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Toward the 21st Century: Planning for the Protection of California's Environment

California Comparative Risk Project

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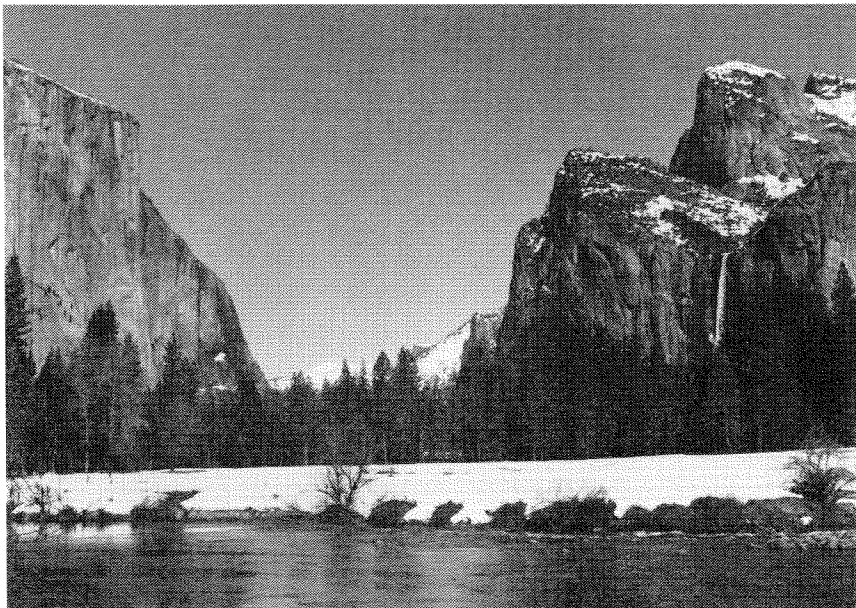
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Toward the 21st Century: Planning for the Protection of California's Environment



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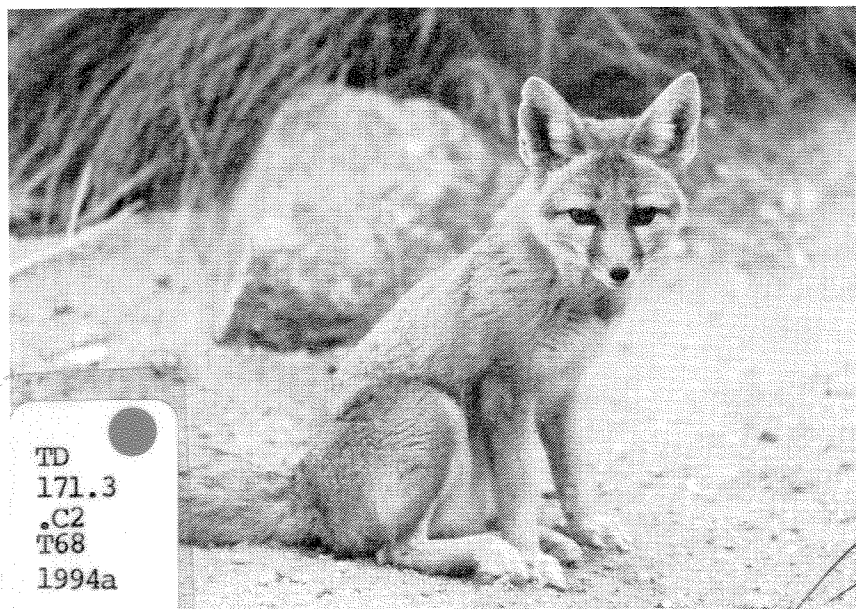
Summary Report

Submitted to
California Environmental
Protection Agency by:



California Comparative
Risk Project

May 1994



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Summary Report

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Winter in Yosemite National Park.

The California desert Kit Fox; an endangered species.

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Preface

California is among the nation's largest states in land area and is the largest in terms of population, government, and economy. We are often perceived as the leading state in promoting environmental issues. But California's unique blend of natural resources and beauty, industry, agriculture, and recreational potential, combined with its size, diversity, and social awareness makes our job of protecting public health and the environment especially challenging. As we look forward to the next century, we want to take the most effective and efficient measures to ensure a healthy environment for future generations.

Faced with similar challenges, the U.S. Environmental Protection Agency (U.S. EPA) recognized the possibility that its environmental protection efforts were not being effectively targeted. In particular, it was feared that focusing on environmental threats in isolation, rather than collectively, had resulted in a misdirection of scarce funds to less serious environmental problems. In 1986, U.S. EPA initiated a project aimed at setting priorities using a model that first quantifies then compares and ranks risks. Some states, following U.S. EPA's lead, also found the risk-ranking model useful for focusing on environmental issues of greatest concern. These projects have been generally referred to as "comparative risk projects."

To help identify environmental priorities for the future, the California Environmental Protection Agency (Cal/EPA) sponsored the California Comparative Risk Project with partial funding from U.S. EPA. As with other states before us, our project sought to incorporate the views of people with diverse backgrounds, cultures, and interests into a process that combines scientific analysis and judgment, with societal values and education. The results of the California Comparative Risk Project will be used to assist Cal/EPA in planning, evaluating, and organizing the activities of the Agency.

Participants in the California Comparative Risk Project were charged with identifying environmental threats of the greatest ecological, human health, and societal concern using the risk-ranking model. However, agreeing that risk is not the only factor that should be considered, our project also examined how economics, pollution prevention, environmental justice, education, and public participation contribute to environmental decision-making. The unique inclusion of this aspect in our project was in response to a growing debate nationally and in California about the limitations of a risk-ranking model for setting environmental priorities. I think you will find this innovative and ground-breaking discussion thought-provoking and helpful in understanding the multi-dimensional nature of environmental decision-making.

The findings and recommendations of the California Comparative Risk Project are presented in the following report. It is a compilation of two and one-half years of work involving nearly 300 volunteers representing a wide diversity of backgrounds including industry, agriculture, community groups, county and state government, universities, and environmental organizations. Our report includes a non-technical guide for the general reader, and several longer, more technical reports containing recommendations prepared by our working committees. Recommendations to Cal/EPA from the Statewide Community Advisory Committee, the California Comparative Risk Project's primary citizens' advisory body, are also included in this report.

As the California Comparative Risk Project evolved, we had several objectives, including: 1) to assess and rank environmental threats to human health, ecological health, and social welfare; 2) to critique the risk-ranking model and explore other models for environmental protection and priority-setting, outlining their values and their implications; 3) to incorporate public input in the discussion of the diverse issues that contribute to environmental priority-setting; and 4) to seek consensus among the many perspectives and identify those issues for which there is a lack of consensus. I think these objectives were met, and I hope that you agree our project has charted a course for Cal/EPA through the maze of challenges on its way to planning for the healthy future of our State's environment and its inhabitants.

On behalf of all of the California Comparative Risk Project's participants, I am pleased to submit this report to James Strock, Secretary for Environmental Protection, for consideration in Cal/EPA's strategic planning, budgeting, and legislative processes. It is my sincere hope that other Californians will also find this report useful in making informed decisions on environmental priorities and learning about the environment in which we live.

I want to thank all of those who volunteered to be part of this project; it was a pleasure working with you. The primary lesson I learned as Project Director is that the end result is not as important as the means. I hope that this process invokes in all of us a desire to preserve our State's natural resources and to protect our health and welfare.

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Staff of the California Comparative Risk Project (CCRP) would like to thank James Strock, Secretary for Environmental Protection, for his support in the actualization of this project.

We want to express our appreciation for the financial support received from the U.S. Environmental Protection Agency (U.S. EPA), and the support of U.S. EPA Headquarters' staff including Kathleen Ehrensberger, Debra Martin, and Holly Stallworth; Region 9 staff including Janis Gomes, Anna Hackenbracht, and Jerry Hiatt; and Kate Kramer, Rick Minard, and Ken Jones of the Centers for Comparative Risk. We thank the California Public Health Foundation for administering the Federal and some of the State contracts associated with the CCRP. We would also like to thank the Department of Water Resources Photography Library for providing photographs for this report.

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We also recognize the following individuals for their contribution and support to the CCRP: Tom Soto and staff of PS Enterprises for their exceptional work in organizing and convening the regional public roundtables; John Gamman and Scott McCreary, CONCUR; Letty Reid, Joe Irvin, and Lou Smallwood, Cal/EPA; Karen Cogan and Lori Loftis, OEHHA; clerical staff of the Pesticide and Environmental Toxicology Section, OEHHA; and members of the Statewide Community Advisory Committee and the Interagency Management Cooperative for their dedication.

Finally, we wish to thank all of the volunteers who have given their valuable time to the working committees of the CCRP.

Summary Report

INTRODUCTION

California Overview

From the time that humans first arrived in what we now call California, the dramatic landscapes — ranging from ice-covered crags and barren deserts to lush forests, fertile valleys, and misty coastlines — have inspired legions of explorers and residents. Today, California, which is the largest state in terms of population and economy, is still one of the most beautiful states in the country. Indeed, much of the State’s wealth lies in the value of its landscapes and natural resources.

CALIFORNIA AT A GLANCE ^{1, 2}

<i>Area:</i>	155,973 square miles
<i>Highest Elevation:</i>	Mt. Whitney (14,494 feet above sea level)
<i>Lowest Elevation:</i>	Death Valley (282 feet below sea level)
<i>Coastline:</i>	1,264 miles
<i>Water Area:</i>	7,734 sq mi
<i>Deserts:</i>	Mojave, Death Valley, Sonoran
<i>Mountain Ranges:</i>	Sierra Nevada
<i>Endangered/threatened animal species:</i>	67
<i>Endangered/threatened plant species:</i>	43
<i>Current Population</i>	30,380,000
<i>Projected Population for 2010:</i>	38,096,000

Yet for thousands of years, the people living in this region have altered it, by fishing in its rivers, hunting in its forests, felling its trees, disposing of trash, and even making simple fires for warmth. In the last century, alterations of the environment have become much more severe and much less reversible. Free-flowing rivers have been dammed. Highways criss-cross the entire State, connecting densely settled residential and business areas. Habitats for fish, mammals, reptiles, and birds have been damaged. And many people live with an underlying fear that the pollution in our air, our water, and our land is hurting them, or will harm their children in the future.

Some environmental problems, like wild-fires and background radiation, occur naturally. Others, like pollution and development, are clearly caused by humans and have been exacerbated by the State’s rapidly expanding population, by resource extraction, and some believe by a lack of centralized planning.

Of course, the word “environment” means different things to different people. For many,

¹ From World Resource Institute (1994). *The 1994 Information Please Environmental Almanac*, Washington, D.C.
² Department of Finance (1993). *Population Projections by Race/Ethnicity for California and Its Counties*.

it conjures visions of deserts, mountains, and streams, a wilderness that is separate from where we live and work. For others, “environment” refers to the built environment around them, the streets, parks, and buildings, for instance, that make up our cities and towns.

But whether they live in rural, suburban, or urban areas, Californians have argued for decades about the best way to protect residents and ecosystems. The State has passed many laws and regulations; many of them have set standards for the rest of the country. Too often, the legislation has often focused on one environmental medium (water or air) or problem (pesticides) rather than using an inclusive approach. This has resulted in environmental protection that is either fragmented or overlapping. The need for environmental protection also has conflicted with the State’s other priorities, including education, economic growth, transportation, crime prevention, and other social programs.

Rationale for Organizing This Project

How can policymakers and the public decide which resources to dedicate to which problems? One proposed way to prioritize environmental problems — and develop viable solutions — is through “comparative risk assessment.” In this process, environmental problems are categorized, analyzed, and then ranked in terms of their relative severity. Such rankings help policymakers identify the environmental problems in their area, decide which ones pose the greatest relative risk, and structure the debate about priority-setting.

To help identify and structure environmental priorities, the California Environmental Protection Agency (Cal/EPA) sponsored the California Comparative Risk Project (CCRP). The end product of this two and a half-year process is a final report to Cal/EPA which, together with public comment, will be used to assist its planning. Equally important, the CCRP expands the methods of past

WHERE CAN I FIND ...

Recommendations from the CCRP to Cal/EPA?

Recommendations can be found at the end of each section and in the final section of the summary report, as well as in the full technical report.

Risk-rankings of California’s environmental threats?

The first three sections include rankings by individual committees. A summary of the three rankings of environmental health stressors can be found on page 37.

Discussion about environmental decision-making factors?

The California Comparative Risk Project considered factors other than risk that should be used in environmental decision-making. For a discussion on these topics, refer to the Education, Economic Perspectives, and Environmental Justice committees’ reports.

An explanation of the CCRP process?

The introduction of this summary report provides an overview of the CCRP’s work. The technical reports contains more detailed information of the project structure as a whole, as well as the full reports of the individual committees.

comparative risk projects using innovative approaches.

