 0, if they think swimming in water polluted by industrial waste would not make them sick
= 1, if they think swimming in water polluted by industrial waste (oils and chemicals) would make them sick
= 2, if they think it would make them very sick

Perception of Importance

In addition to these four indices of risk perception, we also asked respondents to decide whether the ocean water pollution problem was more important to them than a) crime, b) air pollution, and c) the quality of public education.

imp (importance): From question 5: *"We'd like to know which problems are most important to LA residents today. For each set of issues I read, please tell me which one is most important to you personally:"*
=0, if they never chose ocean water pollution as being more important
=1, if they chose ocean water pollution problem once as the more important issue

=2, if they chose ocean water pollution problem twice as the more important issue
=3, if they chose ocean water pollution problem all three times as the most important issue

Perception of Problem Change

Finally, we asked the respondent whether they felt ocean water quality was better or worse now than five years ago. This question was used as a proxy for an individual's relative sense of pessimism or optimism about the state of ocean water quality.

wworse**:** From question 2.7, respondents were asked: *"Do you think the ocean water pollution problem has gotten better or worse over the last five years?"*

=0, if they think ocean water quality has either gotten better or remained the same over the last five years
=1, if they think ocean water quality has worsened over the last five years

4. Methods and Results

Data Collection

This study was conducted in Los Angeles California during the summer of 1999 and administered from the University of Southern California in association with the USC Beach Project. The survey was part of a larger study assessing the economic impacts of stormwater pollution on beach recreation in Southern California. A final version of the survey was completed at the end of June of 1999 and pretested via phone interviews with Los Angeles County residents. The survey was administered in both English and Spanish (see Pendleton, Martin and Webster, 2000). Phone numbers were acquired through Survey Sampling, Inc (SSI). 4470 units were purchased for the following Los Angeles area codes: 310, 424, 323, 562, 626, 818, 213. Phone interviews were conducted during the months of July, August, and September of 1999. Surveys were performed Monday through Thursday of each week from 6:30 to 8:30 pm.

Each interview lasted approximately 10 to 15 minutes. A total of 404 surveys were completed; 84 of those were in Spanish.

Factors Influencing Perceptions of Risk

Table 1 summarizes the results of respondents' perceptions of risk associated with each of the four pollutant sources: sewage, stormwater, trash, and industry. Clearly, the majority of respondents felt that swimming in water polluted by any one of these pollutant sources posed at least a moderate health risk, if not a potentially serious one. Sewage (89.3%-sick, 72% very sick) and industry (90.1%-sick, 76.9%-very sick) were perceived most commonly as significant health threats.

Risk Perceptions: Results from Probit Analysis

We want to formally explore how psychometric and cultural factors influence the way people perceive health risks associated with polluted bathing waters. To do so we use probit analysis to identify factors influencing whether or not people think they will get sick if they swim in waters polluted by four different pollutant sources; sewage, stormwater, trash and industrial waste. Probit analysis allows us to assess the relative likelihood of an event. In terms of this study, the estimation results indicate whether an individual is "more likely" to perceive risk in a particular way, depending on particular explanatory variables examined. Table 2 gives summary statistics for all variables used in the probit analyses.

We also are interested in determining what people know about ocean water pollution. Like risk perceptions, an individual's awareness of the pollution problem might be influenced by psychometric or cultural factors. An individual's knowledge about the ocean water pollution is examined by assessing their ability to volunteer various pollutants as sources of ocean water

pollution, (i.e. sewage, stormwater, trash, and industry.) Respondents were first asked an open-ended question to provide the interviewer with sources of ocean water pollution. If they did not volunteer any of the four sources of pollutants used in our study, they were prompted and asked to convey perceived risk (see *Perception of Risk Severity* above). We also use probit analysis to determine which factors influence an individual's likelihood of volunteering the various contaminants as potential pollution sources (prior to being prompted.)

Table 3 shows the results from the ordered probit analyses performed for each of the four pollutant sources. The media and other sources of public information such as hazard signs at the beach are important explanatory variables for risk perceptions associated with sewage, stormwater, trash and industry. People who recall hearing news stories about water quality or watch television news programs regularly are more likely to think that they would get sick or very sick from swimming in water affected by urban stormwater outfalls. Individuals who report hearing about beach closures are more likely to think they could get sick or very sick from swimming in water polluted with trash. Likewise, individuals who recall seeing a hazard sign at the beach are more likely to think they would become sick or very sick from water containing industry pollutants. However, individuals who report reading the newspaper regularly are less likely to think they would become sick or very sick from swimming in water polluted by either sewage or trash.

