The Southern California Bight Pilot Project: An Overview

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The Southern California Bight (SCB) is an important and unique ecological resource. It is also a region of multiple demands, including municipal and industrial waste disposal, energy and oil production, marine transportation, commercial and sport fisheries, recreation, and aesthetics. Nearly 15 million people live in the region and their effect on the coastal marine environment has been profound. For example, 75% of the bays and estuaries have been dredged and filled and converted into harbors and marinas (Horn and Allen 1985). Human changes in the SCB have been superimposed on an environment that is subject to large natural fluctuations, such as El Niño and devastating winter storms.

Millions of taxpayer dollars are spent each year monitoring water quality in the coastal marine environment off Southern California. Some of this information has played a significant role in management decisions. For example, high levels of fecal coliform bacteria in the surf zone of Santa Monica Bay in the 1940s and 1950s caused beaches to be closed for years at a time and prompted the city of Los Angeles to extend its municipal wastewater outfall into deeper waters offshore (Garber and Wada 1988). Most of the monitoring data, however, are described in lengthy and detailed reports that are not readily accessible, or critically evaluated and summarized for policy makers and the public (National Research Council 1990a).

Existing programs that monitor the effects of man on the coastal marine environment off Southern California suffer from a number of problems. The emphasis of most programs is on meeting standards, not on understanding what is going on in the environment. Most coastal monitoring is required to comply with National Pollution Discharge Elimination System (NPDES) waste discharge permits that are issued by California and the federal government. Protecting the environment is implicit in the permits, but most compliance monitoring programs lack clear management and scientific objectives.

Compliance monitoring programs do not evaluate the cumulative effects of all discharges in the area. The NPDES permits set limits for individual point discharges, but they do not address pollutants discharged from other nearby sources. This is important because the input of pollutants from point sources has declined significantly over the past two decades (Shafer 1989) and the input of pollutants from nonpoint sources is comparable or greater than the input from point sources (Table 1).

The boundaries of existing compliance monitoring programs do not match the spatial and temporal boundaries of the important physical and biological processes. The area covered by the monitoring programs is less than 1%

TABLE 1. Estimated annual mass inputs to the Southern California Bight from municipal wastewater discharge, surface runoff, and ocean dumping.[a]

	Mass Emission (MT)					
	1970-72			1988-90		
	Municipal Wastewater	Surface Runoff	Ocean Dumping	Municipal Wastewater	Surface Runoff	Ocean Dumping
Cadmium	54	1.2	14	1.9	1.9	1.4
Chromium	649	25	28	15	31	32
Copper	567	18	28	62	62	56
Lead	211	90	28	11	109	38
Nickel	313	17	28	43	24	9.3
Silver	15	1.1	1.5	10	—[b]	0.6
Zinc	1,680	101	56	127	256	114
Total DDT	19	0.12	14	0.02	0.06	0.05[c]
Total PCB	9.7	0.25	28	nd	0.10	0.03

[a]Estimates within a factor of two or three for a particular compound from a particular source probably are not significantly different. Data for 1970-72 from SCCWRP (1973); data for 1988-90 from SCCWRP (1990a,b, 1992a,b).

[b]Not measured.
[c]Total pesticides.
nd=not detected.

of the total area of the SCB (»78,600 km^2) and less than 10% of the nearshore zone. Compliance monitoring programs emphasize small-scale, discrete questions, not Bight-wide processes in a region where large natural environmental fluctuations like El Niño have a significant effect on the ecology (Cross and Allen 1993). Compliance monitoring programs do not provide enough information to distinguish the effects of human activities from the effects of natural environmental variability.

The sampling designs, parameters measured, methods, and sampling frequency differ among the monitoring programs. Some of the laboratory analytical methods have not changed in a decade despite evidence that better methods exist. The NPDES permits lack the flexibility to incorporate new and improved designs and methods.

Data from the existing programs cannot be integrated into a regional database because there is no accessible, user-oriented data management system. Existing monitoring programs use a variety of approaches to data management. Furthermore, environmental managers do not have the resources to analyze and evaluate the monitoring data even if it were available to them. Most of the financial resources spent on monitoring are used in collecting and analyzing samples, and reporting the data. Few resources are directed at integrating and synthesizing the data and making it available to decision makers and the public.

Despite two decades of large annual expenditures on marine monitoring in Southern California, environmental managers do not have the scientific information they need to make informed decisions about use of the coastal environment. Existing monitoring programs address small-scale, discrete questions, not bight-wide questions of regional interest. As a result, it is difficult to draw conclusions about the status of the SCB as a whole and about whether beneficial uses are being protected. Better technical information is needed about the status and trends of the marine environment to guide management and regulatory decisions, to verify the effectiveness of existing programs, and to shape policy on marine environmental protection (National Research Council 1990a,b).