This summary report provides an overview of the methods and findings of the committees of the CCRP. Full technical discussions of the committees’ work are in the much larger technical report. Both of these reports are the products of the CCRP — the content presented without substantive changes from Cal/EPA — thus they are not Cal/EPA reports. Accordingly, the results and conclusions in all of the CCRP reports represent those of the CCRP participants and the committees and do not necessarily reflect the policies of Cal/EPA or the opinions of the members of the Statewide Community Advisory Committee. However, those who volunteered to work on the CCRP

hope that Cal/EPA will use the results and apply the recommendations to improve planning for the protection of California's environment and its inhabitants.

Why Analyze Risk?

The United States Environmental Protection Agency (U.S. EPA) initiated a comparative risk project for the country in 1986. At that time, analysts suspected that significant resources were being targeted towards problems that posed only moderate risks, while the Agency's mandate to focus on existing risks prevented it from addressing new or multifaceted problems (like indoor air pollution and global climate change). What was missing, Agency representatives thought, were comprehensive strategies for reducing current environmental risks in a cost effective manner and identifying those that might emerge in the future.

In 1987, the U.S. EPA published *Unfinished Business*, a ranking and analysis of 31 environmental problems facing the country at that time. The U.S. Environmental Protection Agency regional offices and several states (including Vermont, Louisiana, Colorado, and Washington) subsequently undertook similar projects. No two of these studies have been alike, but each has used a combination of science (for example, pollutant release data, computer modelling, and case studies) and the judgment of scientists, citizens, and other community members to rank human-made environmental risks. Comparative risk projects historically have not addressed "natural" environmental risks like earthquakes and floods.

In the context of environmental assessment, "risk" is the likelihood of harmful effects, including human disease or death, damage to ecosystems, property losses, and anxiety about the future. The *degree* of risk attributed to an environmental problem is based on both technical analysis and expert judgment, and it usually refers to current risk, or

Who paid for the CCRP?

The California Environmental Protection Agency and the U.S. EPA provided the only financial support to the project.

How many people took part?

More than 250 people from a wide range of backgrounds including universities, government agencies, businesses, and citizen and environmental activist groups volunteered in the CCRP.

How long did the CCRP take?

The project began in February 1992 and was concluded in May 1994.

What will the CCRP be used for?

The results of the CCRP, together with public comment on the project, will assist Cal/EPA in its ongoing planning budget, and legislative processes. Other agencies and decisionmakers interested in environmental policy will find the systematic evaluation of central issues useful.

the risk that remains even with existing environmental programs in place. This gives policymakers a "snapshot" of *existing* threats, rather than those that would exist without public and private efforts or that are likely to exist in the future.

Typically, a risk becomes a "priority" when the public is concerned and policymakers decide to address it. This model of environmental priority-setting is a two-stage process. Analysts first have to understand the size and scope of various problems. Second, they have to decide which problems to address in light of feasibility, cost, equity, and other factors.

Some comparative risk projects have looked at risks *per se* (that is, *how severe is each problem?*). Others have developed priorities and recommendations (that is, *what problems should we address in the future?*). Still others have looked at a mix of risks and priorities.³

³ Northeast Center for Comparative Risk (1993). *State Comparative Risk Projects: A Force for Change*. Vermont Law School, South Royalton, VT.

The Traditional Risk-ranking Model

The first step in most comparative risk projects is to develop a list of environmental problems to analyze. The second step involves an analysis by project participants of the aspects of risk associated with those problems. Analysts then rank the severity of each problem area. Because the rankings are rarely the same among the categories of human health, ecological health, and social welfare, some comparative risk projects create a list that integrates the three rankings into one. Others maintain separate lists.

Three categories of risk-ranking

Human health

Human health risks are the actual or estimated cases of human disease or injury caused by human-made environmental stressors. These include both cancer (for example, lung cancer caused by exposures to asbestos) and noncancer effects (for example, retarded mental development caused by ingesting lead in paint).

Ecological health

Ecological health risks are the estimated or anticipated damages to the structure and function of natural ecosystems. Examples include loss of fish and plant life due to water pollution, loss of

wildlife habitat, changes in the physical landscape, and reduced growth rates in forests exposed to high levels of smog.

Social welfare

Social welfare risks reflect the degradation in the quality of life for an area's citizens. Some of this degradation such as crop losses due to the invasion of non-native species can be quantified. Other forms of degradation such as anxiety about ozone depletion in the future can be judged only qualitatively by surveying citizens and relying on expert judgment.

COMPARATIVE RISK GLOSSARY

Economics. Study of how people make tradeoffs when faced with scarce resources.

Environment. The total surroundings on Earth, including the sum of living organisms, energy sources, and non-living natural and manufactured resources that affect the life, homeostasis, development, reproduction, and survival of all organisms.

Environmental justice. According to several studies, poor communities and communities of color bear a disproportionate burden of environmental hazards. The principles of environmental justice recognize this and other environmental disparities and maintain that everyone has an equal right to a clean, healthful environment in which to live, work, and play.

Exposure. The amount of a stressor that an organism contacts over a certain period of time.

Hazard. The measure of the stressor's potency or ability to cause health problems.

Pollution prevention. An environmental policy approach that seeks to reduce hazardous or toxic substances throughout their life cycle, from the extraction and processing of raw materials, through manufacturing, distribution, use, and disposal.

Public participation. The involvement of citizens in governmental decision-making processes. Participation ranges from being given notice of public hearings to being actively included in decisions that affect communities.

Risk. The probability or chance that a desired or unwanted action, circumstance, or event will result in loss or harm.

Stressor. A chemical, material, organism, radiation, temperature change, or activity that stresses human health, the environment, or quality of life.

WHO TOOK PART IN CALIFORNIA'S COMPARATIVE RISK PROJECT?

The *Executive Staff* included a Project Director (a Senior Toxicologist from Cal/EPA's Office of Environmental Health Hazard Assessment), an Assistant Secretary of Cal/EPA, and the Director of the Office of Environmental Health Hazard Assessment.

Project Staff provided technical support and administered and provided documentation of the entire project.

Three *Risk-ranking* committees collected and analyzed data, and ranked risks to *Human Health, Social Welfare, and Ecological Health*.

The *Education Committee* analyzed the state of public environmental and occupational health education, developed criteria for curricula, and provided recommendations for public participation in the CCRP.

The *Environmental Justice Committee* critiqued the comparative risk process as it had previously been carried out by other states and the U.S. EPA and recommended ways to set environmental priorities that reflect an environmental justice and pollution prevention perspective.

The *Economic Perspectives Committee* examined the ways in which economic factors influence environmental decision-making.

The *Interagency Management Cooperative*, with representatives of over 30 State agencies, provided a forum for discussing CCRP issues and created case studies on how factors other than risk have influenced environmental protection strategies used in the past.

The *Statewide Community Advisory Committee*, the primary policy advisory committee, was made up of non-State-government members who were representatives of environmental and community organizations, local government, business, industry, agriculture, and academia. Members of the Statewide Community Advisory Committee provided perspectives and advice on procedures and helped develop recommendations on priority-setting and decision-making.

The *California public* had an opportunity to participate through a series of roundtables on the State's environmental issues. The public will continue to have an opportunity to contribute during the public comment period which will follow the release of this report.

Concerns about the traditional risk-ranking model

Using the comparative risk model alone to set priorities has been widely criticized since U.S. EPA initiated the process in the mid-1980's.⁴ The primary complaints have been that:

- ◆ Risk alone should not predominate the decision-making process.
- ◆ Focusing on the quantitative aspects of risk does not provide enough information on the qualitative aspects, such as anxiety about the future, involuntariness of exposure, and equity concerns.
- ◆ Risk assessment and the comparative risk model are not solely "science-based" but incorporate judgments and values and are limited by a high degree of uncertainty.
- ◆ Comparative risk projects often neglect the public participation and social values needed to make good decisions about environmental priorities.

Of course, whether decisions are about a personal purchase, a job, or a travel plan, we all make them based on a myriad of factors. Perhaps the most realistic way to view risk assessment is not as a science, but a procedure that provides information about the degrees of hazards associated with activities and exposures. The more information we have on relative risks, the better able we are to make good decisions.

The California Project

The California Comparative Risk Project's original mission was to identify environmental threats of the greatest ecological, human health, and societal concern, using traditional risk-ranking methods. The national debates about risk assessment and comparative risk, however, figured very prominently in the evolution of the final CCRP's objectives, which were:

- 1) to assess and rank environmental threats to human health, ecological health, and social welfare;

⁴ Resources for the Future (1992). *Setting National Environmental Priorities: The EPA Risk-based Paradigm and Its Alternatives*. Conference Proceedings, November 15-19, 1992.

- 2) to critique the risk-ranking model and explore other models for environmental protection and priority-setting, outlining their values and their implications;
- 3) to incorporate public input in the discussion of the diverse issues that contribute to environmental priority-setting; and
- 4) to seek consensus among the many perspectives and identify those issues for which there is a lack of consensus.

In order to achieve the CCRP's objectives, the original project structure and approaches were reevaluated and eventually revised. The final workplan of the CCRP presents several unique features.

The California Comparative Risk Project's content

Committees in the CCRP used quantitative approaches to identify and rank environmental topics where possible. But recognizing that factors other than *risk* are relevant to priority-setting, the CCRP devoted considerable time and resources to examining ways in which *economics, pollution prevention, environmental justice, education, and public participation* can be more fully included in risk-ranking and environmental decision-making process. *Sustainability* (improving the quality of life while preserving environmental potential for the future - or "living within the Earth's means"), was a sixth factor identified by the CCRP as important in environmental decision-making. However, due to limits in available expertise in this area, this factor was not considered to the same degree as the other five.

Environmental decision-making is a multi-dimensional process. Risk-based rankings of environmental topic areas are valuable and should be used for priority-setting in conjunction with other factors, including economics, public input, the potential for pollution prevention, the need to address the existence of disparate impacts on different populations, and the emergence of future risks.

–Statewide Community Advisory Committee
March 24, 1994

The California Comparative Risk Project's structure

Previous projects generally have a risk-ranking stage, and, more often than not, a risk-management stage (the development of plans to mitigate those risks). The original CCRP workplan called for a similar structure. However, as the debate about the risk-ranking model limitations advanced, the participants in the CCRP re-evaluated the direction of the State's project. What resulted was a unique three-component structure which incorporated the decision-making factors mentioned above. These three complementary components are described below.

Component 1: risk-ranking

The Human Health, Social Welfare, and Ecological Health committees assessed and reported on the environmental issues under their purview. During this process, analysts used existing methods and data to quantify, to the extent possible, the risks associated with environmental threats. This process used varying degrees of judgment and issues or values, depending on the availability and quality of the data. Some committees incorporated issues or criteria from Component 2 in their rankings. For example, the Social Welfare Committee included "equity" as a ranking criteria. The Human Health Committee considered "hot spots" and susceptible subpopulations in their approach. In their final reports, each committee provided information about the methods used, the results and conclusions, and recommendations to Cal/EPA.

Component 2: critiquing the risk-ranking model

While Component 1 committees analyzed risk, the Education, Economics, and Environmental Justice committees analyzed the extent to which other factors do or should influence risk-ranking, environmental decision-making, and management strategies. At the same time, the Interagency Management Cooperative (IMC) reviewed case studies of State agencies' environmental decision-making processes to get a sense of how other factors affect the management of environmental problems. In their final reports, each committee provided information about the committee's mission and process, the results of their deliberations, and recommendations to Cal/EPA.

Component 3: integration of components 1 and 2

Our integration involved broad discussion of factors and criteria from each Component. The Statewide Community Advisory Committee reviewed the work products of all the committees, as well as their recommendations. Members of the Statewide Community Advisory Committee developed their own recommendations to Cal/EPA about methods for future environmental decision-making and priorities. These are presented in this report, as are many of the technical committees' recommendations. The California Environmental Protection Agency and its boards and departments will also review the final reports and recommendations.



The Environmental Topic List

Most previous comparative risk projects have developed just one list of environmental problems for analysis. But comparing conceptually diverse categories of problems, such as pollutants (for example, toxic air contaminants or lead), sources (for example, waste sites and industry), and affected populations (for example, workers) resulted in considerable confusion and double-counting. To avoid these “apples with oranges” comparisons, the CCRP developed “environmental topic lists,” which assessed environmental hazards from three distinct and relatively consistent subsets of environmental issues:

List I considered the traditional *statutory division* of environmental problems into the media (that is, air, water, land), that are impacted by the release of toxic substances from different sources (for example, factories and automobiles);

List II addressed major *environmental stressors* (for example, asbestos, environmental tobacco smoke, and ozone); and

List III considered overarching categories of *human activity* which impact the environment (for example, agricultural practices and energy systems). The California Comparative Risk Project decided early on that it would attempt to address these broad issues that account for impacts on the environment. Overpopulation, though potentially a major force behind the negative impact on the State’s environment, was not analyzed.