Gender is a significant explanatory variable for people's perceptions about risks associated with trash and industry. Women are more likely than men to report a health risk associated with swimming in water affected by either of these two sources of pollutants. Blacks were also more likely to think they would get sick or very sick from swimming in waters containing either trash or industry pollutants.

Results from the probit analysis on the four pollutant sources also suggest that an individual's perception of diminished water quality significantly affects their perception of bathing health risks. The variable "wworse", which indicates whether or not the individual thinks

the ocean water pollution problem has worsened over the last five years, is included in the risk perception analysis. (We also ran separate probits with wworse as the dependent variable, although this analysis is discussed in the next section.) "Wworse" is a significant explanatory variable for all four pollution source risk factors. If an individual reports that the ocean water pollution problem has gotten worse over the last five years, they are more likely to associate a higher level of risk with swimming in water polluted by sewage, stormwater, trash or industry.

Probit results for the volunteered responses for ocean water pollution sources are shown in Table 4. For each pollutant, various factors contribute to the likelihood that an individual will volunteer it as a source of ocean water pollution. For sewage, an individual is more likely to volunteer it as a source if they've gotten sick after swimming at the beach in the past, recall hearing about beach closures or report a higher level of education. Blacks, Asians, Mexicans, and Hispanics are all less likely to volunteer sewage as a source. For stormwater, an individual is more likely to volunteer it as a source if they recall hearing news stories about water quality, have heard about beach closures, or have lived in the area for more years. Women and Spanish speaking respondents are less likely to volunteer stormwater and more likely to volunteer trash as a source of pollution. For industry, if an individual recalls hearing news stories about water quality or recalls seeing a hazard sign at the beach, they are more likely to volunteer industry as a source. However, if an individual reads the newspaper or watches television news, they are less likely to volunteer industry as a source. If an individual belongs to an environmental organization they are more likely to volunteer sewage, stormwater and industry as pollutant sources.

Environmental Quality Perceptions

Perceived Changes in Water Quality

The majority of respondents (58.06%) feel that the ocean water pollution problem has gotten worse. About 20% of the respondents feel water quality has improved while the remaining either

feel water quality has not changed significantly over the last five years (9.43%) or they don't know (12.66%).

Concern about Environmental Quality

Coastal water quality is not the most important issue for the majority of individuals in our study. The majority of respondents reported crime (73.45%), air pollution (66.75%), and the quality of public education (79.16%) as being more important than ocean water pollution (Table 5). This relatively low degree of concern for ocean water quality suggests that Los Angeles residents may not be paying as much attention to this problem if they are more concerned with other issues. It's possible that people ignore, or pay less attention to, news stories covering ocean water quality or beach closures. This finding also has policy implications. It suggests that the people of Los Angeles would be less likely to support cleanup programs, or stormwater initiatives for example, in lieu of other programs dealing with issues such as crime and education in their communities. In general, ocean water pollution affects fewer residents of Los Angeles than does crime or public education. These results could translate into both a lower level of concern about the problem, as well as a public less informed about this type of pollution and associated health risks.

Environmental Quality Perceptions: Results From Probit Analysis

The results of the probit analyses for the two environmental quality perception variables, the relative importance of the ocean water pollution problems "importance" and whether or not the problem has gotten worse over the last five years "wworse", are shown in Table 6. The dependent variable used in the regression for "importance" is a scaled value capturing the number of times the respondent chose ocean water pollution as the more important social problem—more important than crime, air pollution, and/or the quality of public education. Past experience with illness after swimming at the beach is a significant perception determinant for whether people

rank water quality as an important issue. People who report getting sick in the past after swimming at the beach are more likely to display a higher level of concern about the problem. When given a choice between two issues, these individuals are more likely to choose ocean water pollution as the more important problem.

The media is an important source of information for respondents who feel the ocean water pollution problem has gotten worse over the last five years. Individuals who recall news stories about water quality or recall hearing about beach closures are more likely to rank deterioration in ocean water quality as important.

Demographic factors also are effective in predicting how important the ocean water pollution problem will be to the respondent. Blacks and Hispanics (not of Mexican-descent) are less likely to choose ocean water pollution as the more important social problem. In addition, women and individuals who report higher income levels are less likely than men to choose ocean water pollution as the more important issue. Language is a significant explanatory variable, with Spanish speaking respondents more likely than English speaking individuals to choose ocean water pollution as a more important issue. In addition, if an individual belongs to an environmental group they are more likely to choose ocean water pollution over other problems.