ENVIRONMENTAL TOPIC AREAS

List I. Environmental Releases to Media By Sources

Water

Industrial releases to surface water
Municipal releases to surface water
Non-point source releases
Releases to groundwater

Air

Mobile sources
Residential and consumer product sources

Land

Active hazardous waste generators
Inactive hazardous waste sites
Solid waste disposal sites
Storage tank releases
Treatment, storage, and disposal facilities

Stationary and commercial area sources

List II. Environmental Health Stressors

Alteration of aquatic habitats
Alteration of terrestrial habitats
Asbestos
Carbon monoxide
Electromagnetic fields
Environmental tobacco smoke
Genetically engineered products or organisms
Greenhouse gases
Inorganics
Lead
Microbiological contamination
New chemicals
Non-native organisms
Oil/Petroleum
Persistent/bioaccumulative organochlorines

Ozone
Particulate matter
Pesticides - agricultural use
Pesticides - nonagricultural use
Radionuclides
Radon
SOx and NOx
Stratospheric ozone depletors
Substances that alter pH, salinity,
and hardness
Thermal pollution
Total suspended solids, biological
oxygen demand, and nutrients
Volatile organics

List III. Potential Threats to Environmental Integrity

Agricultural practices
Commercial/Industrial practices
Energy management practices
Municipal/Governmental practices
Natural resource practices

Recreational practices
Residential/Consumer practices
Transportation systems
Water management practices

Data and methods for risk-ranking

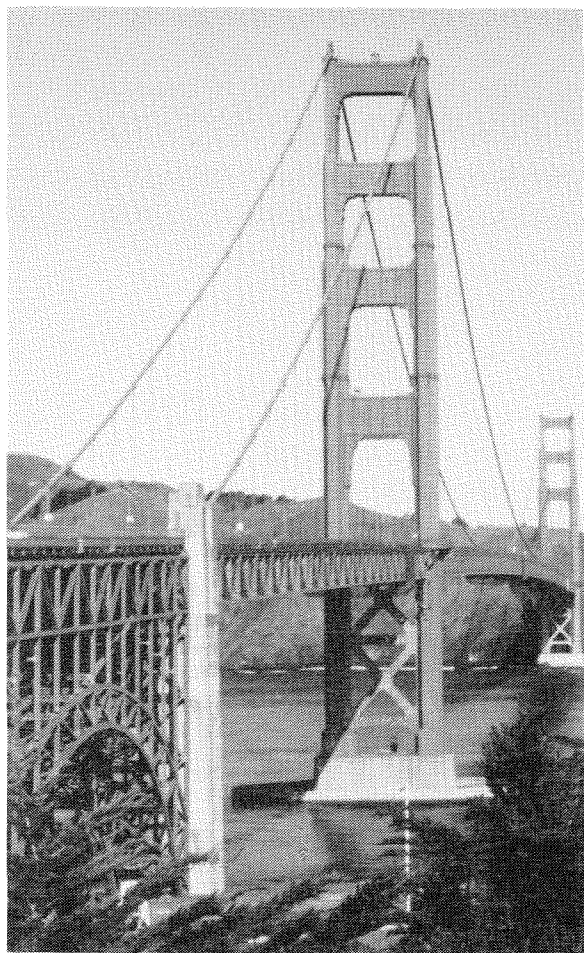
The committees in Component I examined the methods developed by previous comparative risk projects and then both developed new approaches and collected California-specific data to advance and refine the risk-ranking methods.

The Human Health Committee's quantitative analyses included a systematic procedure to identify environmental agents which could be used to best characterize environmental problems, and use of California monitoring data to identify average risks for California and some high-risk populations in the State. Members of the Human Health Committee relied primarily on actual human exposure data, rather than estimated exposures, to characterize many health risks.

The Ecological Health Committee relied on environmental data collected by regulatory agencies, industry groups, regional associations, and

environmental groups. Unlike many other comparative risk projects, however, ecological effects were not fit into a category early in the analysis. Instead, the Ecological Health Committee developed cause and effect "pathways" to identify the most severe threats to California ecosystems. This allowed a more flexible approach to ranking.

Social welfare analyses in some previous projects have focused almost exclusively on economic impacts. Other projects have considered broader dimensions of social welfare, but have not developed systematic measures or databases. In order to consider a wide range of social welfare dimensions in a systematic manner, the Social Welfare Committee developed appropriate concepts and methods and used them to derive a ranking. Dimensions considered ranged from property value and income to peace of mind and equity.



Summary of the Technical Report

The remainder of this summary report focuses on the work of the individual technical and advisory committees. Condensing the text from the lengthy chapters of the full technical report to this smaller, less-technical summary, necessitated leaving out much detailed information. Please refer to the full technical document for a complete report of each working committee. As a reminder, the conclusions and recommendations presented in the following summary reflect the views of the individual committees and their members, and not necessarily those of Cal/EPA or the Statewide Community Advisory Committee. The report of the Statewide Community Advisory Committee is presented as a section in the summary report in its entirety.

WHAT ARE THE RELATIVE RISKS TO HUMAN HEALTH IN CALIFORNIA?

Introduction

In the context of human health, “risk” is the probability that adverse health effects ranging from death to subtle biochemical changes may occur due to exposure to a substance. These adverse effects can be divided into two categories: *carcinogenic* or cancer-causing effects, and *noncarcinogenic* effects, which range from immediate death (such as with carbon monoxide poisoning) to damage to the reproductive system to more subtle changes, like impaired breathing during heavy exercise.

Methods

Human health risk assessors use several different kinds of data, including *incidence data* (information on the actual occurrence of a disease) and *exposure monitoring* (information on the amount of emissions and other pollutants to which persons are exposed) to evaluate potential effects on human health.

To estimate the cancer-causing effects of an environmental topic, Human Health Committee analysts look at both human and animal studies linking exposure to a substance to cancer. The Human Health Committee assumed that any amount of exposure to carcinogens involves some risk for humans and that the risk increases as the dose increases.

Noncancer-causing toxic effects vary with the magnitude, frequency, and duration of exposure. Risk assessors generally assume that some level of

PUTTING HEALTH RISKS INTO CONTEXT

Not all health problems come from environmental pollution. Many other factors also play a role, including: poverty and employment status, which affect nutrition and access to health care, violence, smoking, and drug use. In fact, scientists still do not know the exact degree to which human health problems can be attributed to pollution, and how much should be attributed to other environmental factors of lifestyle choices. The Human Health Committee suggested that given the scientific uncertainties involved in evaluating the impact of environmental stressors on human health, reducing or eliminating preventable exposures to hazardous substances, particularly in high-risk settings, is a sensible public health precaution.

exposure to non-carcinogenic substances will cause no adverse effect and evaluate risks by examining whether people are experiencing exposures that are above or below this apparent threshold.

Assessors estimate two types of risk for these threats: *individual risks* (one person’s added risk of experiencing adverse effects) and *population risks* (the number of people in an exposed population who might experience adverse effects).

THE FIVE STEPS TO RANKING HUMAN HEALTH HAZARDS

In the course of a human health risk assessment, analysts ask a number of questions about each environmental problem. The first four steps comprise the steps of traditional risk assessment; the fifth step is the final step in a comparative risk process.

Hazard identification

Which substances in this topic area harm humans, and what kind of harm is it? Out of all the substances involved in this problem area (for example, air pollution) which substances will we look at in this analysis?

Dose-response assessment

What could happen to humans if they are exposed to different levels of these compounds? What are the cancer-causing effects? The noncancer-causing effects?

Exposure assessment

What are the sources and durations of exposures to this substance? How many people are exposed to the hazardous substance? What range of doses do they receive?

Risk characterization

Given all we have learned so far, what are the human health impacts of current exposures? What is the risk to an individual? What is the risk to an entire population? Are any subpopulations more impacted than others? How confident are we in the overall analysis?

Risk-ranking

How bad is this problem, relative to other environmental problems we have analyzed?

Ranking criteria

Using two criteria – the severity of the impact and the number of people affected – members of the Human Health Committee ranked the risks posed by the environmental topic areas as high, medium, low, or insufficient evidence to categorize. The definitions are as follows:

- (H) Topic area either has severe impact on a large or small population or less severe but still significant impacts on a large population.
- (M) Topic area has a significant impact on the California population, but the average population risk is lower than the “High” category, or fewer or smaller subpopulations experience high individual risks.
- (L) Topic area has a detectable or potential health impact but with lower risks than topic areas ranked as medium.
- (IN) Topic area lacks sufficient toxicological or exposure data to reach a scientifically supportable evaluation.
- (NR) Not ranked.
- (NP) Not a problem.

Human Health Rankings

Human health caveats

When reviewing the risk-rankings of the Human Health Committee, the following caveats must be considered:

- ◆ The human health risks estimated by the Human Health Committee are only a portion of the total risk, because comprehensive quantitative data are not available for all the compounds released into the environment.
- ◆ Risk assessments are presented as numerical results. This gives an appearance of accuracy which can be misleading. Due to methodological limitations (for example, the quantity and quality of data vary considerably between topic areas) results should be interpreted as order of magnitude indications of potential health impacts, not actual predictions of disease incidence.
- ◆ Risk-ranking results are never determined by quantitative analyses alone. Selecting the data used, adopting risk assessment methods, and extrapolating from analyzed risks involves making major assumptions based on scientific judgment. The results of the Human Health Committee reflect the expertise and values of the scientists participating in the analysis. No single risk-ranking is based only on scientific data.
- ◆ The technical approach of the Human Health Committee was not designed to evaluate emerging environmental problems. The focus on current risks, for example, cannot be used to identify problems that could be prevented by making proactive management decisions.

HUMAN HEALTH RISK-RANKINGS OF ENVIRONMENTAL RELEASES TO MEDIA BY SOURCES

(Populations at disproportionate risk of high impact are given in parentheses)

High-ranked Risks

Mobile source releases to air (children; people with respiratory or cardiac conditions; those living near transportation corridors)

Natural source releases to groundwater (those drinking from contaminated water supplies)

Residential and consumer product source releases to air (children; smokers; those living in regions with high radon sources)

Stationary and commercial area source releases to air (children; people with respiratory or cardiac conditions; those living near emission sources)

Medium-ranked Risks

Anthropogenic source releases to groundwater (infants; those drinking from contaminated water supplies)

Inactive hazardous waste sites (those near undiscovered or uncontrolled sites)

Non-point source releases to surface water (subsistence/sport fishers; those on private wells)

Low-ranked Risks

Industrial releases to surface water (subsistence/sport fishers)

Municipal releases to surface water (subsistence/sport fishers)

Treatment, Storage, and Disposal Facilities (those near uncontrolled releases)

Unable to Rank

Topic area lacks sufficient toxicological or exposure data to reach a scientifically supportable evaluation.

Active hazardous waste generators

Solid waste disposal sites

Storage tank releases

Topics within each rank are ordered alphabetically.

HUMAN HEALTH RISK-RANKINGS OF ENVIRONMENTAL HEALTH STRESSORS

(Populations of disproportionate risk of high impact indicated in parentheses)

High-ranked Risks

- Environmental tobacco smoke (children with parents who smoke)
- Inorganics (subsistence fishers; those with contaminated drinking water supplies or living near emission sources)
- Persistent organochlorines (subsistence/sport fishers)
- Ozone (people with respiratory conditions; or those who work or exercise outdoors)
- Particulate matter (children; people with respiratory conditions)
- Radionuclides (natural sources)
- Radon (smokers; those living in areas with high radon concentrations or with highly contaminated groundwater)
- Volatile organics (those with contaminated drinking water supplies or living near emission sources; users of certain consumer products)

Medium-ranked Risks

- Carbon monoxide (pregnant women; unborn fetus; those with cardiac conditions or using unvented combustion equipment)
- Lead (children living in contaminated older housing or urban areas)
- Microbiological contamination (those with compromised immune system or drinking contaminated or untreated drinking water supplies)
- Pesticides - agricultural use (pesticide applicators; some subpopulations with high dietary intakes)
- Pesticides - nonagricultural (pesticide applicators; those living in frequently treated home or workplace)

Low-ranked Risks

- Radionuclides (anthropogenic sources)
- SOx and NOx (those with respiratory conditions, children in homes with unvented gas appliances)
- Substances that alter pH, salinity, and hardness
- Total suspended solids, biological oxygen demand, and nutrients (children drinking high-nitrate water)

Unable to Rank, Not Ranked, or No Problem

- Topic area lacks sufficient toxicological or exposure data to reach a scientifically supportable evaluation.
- Asbestos (IN)
- Greenhouse gases (IN)
- Alteration of aquatic habitats (IN)
- Alteration of terrestrial habitats (IN)
- Stratospheric ozone depletors (IN)
- Electromagnetic fields (IN)
- Genetically engineered products or organisms (IN)
- New chemicals (IN)
- Non-native organisms (IN)
- Thermal pollution (NP)
- Oil/Petroleum (NR)

Topics within each rank are ordered alphabetically.

Risk-ranking environmental topic lists I and II

The Human Health Committee risk-rankings appear in full in the technical document. It is important to consider the specific populations at risk when interpreting these rankings. Some examples are given for each environmental topic, but because of space considerations, the complete information cannot be included in this report summary.

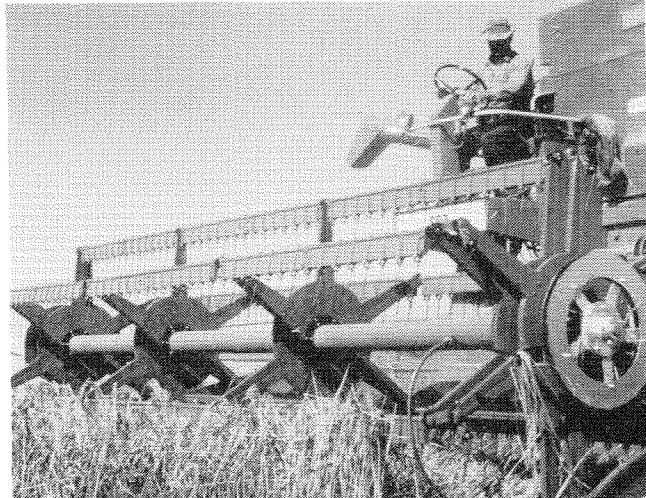
Conclusions

Based on their work, the Human Health Committee developed three general conclusions about environmental health risks in California:

Several environmental stressors cause adverse health impacts that are more significant than others. In particular, the extent and severity of noncancer impacts determined some of the final risk rankings.

This is the first comparative risk project in which some major noncancer impacts have specifically been quantified and included in the overall ranking process. Substances of greatest concern are *particulate matter*, and also *ozone*, *environmental tobacco smoke*, and *lead*. Respiratory disease (for example, asthma and bronchitis), aggravated cardiovascular disease, developmental or neurological toxicity, and premature mortality are the major related health effects.

Among cancer causing substances, the largest proportion of estimated cancer cases is associated with pollutants of natural origin (*radon*, *natural background radiation*, and *arsenic*). Exposures to these agents vary in the degree to which they can be controlled or reduced. Other contributors to estimated cancer cases include *environmental tobacco smoke*, *diesel exhaust*, *dioxins*, *volatile organic chemicals*, and *pesticides*, all of which have extensive population exposure due to their frequency as contaminants in ambient air, indoor air, or the



food supply. Small populations also suffer high exposures to *persistent organochlorines* (substances, like DDT and PCBs, whose levels increase as they travel up the food chain) in edible organisms, like fish.

From the perspective of environmental releases to media, the highest estimated human health risks are associated with various sources of air pollution.

Substantial portions of California's population are frequently exposed to air pollutants at levels that exceed regulatory standards. Exposure to *indoor air pollution* is of special concern, as people spend more time indoors than outdoors and they can be exposed to many different sources of pollution at once (including combustion appliances, consumer products, and emissions from domestic water use).

Most topic areas, including many ranked as "low" human health risks, can pose high risks to smaller populations.

Some groups of people are particularly *susceptible* to some pollutants (for example, children to lead). Other groups suffer unusually high exposures because of their *activities* or *location* (some ethnic groups engage in subsistence fishing where fish are contaminated). Some groups also may be exposed to *multiple* contaminants by different ex-

posures to contaminated media (for example, air, water, and food). This may increase their potential for adverse health effects. In other words, even if an environmental topic area is rated “medium” or “low” for the State as a whole, some exposed groups may be at “high” risk.

What are the greatest threats by environmental media?

All the major categories of *air releases* were evaluated as having high human health risks. Among noncancer risks, outdoor exposure to air pollutants from mobile, stationary, and residential sources are of concern due to widespread exposures. Among cancer risks, residential and consumer product sources in the indoor environment are of greatest concern, because people spend most of their time inside, where they are exposed to multiple contaminants, including *radon* and *environmental tobacco smoke*.

Among *water release categories*, groundwater contamination represents the most significant source of health risk for average Californians, due primarily to exposure to natural contaminants like arsenic and radon. Other significant exposures involve cancer-risks (DBCP) and noncancer-risks (nitrate) from inadequately treated public water supplies. Those relying on private wells in areas of contaminated aquifers are at highest risk.

The human health risks from *land releases* are generally low to medium, because exposures are not high. The highest risks are associated with exposures to uncontrolled inactive hazardous waste sites. The volume of hazardous waste generated annually (1.9 million tons) carries the potential for high human health risks to large populations, if regulatory oversight programs are not in place.

Who is most at risk?

One of the primary criticisms of past comparative risk projects has been that they do not identify the populations that are most affected by environmental stressors, either because of their susceptibility or their high exposures. Without this information, directing resources towards places and

people at highest risk can be difficult. The Human Health Committee developed a list of populations that are potentially at greatest risk in the State, according to media. The full table can be found in the Human Health Committee chapter of the technical report. Some examples are provided here:

- ◆ *Children* are at higher risk from exposure to environmental tobacco smoke, particulates, ozone, and nitrogen dioxide because these substances would aggravate asthma and lower respiratory infections.
- ◆ *People of color* are at higher risk from exposure to lead, particulates, ozone, inorganics, and volatile and persistent organics. Preliminary analyses indicate that mass loadings of air toxicants from manufacturing facilities are greater in areas where the population is predominantly people of color.
- ◆ *People with preexisting medical conditions* are at high risk from exposure to particulates, ozone, and carbon monoxide because these substances aggravate these conditions.

Other populations at higher risk noted by the Human Health Committee include smokers, workers, pregnant women and the developing fetus, private well users, the elderly, and subsistence and sport fishers.

Some geographical areas in California are also exposed to potentially more hazardous levels of toxicants. Inner city neighborhoods, for instance, may be near manufacturing facilities, hazardous waste sites, waste treatment plants, or freeways. The combined effect of the pollutants in these “*hot spots*” (or places with multiple sources of exposure) may be greater than the sum of the individual pollutants.

Data for a Statewide analysis of “hot spots” do not exist. The Human Health Committee did identify regions that may have disproportionately high exposures to pollutants (Table 4, Attachment B, Human Health Committee report), and some are listed here:

- ◆ Regions with high geological radon (Santa Barbara, Ventura, Nevada, and Sierra counties).

- ◆ Regions with contamination “hot spots” affecting aquatic biota (San Francisco Bay/Delta, Santa Monica and San Diego Bays, Lakes in northern and southern California).
- ◆ Regions where water supplies are high in arsenic (San Joaquin Valley).

Other areas listed in the Human Health Committee technical report include: residential neighborhoods near air emission sources or uncontrolled hazardous waste sites, with older housing stock, in air basins regularly exceeding air quality standards; and regions affected by releases from Mexico, and where water supplies contain chemicals resulting from human activities.

The Human Health Committee also attempted to do an “environmental equity analysis,” to see if there are any correlations between race, ethnicity, or income and exposure to air pollutants. The analysis is limited, due to incomplete data. Preliminary analyses indicate that:

- ◆ Blacks and Hispanics live in areas that receive greater air pollutant emissions than whites, and
- ◆ Variation in income level does not appear as correlated with proximity to air pollutant emissions as race is.

What kind of research is needed to improve our understanding of human health risks?

More research needs to be done to thoroughly understand the risks that environmental pollution poses to Californians, including:

- ◆ Toxicity data are missing for many substances released in large quantities in this State. Monitoring data to describe actual human exposures to most pollutants are also not available.

- ◆ Noncancer risk assessment methods need to be further developed.
- ◆ The California Environmental Protection Agency should devote more resources to characterizing population exposures to toxicants in California, focusing on high exposure settings (for example, indoor environments or neighborhoods subject to accidental releases) and highly exposed groups..

Recommendations From the Human Health Committee

- ◆ General topic area ranks can be used to guide agencies in setting environmental priorities. The Human Health Committee recommends that the priority-setting process also consider whether environmental health risks are equitably distributed. The priority-setting process should recognize that the identification of highly impacted populations may offer cost-effective opportunities for preventing environmental health impacts.
- ◆ Levels of current risks are often relatively low because many topic areas have been the subject of controls on exposure. Any redirection of resources based on general rankings must consider the increased risks that might result if existing regulatory controls are reduced.
- ◆ The Human Health Committee recommends that the risk-management process develop greater capacity to act to prevent predictable future impacts on public health.
- ◆ The Human Health Committee recommends that comparative risk assessment should be integrated into regulatory agencies’ planning processes and that rankings should be reviewed regularly (perhaps every three to five years) in order to incorporate new scientific information into the priority setting process.

WHAT ARE THE RELATIVE RISKS TO CALIFORNIA'S ECOSYSTEMS?

Introduction

In California, human activities have had significant impacts on many types of ecosystems. Whether it is urban development reducing the habitats for endangered species, water diversions blocking Chinook salmon runs, or chemicals from irrigation run off damaging the reproductive systems of nesting birds, risks to California's ecosystems have created some of the most bitter debates in the State's history.

Methods

To determine the relative severity of these risks, the Ecological Health Committee examined the chains of influence that flow from human activities to wildlife and ecosystems. These chains are called "exposure pathways." It should be noted that the Ecological Health Committee did not start with the

topic areas in the environmental topics list. Members eventually translated their findings into similar topic areas, however, as described at the end of this chapter.

The 1991 transportation spill of a pesticide in the Upper Sacramento River provides a good example of an exposure pathway. At the beginning of the chain, or pathway, is an *activity* (in this case, *transportation* of hazardous materials). This creates a specific *stressor* (metam sodium, widely used as a soil fumigant), which moves through a *medium* (this could be air, water, or land, but in this case it is water and air). The stressor comes in contact with a *receptor* (aquatic life), which may produce an *effect*. The effect of the metam sodium spill in the Sacramento River was that aquatic life for over forty miles was killed. The exposure pathway for this incident, then, can be written as follows:

Activity → *Stressor* → *Medium* → *Receptor* → *Effect*
(*Transportation*)(*Pesticide*) (Water) (Aquatic (Mortality)
Life)

Members of the Ecological Health Committee used a "bottom-up" approach to explore exposure pathways, starting from the effect on biological receptors and then moving back up to the stressor and activity. (In the metam sodium spill example, Ecological Health Committee members would begin with the death of aquatic life, and move back up the chain to transportation.)

The Ecological Health Committee ranked the magnitude and severity of the impact of approximately 100 effects as "high," "medium," or "low," by analyzing four factors of that risk: intensity, extent, reversibility, and probability/uncertainty. Then the Ecological Health Committee as a whole ranked all the effects investigated.

THE FOUR FACTORS OF ECOLOGICAL RISK

Intensity measures the ecological severity of the effect and ranges from non-lethal effects on organisms to complete destruction of ecosystems.

Extent measures the proportion of the ecosystem affected and ranges from less than one to 100 percent.

Reversibility measures the time required for the system to recover and ranges from less than one year to more than 70 years (which is “unrecoverable”).

Uncertainty/probability measures the certainty that the effect will occur or the probability that the event producing the stressor will occur and ranges from no direct evidence to documented evidence it will occur.

The Ecological Health Committee then grouped the exposure pathways together based on the similar activities and stressors that cause negative effects in California’s ecosystems.

These groupings are called the “aggregate threats.”



What Are the Greatest Threats to California's Ecosystems?

Ecological health caveats

When referring to the risk-rankings of the Ecological Health Committee, the following caveats must be considered:

- ◆ The ranking of aggregate threats by the Ecological Health Committee incorporated evaluation of available data together with decisions based on scientific judgment. The aggregate threats and the rankings assigned were influenced by the experience and knowledge of Ecological Health Committee members.
- ◆ The Ecological Health Committee believes the aggregate threats, as presented, reflect the major potential threats to California ecological systems and that there is a major difference in the magnitude of the threat between high, medium, and low groups.
- ◆ The Ecological Health Committee was generally dissatisfied with the results of the translation from their "Aggregate Threat List" to the CCRP's general environmental topic lists. Although the translation to list II was adequate, the other translations would need substantial revision to conform with Ecological Health Committee members' perceptions of threats to California ecological systems.
- ◆ Members of the Ecological Health Committee maintain that an aggregate threat ranking provides the best means to evaluate risks to ecological health in California.

Aggregate threats

The Ecological Health Committee presented its rankings of aggregate risks as the most pertinent means for evaluating environmental threats to California's ecosystems based on risk. These are presented in the following box.

RELATIVE RANKING OF AGGREGATE THREATS

High-ranked Risks

Atmospheric oxidants
Introduced species
Mining waste and drainage
Resource extraction from aquatic ecosystems

Resource extraction from terrestrial ecosystems
Urban runoff
Urban sprawl
Water diversion

Medium-ranked Risks

Accidental releases of hazardous materials
Agricultural practices
Greenhouse gases
Municipal wastewater
Persistent toxicants

Pesticides
Petroleum, natural gas, or geothermal development
Recreation

Low-ranked Risks

Acid deposition
Particulates
Pathogenic microorganisms

Road development
Wild fires

The order of these topics within each category has no bearing on its severity.

Translation of aggregate risks to the environmental topic lists

Although a complete translation from aggregate threats to the environmental topic list developed by the CCRP was not possible, the Ecological Health Committee did translate its findings, as follows:

ECOLOGICAL HEALTH RISK-RANKING OF ENVIRONMENTAL HEALTH STRESSORS

High-ranked Risks

SOx and NOx (including acid deposition)
Inorganics
Alteration of aquatic habitats

Alteration of terrestrial habitats
Ozone
Non-native organisms

Medium-ranked Risks

Greenhouse gases
Lead
Oil/Petroleum
Persistent organochlorines
Pesticides - agricultural use

Pesticides - nonagricultural use
Substances that alter pH, salinity, and
hardness
Total suspended solids, biological oxygen
demand, and nutrients

Low-ranked Risks

Microbiological Contamination
Particulate Matter

Volatile organics

Unable to Rank or Not Ranked

Asbestos
Carbon monoxide
Electromagnetic fields
Environmental tobacco smoke
Genetically engineered products
or organisms

New chemicals
Radionuclides
Radon
Stratospheric ozone depletors
Thermal pollution and heat stress

The order of these topics within each category has no bearing on its severity.