Frequency of visitation to the beach (visits) is a significant explanatory variable for both "importance" and "wworse", but the signs are different for each. The more often an individual visits the beach, the more likely they will choose ocean water pollution as the more important issue. However, the more often an individual visits the beach, the less likely they are to report that ocean water quality has deteriorated over the last five years. These may be explained by an individual's degree of "familiarity" with the problem. With increased visitation, they may know from experience that water quality actually has not deteriorated over the last five years. Further, the respondent may be more concerned about the problem if the beach serves as an important recreation amenity to that individual.

5. Discussion

Risk Perceptions

Probit results for risk perception analyses indicate that specific factors differentially affect peoples' perceptions of health risk across different sources of pollution. These factors vary quite significantly across different types of pollutants. In general, we do not observe a significant relationship between an individual's cultural background and how they perceive the severity of risks from coastal water pollutants, although there were a few exceptions. For example Blacks were more likely to think they would get sick or very sick from swimming in water polluted by either trash or industry.

Unlike cultural background, media appears to be an important determinant of public perceptions about bathing health risks. Media sources of information about ocean water quality such as news stories, announcements about beach closures, and television news in general all contribute to an elevated sense of risk. Respondents who recall news stories about ocean water quality were more likely to associate bathing risks with stormwater. In addition, an individual who recalls seeing a hazard sign at the beach is more likely to report a risk associated with bathing in waters polluted by industry. Information and visual cues such as hazard signs and news stories about water quality and beach closures, could be extremely important in amplifying people's perception of risk.

We also find that an individual's overall perceptions about water quality can influence how they perceive health risks associated with any single pollutant source. An individual's negative perception about water quality trends over the last five years is significant in explaining risk perceptions across all four pollutant sources, as well as decisions to avoid bathing altogether due to polluted waters. If an individual reports deterioration in ocean water quality over the last five years, they are more likely to associate higher levels of risk with swimming in waters polluted by sewage, stormwater, trash or industry. These results suggest that general perceptions

about environmental quality can affect decisions about specific environmental hazards, regardless of how accurate these perceptions might be.

We hypothesized that individuals with more information about water quality issues will be in a better position to make decisions regarding health risks and participating in behavior that may expose them to such risks. Results from probit analyses suggest that information is a vital determinant of an individual's ability to identify pollutant sources. News stories, beach closures and hazard signs all contribute to a greater likelihood that an individual will volunteer one of the four sources of ocean water pollutants. Socio-economic and cultural influences may also affect an individual's familiarity with the problem. In addition, membership in an environmental group may provide individuals with more information about environmental problems and pollution concerns. Clearly, efforts to fully inform the public about beach risks must pay special attention to the ways in which, culture, media, and socio-economic factors influence access to environmental information.

Environmental Quality Perceptions

We find evidence that personal characteristics and experiences play a significant role in affecting an individual's relative concern about ocean water pollution. If the respondent had reported getting sick in the past after swimming in polluted waters, they are more likely to view ocean water pollution as a more important issue. In addition, the more often an individual visits the beach, the more likely they are to view ocean water pollution as a more important problem. In effect, greater familiarity with the ocean water pollution problem, either through past illness or more frequent visitation, is associated with an increased level of concern about the issue.

6. Policy Recommendations and Implications

These findings suggest a greater role for public education programs, both in communicating potential risk sources and in providing the public with accurate information about

water quality so that they do not have to avoid swimming or going to the beach altogether. For example, increased awareness about the nature of stormwater pollution itself would enable people to make better decisions about when and how they will use the beach. This study suggests that certain segments of the population, principally women and Spanish speaking individuals, may be less aware of the stormwater pollution problem than other groups. This may be due to differences in personal characteristics or lack of information received through the media. Particularly in the case of Spanish speaking individuals, language barriers may block certain information about stormwater pollution disseminated through the media. More efforts could be made to communicate stories about stormwater through Spanish-language media sources.

Greater media coverage of ocean water pollution problems in Southern California and a subsequent heightened awareness may have made the public wary of potential health risks associated with swimming at the beach. Coastal managers may need to consider investment in public education programs aimed at alleviating such fears and encourage continued public use of these popular, and generally safe, recreation areas. Increased communication to the public should focus on avoiding swimming at the beach after heavy rains and avoiding swimming near stormdrain outlets at all times. People need not avoid beach recreation activities such as swimming altogether, as long as they are aware of potential risks and are able to avoid them.