What are the most sensitive ecosystems and species in the State?

In ranking aggregate environmental threats to California's ecosystems, the Ecological Health Committee identified biological receptors at highest risk. As an analogy, these more sensitive receptors are comparable to the more sensitive human subpopulations exposed to environmental contaminants. The biological receptors at highest risk should be placed in the context of the aggregate threat of concern. The full list of ecological receptors at the greatest risk for aggregate threats can be found in Table 3 of the Ecological Health Committee's report in the full technical document.

Some examples of the most sensitive ecological receptors for the highest ranked aggregate threats include:

- ◆ *Atmospheric oxidants*: coniferous forests.
- ◆ *Introduced species*: geographically restricted or specialized native species.

- ◆ *Mining waste and drainage*: river communities; riparian communities.
- ◆ *Resource extraction from aquatic ecosystems*: river communities; anadromous fish populations; marine invertebrate populations.
- ◆ *Resource extraction from terrestrial ecosystems*: old-growth forest communities; hunted or collected species; forest communities.
- ◆ *Urban runoff*: aquatic populations near large cities.
- ◆ *Urban sprawl*: geographically restricted terrestrial populations near large cities.
- ◆ *Water diversion*: aquatic and terrestrial estuarine communities; river communities.

Which ecological health threats need to be studied more?

Contaminants in non-point sources and sediments

Non-point sources (for example, runoff from land surfaces) are the major contributors to contaminants in surface waters. Sediment contaminants may contribute more to water column concentrations in enclosed bays than point source inputs (for example, heavy metals in sediments) to surface water.

Ecological systems impacted by multiple toxicants in multiple media

Salmon populations, biological communities in enclosed bays or estuaries, coniferous forest ecosystems near large population centers, and migratory waterfowl populations are all exposed to multiple threats.

Loss of diversity

Effort should be directed to determining the degree to which species diversity is reduced and ecosystem functions impaired in heavily impacted ecological systems. Non-native species may also be a significant threat, as they can crowd out native species and reduce diversity.

Recommendations From the Ecological Health Committee

- ◆ Increased human population, coupled with the associated land-use changes present “overarching” impacts on California ecosystems. The size of the human population, the location of population centers and the development and operation of the infrastructure necessary to support the human population pose the most serious current threat to California ecosystems. The potential for further degradation of ecological systems could be reduced by regional or Statewide land-use planning that incorporates consideration of ecological impacts.
- ◆ Protection of groundwater resources is a serious problem which should be addressed. Groundwater resources should be protected to the same degree that surface waters are protected. Protection of groundwater resources should address potential contamination as well as excessive consumption rates.



WHAT ARE THE RELATIVE ENVIRONMENTAL RISKS TO CALIFORNIANS' SOCIAL WELFARE?

Introduction

A polluted river, an endangered species, or a sick human can be a symptom of an environmental problem, and methods often exist to measure the extent of their effect. But many environmental problems impact something far less tangible than an organism or ecosystem: the “social welfare” of an individual, family, or community.

“Social welfare” includes many dimensions, ranging from economic well-being to a sense of personal security and equitable distribution of impacts and benefits. Environmental problems, for instance, can diminish recreational opportunities; reduce property values or increase taxes; cause pain and suffering as a result of illness; create divisions and conflicts within communities; and undermine confidence in governing institutions. Environmental problems may also disproportionately impact subpopulations.

These dimensions are reflected in widespread concerns which cut across lines of education, income, age, and gender. In the more serious cases, these concerns reveal a depth of disruption of people’s lives that is not captured in standard statistics of lost work days or frequencies of disease. To evaluate these kind of impacts, some comparative risk projects conduct a “quality of life” or social welfare analysis that focuses primarily on economic impacts (like property damage and lost work days), because these are easier to quantify. In the CCRP, the Social Welfare Committee also examined those social impacts which cannot really be quantified, such as peace of mind, aesthetics, equity, and future well-being.

Methods

What is optimal social welfare?

Although social ideals are highly subjective, the Social Welfare Committee developed the following definition of optimal social welfare as a standard for their analysis:

“People enjoy high levels of social welfare when they have good health and health care, personal security, meaningful employment, adequate income, a pleasing functional and diverse environment, a well-functioning infrastructure providing basic services, a range of satisfying recreational opportunities, good educational services, and a sense of community cohesiveness, participation, control, and trust with regard to governing institutions. There must also exist opportunities for personal choice, continuous self and community improvement, and an assurance that these benefits will be available to future generations.”

The subjective experience of ranking social welfare impacts

The Social Welfare Committee used a number of questions to help develop their ideas about social welfare impacts, including:

- ◆ Is my health or the health of loved ones affected?
- ◆ Will this threat affect my employment? The safety or value of my home?
- ◆ Will I give birth to a deformed child?
- ◆ Has my faith in human nature been damaged? Has my child’s view of the world as a safe and nurturing place been damaged?

- ◆ Was information withheld from me?
- ◆ Can I still trust my government?
- ◆ Did this happen to my community because of a lack of concern about minorities or poor people?
- ◆ Will it polarize my communities and create scapegoats?

Social Welfare Committee ranking criteria

After developing a measure of optimal social welfare, Social Welfare Committee members developed criteria to determine whether a social welfare impact exists. Some of the criteria focus on objective impacts (like environmental or economic well-being). Others focused on more subjective perceptions (like peace of mind and community well-being).

Environmental and aesthetic well-being. Functioning natural ecosystems; pleasing urban, suburban, and rural communities.

Economic well-being. Meaningful employment; adequate income; well-functioning infrastructure; affordable housing.

Physical well-being. Good physical health; access to health care; and affordability of health care.

Peace of mind. Good mental health; trust of governing institutions; access to reliable information; personal security; and healthy personal relationships.

Future well-being. Assurance for the well-being of future generations; sustainability of economic practices; and sustainability of ecosystems.

Equity. Shared decision-making power; democratic control of government; and equitable distribution of impacts and benefits.

Community well-being. Cohesiveness; accountability of decisionmakers; resources and opportunity to participate in decision-making.

The Social Welfare Committee then developed eight measures to evaluate the extent of the impacts associated with each criteria. Those measures were: number of people exposed, number of people impacted, severity of impact, irreversibility (degree to which impact is reversible), involuntariness (degree to which people have a choice in being exposed), uneven distribution (degree to which exposure falls disproportionately on a subpopulation), potential for catastrophic impact, and lack of detectability.

The Social Welfare Committee created matrices for each environmental topic area, so that each criteria could be measured as “high,” “medium,” or “low.” After matrices had been developed, the Social Welfare Committee reviewed all of them together to determine their relative levels of concern.

Social Welfare Risk-ranking

Social welfare caveats

When referring to the risk-rankings of the Social Welfare Committee, the following caveats must be considered:

- ◆ The nature of social welfare impacts precludes a systematic weighing and comparison of topic areas. However, in order to “rank,” artificial separations and groupings occurred in terms of the topic areas and lists, the impacts on health, ecology, and social welfare, and the aspects of social welfare impacts themselves (in the form of criteria and measures). Currently, there is no effective way to validate whether such an approach can adequately capture the social welfare impacts present in the complex California system.
- ◆ No well-established methodology or conceptual framework exists for assessing the social welfare impacts of environmental problems. Nor are there any systematic measures or databases available to use in these assessments.

- ◆ The Social Welfare Committee was a group of diverse professionals, but did not comprise a representative cross-section of the State's population.
- ◆ The rankings do not include a consideration of social welfare benefits, mitigation, or regulation costs.
- ◆ The Social Welfare Committee was constrained by insufficient time, data, and resources.
- ◆ Linking environmental problems to traditional social welfare impacts, like economics and aesthetics, is often tenuous, as any activity can have both beneficial and detrimental effects. Linking environmental problems to less traditional social welfare impacts, like anxiety or community fragmentation, can be even more difficult, as people's definitions of what is pleasing or desirable depend greatly on their background, circumstances, and personal taste.

Social Welfare Committee rankings

The rankings of environmental topic area list II (Environmental Health Stressors) according to relative impact on social welfare are presented here.

SOCIAL WELFARE RANKING OF ENVIRONMENTAL HEALTH STRESSORS

High-ranked Risks

Alteration of aquatic habitats
 Alteration of terrestrial habitats
 Environmental tobacco smoke
 Greenhouse gases
 Lead
 Ozone

Particulate matter
 Pesticides - agricultural use
 Pesticides - nonagricultural use
 Radionuclides
 Stratospheric ozone depletors
 Volatile organics

Medium-ranked Risks

Asbestos
 Inorganics
 Microbiological contamination
 Non-native organisms

Oil/Petroleum
 Persistent organochlorines
 Radon
 SO_x and NO_x

Low-ranked Risks

Carbon Monoxide
 Substances that alter pH, salinity, and hardness
 Thermal pollution

Total suspended solids, biological oxygen demand, and nutrients

Unable to Rank

Electromagnetic fields
 Genetically engineered products or organisms
 New chemicals

The order of these topics within each category has no bearing on its severity.

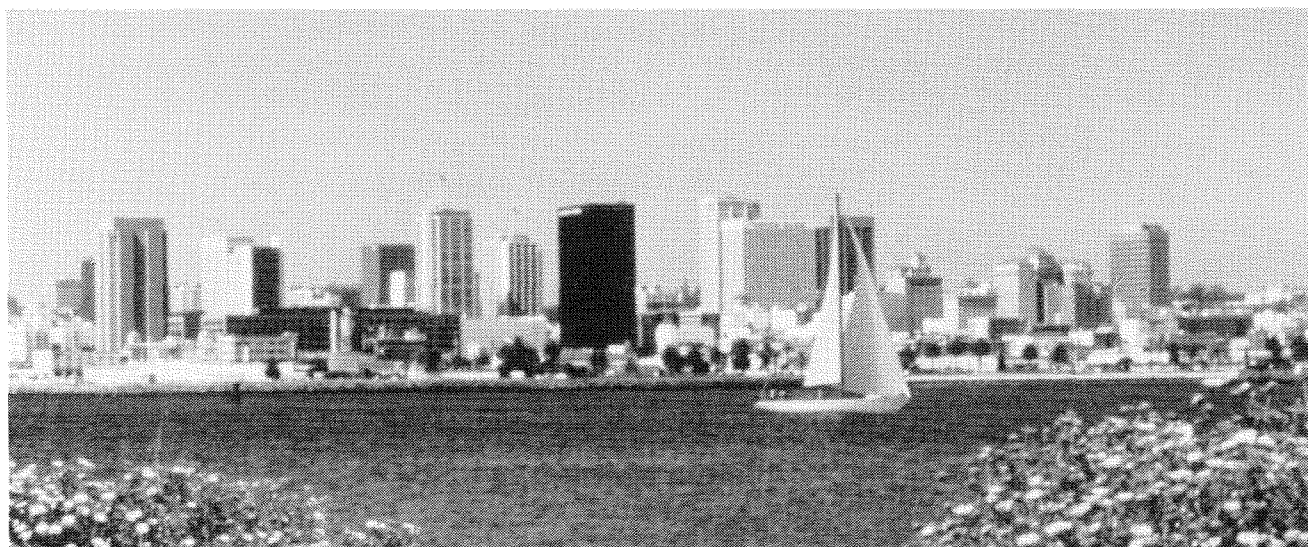
Social welfare priorities

Based on the Social Welfare Committee's assessment, some of the environmental health stressors with the greatest overall social welfare impacts are *environmental tobacco smoke, ozone, particulate matter, alteration of aquatic habitats, alteration of terrestrial habitats, and radionuclides.*

All six ranked high in their impact on peace of mind. Environmental tobacco smoke, ozone, and particulate matter were judged to most significantly impact the environment and aesthetics, economics and/or health. The greatest impacts of habitat alteration were on the environment and communities, as well as on future well-being and equity. The impact of radionuclides is primarily on economics, the future, communities, and equity.

Recommendations From the Social Welfare Committee

- ◆ Social welfare must be considered in any similar policy exercise or risk assessment.
- ◆ Future study of social welfare impacts should be provided with resources necessary for full examination of appropriate data.
- ◆ In any analysis of social welfare benefits, the relative distribution of these benefits should be determined. An analysis of "activities," rather than environmental topic areas, would facilitate an analysis of social welfare impacts.
- ◆ In environmental policy processes, Cal/EPA must include community and public participation and input at every stage of the process. Impacted communities in particular should be involved. Appropriate models for such participation should be developed.
- ◆ The California Environmental Protection Agency should continue to develop appropriate criteria, methods, and databases for addressing social welfare considerations. The most knowledgeable and experienced professionals in the State should be involved and the data collection, methodology, and analysis should undergo scientific peer review and community and public reviews at all stages of the process.
- ◆ To enhance environmental decision-making, policymakers should obtain a full view of the issues and options by listening to the perspectives of persons from different sectors, as well as members of the public. Values are an important component in prioritizing risk or risk-reduction strategies, and should be made explicit where possible.