Tables

Table 1: Summary of perceptions of the four primary risk measures.

Percentage of Individuals who though that it would make them:

Pollutant Source	sick	very sick
Sewage	89.3%	72.0%
Stormwater	74.7%	46.9%
Trash	75.9%	47.1%
Industry	90.1%	76.9%

Table 2: Summary Statistics for Variables Used in Probit Analyses

Variable	Obs	Mean	Std. Dev.
stories	403	0.734	0.442
close	402	0.687	0.464
sign	401	0.424	0.495
read newspapers	403	0.926	0.61
tv	403	0.921	0.271
got_sick	403	0.159	0.366
visits	403	1.658	1.251
years	399	25.118	17.246
blk	399	0.095	0.294
asn	399	0.065	0.247
mex	399	0.258	0.438
hisp	399	0.153	0.36
ctzn	397	0.748	0.435
language	403	0.208	0.407
env	402	0.085	0.279
education	402	1.06	0.718
income	369	2.545	1.603
age	393	50.181	140.524
sex	402	0.575	0.495
sewage	403	1.613	0.672
stormwater	403	1.216	0.82
trash	403	1.231	0.813
industry	403	1.67	0.649
importance	346	0.633	0.835
wworse	403	0.581	0.494
don’t go in	249	0.277	0.448

Table 3: Risk Perceptions: Ordered Probit Results

	Sewage	Stormwater	Trash	Industry
stories	0.185	0.315***	0.115	-0.009
	(0.179)	(0.157)	(0.158)	(0.192)
close	0.063	0.158	0.331***	0.231
	(0.176)	(0.153)	(0.154)	(0.182)
sign	0.177	-0.032	0.172	0.320***
	(0.157)	(0.134)	(0.136)	(0.166)
read newspapers	-0.191*	0.059	-0.253***	-0.024
	(0.123)	(0.108)	(0.112)	(0.131)
tv	0.265	0.455**	-0.153	0.024
	(0.256)	(0.241)	(0.244)	(0.271)
got_sick	0.115	0.122	0.058	0.076
	(0.219)	(0.182)	(0.186)	(0.230)
visits	-0.035	0.051	0.050	-0.068
	(0.068)	(0.059)	(0.060)	(0.070)
years	0.004	0.00	0.007	-0.003
	(0.006)	(0.006)	(0.006)	(0.007)
blk	0.128	-0.070	0.455**	0.476*
	(0.257)	(0.229)	(0.238)	(0.295)
asn	-0.433*	0.170	0.324	-0.038
	(0.285)	(0.275)	(0.272)	(0.303)
mex	0.219	-0.342**	-0.029	-0.052
	(0.246)	(0.210)	(0.209)	(0.255)
hisp	0.142	-0.094	0.229	0.193
	(0.237)	(0.202)	(0.204)	(0.243)
ctzn	-0.172	0.434**	-0.235	0.143
	(0.284)	(0.238)	(0.238)	(0.286)
language	0.188	0.220	0.441*	0.472
	(0.351)	(0.285)	(0.290)	(0.368)
env	0.121	0.206	0.032	-0.186
	(0.289)	(0.247)	(0.239)	(0.276)
education	0.004	-0.162	-0.053	-0.093
	(0.130)	(0.115)	(0.115)	(0.135)
income	0.030	-0.024	-0.036	-0.043
	(0.050)	(0.045)	(0.046)	(0.053)
age	-0.007	0.001	0.003	0.001
	(0.007)	(0.006)	(0.006)	(0.007)
sex	0.176	0.181	0.282***	0.459****
	(0.150)	(0.130)	(0.133)	(0.159)
wworse	0.484****	0.418****	0.379****	0.506****
	(0.151)	(0.132)	(0.133)	(0.159)
N	353	353	353	353
log-likelihood	-245.47666	-352.93581	-341.1968	-220.14101
Pseudo R2	0.0804	0.0533	0.0758	0.0932

Standard errors in parentheses.