SUMMARY OF RISK-RANKINGS

The risk-rankings for Environmental Health Stressors (environmental topic list II) from the three Component 1 committees are provided together here for easy comparison. These rankings should be considered in the context of the other decision-making factors discussed in the summary report.

In using these rankings, the caveats must be considered and included in any reproductions or citation of these results. Furthermore, the additional information provided by the committees, for example the information about aggregate risks presented by the Ecological Health Committee, and the information on populations at risk presented by the Human Health Committee must also be referenced.

ENVIRONMENTAL HEALTH STRESSORS

(to be used only in conjunction with the caveats on pages 22, 29, 34, and 35)

HUMAN HEALTH

HIGH

Environmental tobacco smoke
Inorganics
Persistent organochlorines
Ozone
Particulate matter
Radionuclides
(natural sources)
Radon
Volatile organics

MEDIUM

Carbon monoxide
Lead
Microbiological contaminants
Pesticides-agricultural use
Pesticides-non agricultural use

LOW

Alteration of acidity, salinity or
hardness of water
Radionuclides (anthropogenic)
SO_x and NO_x
Total suspended solids, biological
oxygen demand, or nutri-
ents in water

SOCIAL WELFARE

HIGH

Alteration of aquatic habitats
Alteration of terrestrial habitats
Environmental tobacco smoke
Greenhouse gases
Lead
Ozone
Particulate matter
Pesticides-agricultural use
Pesticides-non agricultural use
Radionuclides
Stratospheric ozone depletors
Volatile organics

MEDIUM

Asbestos
Inorganics
Microbiological contaminants
Non-native organisms
Oil and petroleum products
Persistent organochlorines
Radon
SO_x and NO_x

LOW

Alteration of acidity, salinity or
hardness of water
Carbon monoxide
Thermal pollution
Total suspended solids, biological
oxygen demand, or nutri-
ents in water

ECOLOGICAL HEALTH

HIGH

Alteration of aquatic and wetland
habitats
Alteration of terrestrial habitats
Inorganics
Non-native organisms
Ozone
SO_x and NO_x

MEDIUM

Alteration of acidity, salinity, or
hardness or water
Greenhouse gases
Lead
Persistent organochlorines
Oil and petroleum products
Pesticides-agricultural use
Pesticides-non agricultural use
Total suspended solids, biological
oxygen demand, or nutri-
ents in water

LOW

Microbiological contaminants
Particulate matter
Volatile organics

AN ENVIRONMENTAL JUSTICE PERSPECTIVE ON COMPARATIVE RISK

Introduction

Freedom from ecological destruction, freedom from environmental discrimination, and the need for democratic participation at every stage of policy-making should be central to just environmental policy.

--Environmental Justice Committee

On July 26th, 1993, a toxic cloud resulting from the accidental release of sulfuric acid at a local plant spread over Richmond, just northeast of San Francisco. A vital and diverse community, the most heavily exposed area of Richmond is home to primarily lower-income Black, Latino, and South East Asian residents. The town is the site of many large and small facilities that use or produce highly toxic substances, and that release contaminants into the environment every day.

Richmond residents are a high-risk population for environmental exposures. The fact that they are also poor and people of color is not unusual. Numerous studies have shown that poor communities and communities of color throughout the nation are subject to more pollution than wealthier and predominantly white communities.

Residents of such so-called "hot spots" may be more susceptible to health problems because of these exposures, and because they may not have ready access to adequate health care. National studies have indicated that environmental regulations also have been found to be less well enforced in such communities.⁵

These findings are among the basic tenets of what is called the "environmental justice movement." Environmental justice describes a policy approach that seeks to avoid putting disproportionate pollution burdens on any one community. But rather than try to "even-out" the pollution

burden, environmental justice asserts the right of all communities to a healthful environment and strives to reduce pollution everywhere.

Mission

The mission of the Environmental Justice Committee was to provide the CCRP with a firm environmental justice framework. Rather than ranking the environmental topic areas, the Environmental Justice Committee commented on and provided alternatives for the comparative risk process itself. The findings and conclusions of the Environmental Justice Committee affected several aspects of the CCRP. The inclusion of the mission to examine and propose changes in environmental decision-making processes in the State; the Human Health and Social Welfare committees' work; and the Statewide Community Advisory Committee's recommendations for more public participation, for a multidimensional approach in considering risks, and for pollution prevention programs are just some examples of those effects.

To begin their work, members of the Environmental Justice Committee developed three fundamental principles for environmental justice:

- 1) The Environmental Justice Committee believes that *public participation* is inviolate and that full and meaningful public participation must be incorporated into agency activities and be a primary consideration in reviewing agency policies.
- 2) Environmental policies must *incorporate consideration of subpopulations* that bear disproportionate risks.
- 3) The principle of *pollution prevention* should guide all efforts at risk reduction and policy implementation.

⁵ For examples of studies on environmental justice, see Cole, L. (1993). Empowerment as the key to environmental poverty law. *Ecology Law Quarterly*, 19, 619-683.

Critique of the Risk-ranking Model

With the four principles in mind, the Environmental Justice Committee presented its critique of the traditional comparative risk process as follows:

The structure of decision-making procedures in comparative risk projects (and in environmental decision-making generally) has not adequately provided for full and meaningful community participation.

Communities of color or with low income are often unable to participate on equal terms with industry and government. But people who live in a community are expert about what is happening there, and should have a strong voice in making decisions about its future.

Comparative risk exercises are grounded in a presumption that only limited resources are available for environmental protection.

Government agencies often fail to pursue a range of good opportunities for increasing funding for environmental protection, including finding alternatives to hazardous processes and products, or levying pollution taxes. It might be more effective to spend money to develop and use alternatives to pesticides, for instance, than to first regulate them and then mitigate the problems they cause.

Comparative risk projects should distinguish between risks that would benefit from pollution prevention approaches (air pollution emissions) and those that would not (such as abandoned hazardous waste sites and lead paint in dwellings).

Pollution prevention seeks to reduce or eliminate hazardous or toxic substances at all different stages of their use, from extraction of materials from the earth, through processing, manufacturing, distribution and use, to disposal.

Focusing on ways to prevent pollution in each of these steps (whether doing the stage differently or eliminating it altogether by changing the process or the end product) could result in cleaner workplaces, a cleaner environment, and less hazardous products for consumers and industry rather than more health problems and pollution that has to be cleaned up after the fact.

Conventional risk assessment methods do not account for the disproportionate risk burdens borne by certain communities.

Most comparative risk projects do not account for the impacts of cumulative and multiple exposures in toxic “hot spots” or to groups of people like farmworkers and their families. The Environmental Justice Committee would like to see new methods developed to identify such high-risk groups and areas. Methods such as those used by the Human Health Committee to identify groups at risk to disproportionate health impacts should be expanded.

AN ENVIRONMENTAL JUSTICE SUCCESS STORY

Members of the Environmental Justice Committee prepared several historical case studies illustrating the concepts and actions of the environmental justice movement. All of these are included in the Environmental Justice Committee's report in the full technical CCRP document. Here is one example:

Kettleman City, a small, farmworker community in the Central Valley, is 95 percent Latino. The town already hosts the largest toxic waste landfill west of Louisiana. In 1988, plans were announced to build a hazardous waste incinerator there. The citizens began protesting, fearing that increased pollution from the incinerator would damage their crops and possibly their own health.

They also protested the fact that the environmental impact report (EIR), a document that the State requires for any new project that could affect the environment, was available only in English, although 70 percent of the residents of Kettleman City speak Spanish at home.

The residents' protests fell on deaf ears. With the help of a legal advocacy group, they educated themselves, in Spanish, about the project. The result was 120 letters, all in Spanish, protesting the incinerator. The residents ultimately won a lawsuit against the county's approval of the project. Among the judge's reasons for ruling for the residents was that the EIR was not available in their primary language.

The Kettleman City example shows that strategies can be designed that maximize public participation and lead to the inclusion of more voices in environmental decision-making.

Recommendations From the Environmental Justice Committee

The Environmental Justice Committee developed a number of recommendations to improve environmental decision-making, based its environmental justice principles:

Public participation

- ◆ Greater and more meaningful participation should be promoted by providing sufficient technical resources to affected communities. The U.S. Environmental Protection Agency's Technical Assistance Grants, for example, offer community groups funds to hire their own experts.
- ◆ The California Environmental Protection Agency should extend to all State environmental laws provisions for citizens' suits such as those in Proposition 65 (The Safe Drinking Water and Toxic Enforcement Act of 1986) and expand community right-to-know opportunities, as in New Jersey's "*Right-to-Know More*" Act.

- ◆ The California Environmental Protection Agency should protect all provisions for public hearings on decisions that may affect a community's health or safety. The time and location of public hearings should be convenient. Access to public transit, childcare, and translation services, should be provided.

Consider subpopulations ("hot spots")

- ◆ The California Environmental Protection Agency should ensure equitable and effective implementation and enforcement of all its regulations and activities.
- ◆ To avoid the emergence of new "hot spots" across the State, Cal/EPA (and Cal/OSHA) should develop methods to identify potential "hot spots" in advance and start mitigating them. High-risk "hot spot" populations may include not only geographic areas but groups of people, like children and immigrant workers, who might suffer from language barriers and a lack of understanding about their rights.

Pollution prevention

- ◆ Shortages of resources for environmental protection may be relieved by making manufacturers and users of hazardous materials prove that use and disposal of regulated chemicals is “safe.” Currently, this burden is on the government or members of the public; too often, we learn of problems because of illness or accidents.
- ◆ Pollution prevention plans that are now required should also require that methods of implementing them be included. The granting of operating permits should be contingent on such plans.
- ◆ A Governor’s Task Force on Pollution Prevention should be established to provide cross-agency coordination, review state environmental programs, many of which are not the control costs borne by some in Cal/EPA, and integrate prevention criteria directly into the evaluation of all their activities. Additionally, an Office of Pollution Prevention reporting to the Secretary of Cal/EPA might ensure that the pollution prevention principle permeates all the agency’s activities.

ECONOMIC PERSPECTIVES ON ENVIRONMENTAL DECISION-MAKING

Introduction

Many of the aspects we most value about the environment have no agreed-upon price tag. It would be hard to work out the dollar value of having mountain lions in our wilderness areas, for instance, or knowing that Sierra lakes are pristine, or how the worth of a magnificent view or acres of fertile farmland, compare to the tax revenues provided by a shopping mall or a housing development. Obviously these aspects of the environment have value, even if we cannot say how much they are worth. Meanwhile, some control costs of running a business may continue to rise as environmental standards become more stringent.

In an era of diminished State and Federal budgets and increased attention to environmental problems, it can be difficult to decide how many resources should be applied to which problems. In fact, U.S. EPA’s underlying reason for proposing a risk-ranking model to set priorities was the belief that it is increasingly important to address environmental problems in a more cost-effective manner. Currently, most decisionmakers account for economic factors in some way or another. But often it is *ad hoc*, or indirect. Only after priorities are set by the Legislature do decisionmakers make decisions about how best to spend State money.

By carefully studying the economic conditions that both cause and are created by particular environmental problems, policymakers can more fully understand the potential costs and benefits associated with managing them.

The Economic Perspectives Committee of the California Comparative Risk Project developed a guide that policymakers can use to better identify and balance environmental and societal needs. Although many other comparative risk projects have incorporated some sort of economic analysis into their projects (usually in the social welfare analysis), this is the first time a project has offered a “how-to” approach to addressing the economic aspects of environmental problems.

In the course of any economic analysis, the analyst has to ask, *what will we give up — in terms of activities, money, or goods — if we spend resources on this environmental problem?* From an economic standpoint, the ideal management option reduces the most amount of risk for a given amount of money (the “biggest bang for the buck”). Economic analyses should also identify who pays the costs and who reaps the benefits of environmental actions.

Economic Criteria for Decision-making

To set environmental priorities by economic criteria, an analyst would focus on estimating the costs and benefits of the proposed risk-reduction strategy. To provide a framework for this analysis, the Environmental Perspectives Committee developed four economic criteria to use as they evaluate risk-reduction measures. Those criteria are: “economic efficiency,” “distributional impacts,” “uncertainty,” and “time considerations.”

Each of the four criteria have a number of specific impacts and questions associated with them. Impacts that are qualitative are no less important than the quantitative ones. They do demand a different kind of consideration, however.

Economic efficiency

Economic efficiency refers to getting the most benefit for a given cost. The goal is to maximize benefits to the entire society, whether it is in the form of wealth, employment, improved human health, enhanced ecosystems, or greater social welfare. Analysts should also consider those environmental resources that have no real price or money value, like outdoor recreation; the idea that a resource exists, even if we do not use it (like a distant, pristine lake); and the idea that a resource will continue to exist for future generations.

What are the net wealth and income changes on the State’s economy?

What is the ecological net benefit or resource value of the expected risk-reduction?

What is the net value of health benefits of expected risk-reduction?

Distributional impacts

Very efficient economic policies often create “winners” and “losers” in a situation. That is, some groups may get more jobs, more money, or more power than others. Some communities may become more or less desirable to residents or to businesses due to certain governmental decisions.

Which income or ethnic group is burdened and how much does each group benefit?

How does desirability of the community change for social and cultural reasons?

How do government revenues and spending change because of the risk reduction?

How does the desirability of doing business change in the affected area?

Uncertainty

The result of an environmental decision depends on many variables, including natural ecosystem cycles, the dependability of a new technology, changing policies and administrations, and fluctuating economies. Few of these variables can be predicted with precision. But identifying a range of possible outcomes can build in some margin of safety.

How great a factor is natural variation in the success of risk-reduction action?

What is the willingness to pay to reduce the uncertainty in technological development?

Will the risk-reduction action have sufficient political support?

How does the risk-reduction action affect the financial stability of the affected business?

Time considerations (time frame)

Should we act now? Should we wait until we know more? Often environmental decisionmakers have to weigh the costs of acting now against the benefits of holding off. Data and innovations that would make an action cheaper may become available in the future, for instance. But waiting can postpone the benefits of reducing risk or result in irreversible damage to an ecosystem or resource.

What are you willing to pay to collect additional information to decrease uncertainty?

To what degree does today’s investment foreclose tomorrow’s options?

Does reducing risk maintain resources for tomorrow’s generations?

Economic Caveats

When considering economic factors and perspectives in decision-making, there are three caveats that need to be considered:

- ◆ The relative importance of each of the economic criteria will change depending on the circumstance.
- ◆ Not all of the questions can be answered with an identical degree of accuracy.
- ◆ Comparing market and non-market value can be difficult. Because not all factors can be monetized, decisionmakers need to be aware of and sensitive to the more “qualitative” impacts of environmental actions.



Recommendations From the Economic Perspectives Committee

- ◆ Economics is important to environmental decision-making. Policymakers should address economic considerations formally and completely.
- ◆ Policymakers should recognize that reducing risk involves trade-offs and should be addressed explicitly.
- ◆ The California Environmental Protection Agency should complete the economic analysis of the environmental topics using data and recommended methodologies after the project is completed.
- ◆ Full understanding of the economic trade-offs of risk management is an integral part of environmental decision-making.
- ◆ The California Environmental Protection Agency should implement programs in its own departments and boards and coordinate with other State agencies to track and collect data on actual expenditures by private and public entities to protect the environment. Such a knowledge base is fundamental to environmental decision-making and responsible resource allocation.

ASSESSMENT OF EDUCATION AND PUBLIC INVOLVEMENT IN ENVIRONMENTAL DECISION-MAKING

“Education is the cornerstone that enables individuals to feel stewardship for the environment around them - to understand its multi-dimensionality and interconnectedness, and to participate in decisions made about the environment. True public participation is not possible without education.”

–Education Committee

Introduction

One of the stickiest problems in any comparative risk project is the question of the public’s perception of risk. That is, even if scientists, policymakers, and advocates could create the most accurate scientific risk-ranking imaginable, citizens would still have their own perception of the severity of the environmental risks that surround them. Those perceptions are key to developing sound policies, effective education, and responsive government agencies.

Two important issues in any comparative risk project address the state of environmental education (that is, *How much do people know about environmental problems?* and *What are they being taught?*) and public participation (that is, *To what degree are citizens’ views incorporated into the risk-ranking process and into environmental decision-making in general?*)

Such questions are difficult to answer. Several previous risk-ranking projects have tried to incorporate public opinion into their process. And other projects have recognized environmental education as important, and addressed it in their reports. The Education Committee decided early on that they wanted also to both assess the status of occupational health education and environmental education in California. The Education Commit-

tee also felt strongly that the California public should have a voice in the CCRP.

The Education Committee was very concerned with whether or not the programs effect empowerment within individuals and communities, and whether or not they are both targeted at and raise consciousness about multicultural issues. The group feels that these are urgent issues, given the rapidly changing demographic face of the state, and the changing perceptions of environmental problem. The Education Committee also recognized the need for integrating health issues into resource-based environmental education projects and curricula; creating well-coordinated programs; providing basic background in ethics in environmental decision-making; and teaching about the natural, built, and work environments.

History of environmental education

Nature study, conservation education and outdoor education have played important roles in the classroom since the turn of the century. Many national and international events and trends have shaped that education, including the Dust Bowl crisis of the 1930’s, the publication of Rachel Carson’s *Silent Spring* in 1962, the civil rights and anti-Vietnam movements of the 1960’, and the

EDUCATION COMMITTEE'S MISSION

- 1) To identify the status of occupational health and environmental education in the State of California and make recommendations.
- 2) To investigate the public participation process in the CCRP and make recommendations.
- 3) To facilitate communication among committees of the CCRP.
- 4) To educate ourselves as well as other committees about perceptions of risk.

many environmental laws passed during the 1970's and 1980's.

Today, citizens learn about environmental problems through many different mediums, including news reports, newsletters from industries and activist groups, college courses, on-the-job training, and word of mouth. Rarely is this education enough. Indeed, lack of public understanding about environmental issues is consistently listed as a key problem in comparative risk projects. Several states have listed it as a "problem" in their ranking lists. The State of Michigan ranked it in their top six problems. The city of Jackson, Alabama ranked it as the number one problem.

Environmental education is a teaching method that makes connections among science, technology, economics, policy, people, and the environment. Such education is fundamentally different from nature and conservation education because it addresses the interactive interrelationships between humans and the environment. It differs from environmental *science* in that it addresses values and skills as well as empirical knowledge.

Evaluation of Education

To help assess the quality of environmental and occupational health education programs in California, the Education Committee developed:

- 1) a *vision statement* about ideal environmental and occupational health education,
- 2) a set of *criteria* against which materials and programs could be evaluated,
- 3) descriptions of *model curriculum*, and
- 4) *recommendations* for further environmental education in California.

Vision statement

The connection between workplace/ occupational health issues and the environment should be emphasized.

- ◆ Workplace production, handling, and disposal of chemicals directly impacts the environment.
- ◆ Development of viable pollution prevention policies impact both the workplace and the community.
- ◆ Communities most affected by occupational and environmental issues are often the same.

Environmental and occupational health education efforts need to be presented in a multicultural approach.

- ◆ Educators should make sure that many different voices and values are heard and respected.
- ◆ Infusing environmental and occupational health curricula and projects with a diversity of cultural understandings and approaches creates a reflection of the multiculturalism that exists in the real world.
- ◆ Communities of color are often more heavily impacted by environmental and occupational health exposures than white communities. In a multicultural approach, educators and students would recognize that these injustices may have occurred.

Human health concerns need to be reflected in those curricula and projects that are currently focused primarily on natural resource-based issues (for example, recycling, water conservation).

- ◆ There is an integral connection between the health of nature and the health of humans. A lack of a balance in one affects the other. This interrelationship needs to be made explicit.
- ◆ Education about resource issues and human health issues should be joined during environmental decision-making processes.

California programs

In 1968, the California Legislature mandated conservation education in all elementary and secondary schools. This mandate was expanded throughout the 1970's and early 1980's to provide instruction in conservation and protection of natural resources.

Environmental and occupational health education in the State needs further improvement. The California Department of Education has only one full and one half-time staff people to coordinate all of the environmental education activities in the State. There is no central coordinating body for occupational health education. Although the California Environmental Education Interagency Network (CEEIN)⁶ is working to provide interagency coordination and networking for environmental educators, and although many exciting and innovative projects exist at the grassroots level, environmental education in this State could benefit from centralized criteria and coordination.

Education and multiculturalism

Changing demographics occurring in California have made environmental educators focus a new on both *who* their programs reach and *how* students are served. For instance, the environment for urban schoolchildren is more likely to be concrete and city parks than lakes and mountains; all children need to learn about both environments. Issues of environmental justice — that is, the fact that poor people and people of color tend to live in

areas that are more heavily polluted — should be addressed in the classroom. Reaching the diverse communities of California requires a coherent and organized outreach strategy.

The Three Circles Center for Multicultural Environmental Education in Sausalito, California lead the discussions and creations of innovative programs and curricula in multicultural environmental education. The Department of Education also recently published curricula that incorporates multicultural themes which will be made available to educators.

Model curricula and evaluation criteria

The Education Committee found a number of good model curricula that embodied its ideals for environmental and occupational health education. After reviewing a number of these curricula, it developed a set of *criteria* for educators to use in evaluating new and existing educational materials, including that:

- ◆ Issues of literacy should be considered when matching the curricula and approach with the audience.
- ◆ Mechanisms should be in place to enable education and action and provide opportunities for students to decide, plan, and implement action themselves.
- ◆ The curricula should examine the processes that affect risk and should include a discussion of issues regarding risk assessment and risk-ranking. The curricula should present a discussion about the potential benefits of various production processes along with the risks arising from the processes.
- ◆ The program should lead to empowerment of individuals and communities, that is, the power to analyze environmental situations and to take action the individual believes is relevant.
- ◆ Pollution prevention, conservation, and sustainability should be emphasized.
- ◆ Historical, ethical, cultural, geographic, economic, and sociopolitical relationships should be addressed.

⁶ A joint effort of Cal/EPA, the California Department of Education, and the Resources Agency.

Recommendations for environmental education in California

- ◆ The assessment of environmental programs and materials initiated in the CCRP should be continued.
- ◆ The State should formalize interagency partnerships dedicated to improving environmental education.
- ◆ Environmental education should incorporate human health and occupational health concerns.
- ◆ The State should encourage environmental educators to use multicultural and multilingual approaches and materials.
- ◆ The State should acknowledge the connection between public participation and education.
- ◆ The State should enhance existing legislation focused on environmental education.

Public Participation

Previous comparative risk projects have used a number of different methods to survey citizen perceptions of environmental problems in their region. Some projects have held community meetings to discuss local environmental problems. Other projects have depended on mass distribution of surveys.

The Education Committee first contacted the League of Women Voters (LWV), which conducted public participation activities for the CCRP in San Mateo and in Los Angeles. (The LWV also provided ongoing support and advice for the development of the lists of environmental topic areas.) The California Comparative Risk Project then hired an outside consulting firm to conduct regional roundtables, in Hayward, Los Angeles, and Fresno, throughout the fall of 1993. The firm recruited participants from a number of different constituencies, including business, local government, universities, labor organizations, and environmental and ethnic groups.

What do Californians think are the most serious threats to California's environment?

Each roundtable had about 15 panelists who talked about what they saw as environmental priorities in California. Audience members were also invited to participate. A number of themes came clear after all three roundtables had been held, including that policymakers needed to pay more attention to environmental justice issues and to public participation. Panel members also suggested that traditional risk assessment methods can divide communities, and that too often, policymakers miss the context that affects a community's overall needs.

Roundtable participants also proposed solutions to the State's environmental problems. Those solutions ran the gamut from the very general (for example, "rank solutions instead of risks") to the very specific (for example, "reverse car registration fees so that older, more polluting cars pay more"), and included requests for more planned growth, more public communication of risks, and more partnerships between industry and the public.

OBSERVATIONS FROM THE ROUNDTABLES

The Issues in Hayward

Overpopulation	Pollution prevention
Risk assessment methods	Sustainability
Air pollution	Environmental justice
	Public participation

The Issues in Fresno

Water quality	Air quality
Regulations	Education
Unplanned growth	Public participation

The Issues in Los Angeles

Air pollution	Corporate versus individual responsibility
Environmental justice	
Public participation	

Recommendations on public participation in California

- ◆ The public must be seen as a full and equal partner, not as an adversary.
- ◆ Public participation occurs along a continuum. The way in which public participation is done should reflect a sincere attempt of establishing dialogue with the affected communities.
- ◆ Public participation can be seen as a solution to some environmental problems in and of itself.
- ◆ True public participation is not possible without education and an explanation of risks that incorporates an understanding of the culture and language of the affected community.
- ◆ Project managers should decide in advance how public participation will be used; otherwise promises may be made which can not be kept. This will work against developing public trust.
- ◆ Public participation should not be used as a way to buy off the community. It requires a genuine commitment to establishing, growing, and maintaining partnerships.



ENVIRONMENTAL DECISION-MAKING: A REVIEW OF THE INTERAGENCY MANAGEMENT COOPERATIVE CASE STUDIES

Introduction

Project Staff surveyed a number of California agencies, represented on the Interagency Management Cooperative (IMC) to see how five factors (risk, public participation, pollution prevention, economics, and environmental justice) affected the agencies' choices of past environmental decisions, priorities and solutions. Five agencies submitted nine case studies: the Department of Toxic Substances Control, the Department of Pesticide Regulation, the State Water Resources Control Board, the Air Resources Board, and the Department of Forestry and Fire Protection. The case studies are not intended to be representative of the agencies' decision-making process, only to offer examples for consideration by the CCRP.

Survey questions focused on the agency's mandate (that is, what is the agency required to do under Federal and State law); its decision-making processes (that is, how do they prioritize problems and solutions); the management options considered (that is, what solutions were available and which were chosen); and the ways in which risk and "non-risk" factors affected their analyses.