****Significant at 1% level, ***significant at 5%, ** significant at 10%, * significant at 15%.

Table 4: Volunteered as Sources of Ocean Water Pollution: Probit Results

	Sewage	Stormwater	Trash	Industry
constant	-1.276***	-1.510***	-0.593	-0.632
	(0.540)	(0.618)	(0.488)	(0.493)
stories	0.084	0.435**	-0.007	0.418***
	(0.202)	(0.229)	(0.176)	(0.182)
close	0.641****	0.743****	0.049	-0.059
	(0.202)	(0.239)	(0.172)	(0.174)
sign	-0.076	0.064	0.199	0.479****
	(0.161)	(0.181)	(0.149)	(0.150)
read newspapers	-0.040	0.209	-0.120	-0.183*
	(0.132)	(0.148)	(0.12)	(0.122)
tv	0.166	-0.142	0.069	-0.371
	(0.301)	(0.313)	(0.270)	(0.273)
got_sick	0.315*	-0.213	0.011	-0.291
	(0.218)	(0.256)	(0.201)	(0.206)
visits	-0.071	0.028	0.024	0.061
	(0.070)	(0.075)	(0.066)	(0.066)
years	-0.003	0.014**	0.00	-0.009
	(0.007)	(0.008)	(0.006)	(0.006)
blk	-0.537***	-0.886****	0.174	0.107
	(0.277)	(0.326)	(0.250)	(0.253)
asn	-0.707***	-0.334	0.182	-0.029
	(0.347)	(0.356)	(0.300)	(0.303)
mex	-0.407*	-0.264	0.091	0.046
	(0.258)	(0.280)	(0.232)	(0.239)
hisp	-0.904****	-0.266	0.296	-0.009
	(0.258)	(0.269)	(0.221)	(0.226)
ctzn	0.279	0.263	-0.074	0.452**
	(0.308)	(0.369)	(0.265)	(0.269)
language	0.186	-1.209***	0.607***	0.183
	(0.371)	(0.554)	(0.316)	(0.327)
env	0.443**	0.524**	0.144	0.454**
	(0.267)	(0.294)	(0.267)	(0.270)
education	0.332***	0.133	0.049	0.239**
	(0.139)	(0.151)	(0.128)	(0.127)
income	0.021	-0.033	0.003	-0.044
	(0.053)	(0.055)	(0.050)	(0.051)
age	-0.002	-0.009	-0.005	0.000
	(0.007)	(0.008)	(0.007)	(0.007)
sex	-0.041	-0.283*	0.334***	0.113
	(0.160)	(0.179)	(0.145)	(0.148)
wworse	-0.033	-0.162	0.203	-0.049
	(0.160)	(0.177)	(0.149)	(0.150)
N	353	353	353	353
log-likelihood	-185.481	-148.0992	-225.703	-218.638
Pseudo R2	0.1402	0.2487	0.0702	0.0867

Standard errors in parentheses.

****Significant at 1% level, ***significant at 5%, ** significant at 10%, * significant at 15%.

Table 5: Summary Responses for the Relative Importance of Water Quality.

	Crime	% Total	Air	% Total	Education	% Total
More important than ocean pollution	296	73.45	269	66.75	319	79.16
Same	29	7.20	35	8.68	18	4.47
Less important than ocean pollution	78	19.35	99	24.57	66	16.38

Table 6. Perceptions of Environmental Quality: Results from probit analyses.

	Importance	Wworse
constant	---------	-0.785**
		(0.434)
stories	0.215	0.296**
	(0.180)	(0.175)
close	-0.021	0.388***
	(0.169)	(0.168)
sign	0.185	0.171
	(0.146)	(0.148)
read newspapers	-0.014	0.025
	(0.119)	(0.121)
tv	-0.210	0.374
	(0.272)	(0.268)
got_sick	0.325**	0.258
	(0.190)	(0.205)
visits	0.118***	-0.107**
	(0.061)	(0.062)
years	0.001	0.004
	(0.005)	(0.005)
blk	-0.384*	-0.249
	(0.256)	(0.249)
asn	0.417	-0.112
	(0.298)	(0.296)
mex	0.152	0.150
	(0.228)	(0.225)
hisp	-0.357*	0.126
	(0.223)	(0.220)
ctzn	0.302	-0.105
	(0.272)	(0.268)
language	1.003****	0.210
	(0.329)	(0.315)
env	0.683****	0.237
	(0.239)	(0.269)
education	0.052	-0.051
	(0.128)	(0.125)
income	-0.079**	0.018
	(0.049)	(0.050)
sex	-0.502****	0.172
	(0.145)	(0.145)
N	310	359
log-likelihood	-295.807	-223.348
Pseudo R2	0.1072	0.0869

Standard errors in parentheses.
****Significant at 1% level, ***significant at 5%, ** significant at 10%, * significant at 15%.

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