Observations

The analysis of the case studies by Project Staff provided several observations:

- ◆ *Risks* are assessed very differently among the State agencies. All agencies attempted to make decisions based on sound scientific judgments. Most agencies also either considered themselves mandated to look at future or multiple risks or volunteered to do so.
- ◆ *Pollution prevention*, which includes concepts of source reduction (controlling pollution before it occurs) and life cycle analysis (reviewing costs, benefits, and alternatives for each stage of the process under question) is not mandated as frequently. Even so, many agencies indicated that some form of lifecycle analysis was used on a discretionary basis. In contrast, *pollution abatement* (that is, reducing pollution after it has been released) is a dominant mandate.
- ◆ Most of the agencies are mandated to provide public notice and formal hearings for pending decisions and provide access to published information. The full range of activities that might have engaged the public often was not used. None of the agencies, for example, had mandates to use public *education* programs or informal workshops on a significant basis, although some did so on their own. A few agencies required significant *community or public involvement* (typically in the form of co-sponsorships) in grant projects.
- ◆ Formally or informally, most of the agencies interviewed consider some aspects of *environmental justice* in their decision-making processes. Most often, that factor is the identification of subpopulations who may be at more risk than the broader population.

- ◆ Few agencies were mandated to include *economic factors* other than efficiency. Considerations generally took the form of evaluating impacts on businesses, for example, of toxic air emissions regulations on small businesses or of registration processes for new pesticides on agricultural enterprises.

Recommendations

These case studies *begin* an examination of how State agencies address the concerns of many people about public participation, distribution of risks among subpopulations, different economic perspectives, and pollution prevention. Project Staff suggest that the case studies support the need for Cal/EPA to:

- ◆ better understand which models of public participation are appropriate for different decisions,
- ◆ better understand how pollution prevention is interpreted and implemented among different agencies,
- ◆ better understand how and when economic factors should be addressed in different situations, and
- ◆ consider institutionalizing additional public participation activities, pollution prevention principles, and economic perspectives, where appropriate.

REPORT OF THE STATEWIDE COMMUNITY ADVISORY COMMITTEE

Preface

This Preface was prepared by Project Staff without the review of the Statewide Community Advisory Committee and does not necessarily represent the consensus of this committee.

The Statewide Community Advisory Committee (SCAC) served as the California Comparative Risk Project's (CCRP) primary policy advisory body. The mission of the Statewide Community Advisory Committee was to increase public input and integrate multiple and diverse perspectives into advice on the CCRP. The Statewide Community Advisory Committee was made up of 34 individuals who were non-State government representatives of environmental and social organizations, local government, business, industry, agriculture, and universities.

The Statewide Community Advisory Committee was charged with:

- 1) providing a public forum for the discussion of the issues raised during the CCRP that contribute to priority-setting for environmental protection;
- 2) providing advice and comments on the missions, goals, workplan, and implementation of the CCRP;
- 3) helping to identify alternative priority-setting models, in addition to the risk-ranking model;
- 4) participating in the integration of results from Components 1 and 2 and making recommendations to the California Environmental Protection Agency (Cal/EPA) on environmental protection priorities, the process for decision-making, and possible solutions; and,
- 5) contributing to a consensus-building process.

In over a little more than a one-year span, the Statewide Community Advisory Committee met for 10 regular meetings and a two-day Project Review Workshop. At the first meeting held in January 1993, the Statewide Community Advisory Committee expressed their concerns about the budget and timeline of the CCRP, and the limitations of the risk-based approach for environmental decision-making. The Statewide Community Advisory Committee therefore recommended early on that the CCRP workplan, timeline, and scope be revised to reflect these concerns.

During the course of the CCRP, the Statewide Community Advisory Committee was actively involved identifying other priority-setting models (in addition to the risk-based model), and providing feedback on the methodology and scope of work of the technical committees. For example, the Statewide Community Advisory Committee recommended that the Human Health Committee, with input from the Environmental Justice Committee, expand their scope of work to conduct an analysis to evaluate the risks of environmental stressors to highly impacted portions of the population and highly impacted geographical areas in the State.

The Statewide Community Advisory Committee also suggested ways for increasing public participation in the project and was instrumental in helping to organize three Regional Public Roundtable meetings held in Los Angeles, Hayward, and Fresno for the purpose of obtaining information on the most important environmental issues as perceived by the public.

During the last stage of the CCRP (that is, Component 3), all of the CCRP committees generated final technical reports on their work which are

incorporated in their entirety in the full technical CCRP report. During the two-day Statewide Community Advisory Committee Project Review Workshop in January 1994 and the last meeting of the Statewide Community Advisory Committee held in March 1994, the Statewide Community Advisory Committee was provided with the opportunity to review and comment on all aspects of the draft work products from the committees, make recommendations about the project, and provide recommendations on how Cal/EPA should establish priorities and allocate resources. It was during the workshop and the final meeting that the Statewide Community Advisory Committee developed the following report listing their recommendations to Cal/EPA.

The substance of this report includes principles for environmental decision-making, a commentary on the results from the technical committees, and recommendations for future action with regard to filling data gaps, conducting a pilot project for the identification of "hot spots" for human health and ecological risk in the State, preventing future risks, increasing public involvement and pollution prevention activities, and implementing the CCRP results.

The Statewide Community Advisory Committee successfully completed its charges and provided an important avenue for increasing public participation and providing multiple perspectives in the CCRP. The diverse opinions of Statewide Community Advisory Committee members always led to spirited debate, but in the end members would agree that barriers had been broken and communication channels opened for further dialogue on these issues.

Statewide Community Advisory Committee Report

Members of the Statewide Community Advisory Committee for the CCRP support the concepts presented in this report. The group worked to achieve consensus on major policy issues for comparative risk assessment and environmental decision-making. The precise wording of each finding and recommendation may not necessarily represent the verbatim wording that each member would prefer.

I. Principles for environmental decision-making

Environmental decision-making is a multi-dimensional process. Risk-based rankings of environmental topic areas are valuable and should be used for priority-setting in conjunction with other factors. Factors in addition to risk that need to be incorporated into decision-making include, but are not limited to, economics, public input, potential for pollution prevention, need to address the existence of disparate impacts on different populations, and emergence of future risks.

II. Commentary on reports from the Human Health, Ecological Health, and Social Welfare committees

The Statewide Community Advisory Committee endorses the process that the Human Health, Ecological Health, and Social Welfare committees used to prepare their reports and generate rankings of the environmental topic area list. The Statewide Community Advisory Committee recognizes that the technical work to generate the rankings was substantial and commends the efforts of the three committees.

The Statewide Community Advisory Committee believes that it is essential that the caveats developed by these committees on the use of the rankings be presented along with the rankings in all contexts where the rankings are presented so that the results are not taken out of context.

Acknowledging the limitations that have been identified, the Statewide Community Advisory

Committee still finds that the assessments of the Human Health and Ecological Health committees are valuable and advises Cal/EPA to consider them in setting environmental priorities.

The Statewide Community Advisory Committee recognizes that there is considerable uncertainty in analyzing health and ecological risks. Further work should be done to identify the sources of uncertainty in the analyses. The California Environmental Protection Agency should continue to work on development of methods for comparative risk assessment that minimize uncertainty and emphasize scientific principles. The Statewide Community Advisory Committee recognizes that judgment is a necessary element of the ranking process that should be explicitly acknowledged.

Topic areas ranked low or not ranked should be evaluated to determine whether these rankings are a result of 1) low risk, 2) regulatory controls, or 3) lack of data. These limitations of the rankings should be recognized.

The criteria developed by the Social Welfare Committee are important considerations to take into account in priority-setting and decision-making. These criteria are: environmental and aesthetic well-being, economic well-being, physical well-being, peace of mind, future well-being, community well-being, and equity. The rankings of the Social Welfare Committee should be considered preliminary since their work did not allow for a full examination of existing data.

Future studies of social welfare impacts should encompass full examination of data not available to the Social Welfare Committee at the time of their analysis. The California Environmental Protection Agency should continue to develop appropriate methods for addressing social welfare.

III. Highly exposed populations and ecosystems

The Statewide Community Advisory Committee supports the evaluation of risks of environmental stressors to highly impacted portions of

the population and specific ecosystems, in addition to the evaluation of risks on a statewide basis. The results of both analyses should be presented. Specifically, results for highly affected portions of the population and highly impacted geographical areas should be presented for human health, and results for highly threatened ecosystems, identified by use of the aggregate threat list, should be presented for ecological health.

Results of both the overall rankings and the highly impacted populations and ecosystems should be examined to identify areas for which additional research is needed. Further assessment of environmental exposures and epidemiology and ecological effects should be conducted where appropriate.

The California Environmental Protection Agency should give high priority to risk reduction actions in cases where important risks are confirmed after any appropriate further analysis. Priority consideration should be given to high-risk environmental exposures to ecosystems and small populations.

The California Environmental Protection Agency should initiate pilot projects for “hot spots” for human health and/or ecological risks in geographical areas reflecting the diversity of the state, to develop strong empirical data for analysis of the issues of pollution prevention and environmental justice. In these pilot projects, data should be gathered to allow quantification of the releases of environmental contaminants and resulting exposures to humans or ecosystems, including collection of monitoring or exposure data where appropriate. Cumulative risks from all sources should be assessed as well as risks from individual sources. The California Environmental Protection Agency should identify opportunities for exposure reduction with an emphasis on pollution prevention as a first priority to mitigate risks in the selected areas. Appropriate and inclusive public participation models suited to the community should be developed and implemented.

IV. Data gaps

The Statewide Community Advisory Committee recommends that Cal/EPA take steps, within existing resources, to fill the data gaps identified by the technical committees.

V. Identification and prevention of future risks

Future potential impacts are important public health and environmental concerns. Greater capacity to identify and prevent future impacts on public health and the environment from emerging risks should be developed.

VI. Public involvement and education

The Statewide Community Advisory Committee finds that public involvement and education are essential to the multi-dimensional process inherent to environmental decision-making.

The California Environmental Protection Agency should develop and implement a plan to involve the public in its decision-making processes. This includes maximizing meaningful participation in the review of Cal/EPA’s activities and progress in accomplishing its objectives of promoting long-term planning for sustaining a healthy environment and a higher quality of life.

The California Environmental Protection Agency’s public participation groups and advisory committees should reflect the diversity of the State and its communities.

The Statewide Community Advisory Committee recommends that environmental education provide the information necessary for understanding of sound environmental decision-making by the public at all age levels.

VII. Social and economic analysis for risk management decisions

Analysis of social and economic factors should be addressed in priority-setting and decision-making. Economics has a function in environ-

mental decision-making and should be addressed. The Statewide Community Advisory Committee recommends that analysis of economic trade-offs and benefits of risk management options should be an integral part of environmental decision-making. Current costs and benefits, as well as those that will accrue in the future, need to be considered. This analysis should consider the costs and benefits of taking action as well as failing to take action to address risks. The full array of societal impacts should be considered, including economic well-being and positive effects of economic enterprises. Factors to consider in assessing economic well-being include employment, income classification, costs of changes in policy, and effects on business competitiveness.

Uncertainty should be recognized in the analysis, including uncertainties resulting from incomplete information, use of new technologies, political uncertainties, and effects of policy changes. When information is incomplete, benefits of action must be weighed against the costs of losing the ability to act on new information in the future. Scientific understanding often changes based on improved data, and these considerations should be incorporated into the analysis.

VIII. Environmental justice

The consideration of subpopulations that bear disproportionate risks (that is, “hot spots”) must be incorporated into any new and/or existing environmental policies (for example, risk assessment, regulations.)

The California Environmental Protection Agency should ensure equitable and effective implementation and enforcement of all its regulations and activities.

IX. Pollution prevention

The Statewide Community Advisory Committee finds that pollution prevention can be an effective management tool for the reduction of risk and recommends reexamination of the results of other task forces’ work for recommendations concerning pollution prevention. One

alternative would be to consider a Governor’s Task Force on Pollution Prevention. Such a task force would be responsible for reviewing all agency programs that have environmental responsibilities and for integrating multi-media pollution prevention criteria into the evaluation of these activities.

Regardless of the level of risk, priority should be given to identifying risk reduction measures that do not involve substantial tradeoffs (that is, win-win opportunities) and to implementing such measures as fully as possible.

X. Implementation

Comparative risk assessment processes should be integrated into regulatory agencies’ planning processes. Rankings should be reviewed regularly (perhaps every three to five years) in order to determine if better data are available to provide firmer conclusions for risk management decisions. The Statewide Community Advisory Committee recommends that a group be established to oversee the implementation of the results of the comparative risk project.

Opportunities for cross-training of agency personnel, members of the interested public, and researchers on environmental issues should be encouraged. Forums for further development of methods for risk analysis and other elements of environmental decision-making are needed and should be encouraged by Cal/EPA.

The Statewide Community Advisory Committee finds that further work is needed to identify opportunities for merging of environmental and public health risks. For example, ocean water contamination impacts recreational users and also degrades the environment.