THE SOUTHERN CALIFORNIA BIGHT PILOT PROJECT (SCBPP)

To address these concerns, the Southern California Coastal Water Research Project (SCCWRP) began planning for a regional monitoring program in 1993 and coordinated implementation of the project, known as the Southern California Bight Pilot Project (SCBPP), in 1994. The SCBPP was intended to develop and demonstrate an integrated, coordinated, regional environmental monitoring program based on existing compliance monitoring programs. When completed, the SCBPP will provide synoptic information about the ecological condition of the mainland shelf in the Southern California Bight, and will evaluate new assessment approaches and alternative designs for compliance monitoring programs. The SCBPP also encouraged participating agencies to adopt common sampling designs and methods to facilitate comparisons among the programs in the region for years into the future.

The SCBPP grew out of discussions among the regulatory and discharge agencies that make up the SCCWRP Commission and built upon previous efforts at regional reference surveys (Word and Mearns 1979; Thompson *et al.* 1987, 1992). The United States Environmental Protection Agency's (USEPA) Environmental Monitoring and Assessment Program (EMAP) provided the framework for establishing regional monitoring in the SCB. EMAP is a national, interagency monitoring program that measures biological responses to environmental stress in terrestrial, aquatic, and marine ecosystems. It employs a probability-based sampling design that is coupled with standardized methods to provide estimates of the ecological status in a region (Weisberg *et al.* 1993). The EMAP emphasis on interagency participation encourages cooperation among the local, state, and federal monitoring programs operating within a region and results in improved data and reduced cost for all participants.

QUESTIONS ADDRESSED BY THE SCBPP

The SCBPP addressed three questions:

1) What is the spatial extent and magnitude of ecological change on the mainland shelf in the SCB?

2) Is the degree of change similar throughout the SCB, or is it more severe in particular areas?

3) Can the change be associated with identifiable sources of pollution and does that differ in different portions of the SCB?

These questions were addressed by simultaneously collecting measures of biological response, contaminant exposure, habitat condition, and human use. Collecting measurements of contaminant exposure with measurements of biological response allows identification of statistical associations between altered ecological conditions and particular environmental stresses. While statistical associations do not conclusively identify the cause of the response, associations are valuable for establishing priorities for further investigations. The statistical associations may also contribute to developing efficient regional

strategies for protecting or improving the environment by identifying the predominant types of stress in the system.

The questions addressed by the SCBPP differ from the questions addressed by the existing monitoring programs in the SCB in two important ways. First, the SCBPP asked questions about large geographic areas. Second, the questions emphasize estimating the areal extent of the mainland shelf that exceeds a threshold of anthropogenic influence. Historical monitoring in the SCB has tested whether the mean value of some measurement differed statistically between two sites (typically an impacted site and a reference site). Effective management of a region like the SCB requires knowing the areal extent of degradation (e.g., measuring the proportion of the mainland shelf that has sediment contaminants above acceptable levels). For example, if the concentration of some pollutant were above acceptable levels in the sediments in a small area, the management strategy to mitigate effects would most likely focus on a local, source-specific problem. If the concentration were above acceptable levels over a wide area, the management strategy to mitigate effects would most likely focus on a watershed or regional problem.

TECHNICAL CHALLENGES IN ADDRESSING THE SCBPP QUESTIONS

Addressing the questions posed by the SCBPP presented a number of technical challenges, the first of which was standardization of data collection procedures. The sampling designs, parameters measured, methods, and sampling frequency differed substantially among the existing monitoring programs (NRC 1990a). To ensure that each participant produced comparable data, the SCBPP developed standard field and laboratory methods and quality assurance protocols (QA), and documented them in a series of manuals (SCBPP 1994a,b). These included standard methods for collecting water-column and sediment samples, and for trawling. They also included standard methods for processing benthic infauna samples, demersal fish and invertebrate samples, and sediment chemistry samples.

Implementing the standardized methods required development of a region-wide quality assurance/quality control (QA/QC) program to ensure and quantify the consistency among participants. The SCBPP was conducted with nearly 100 field people using five vessels directed by four publicly owned treatment works (POTWs), SCCWRP, and two contractors. The samples were transported to six laboratories for processing. Maintaining consistency in field and laboratory operations and ensuring data comparability was critical to the success of the SCBPP.

The foundation for quality assurance in the SCBPP was the QA plan (SCBPP 1994b), which was jointly produced by the participating agencies. In many cases, common methods were agreed upon by the participants and the QA/QC measurements assured that methods were consistently applied. Where performance-based standards were appropriate, QA/QC procedures for each of the program components (e.g., field operations, water quality, sediment and tissue chemical analyses, benthic and demersal fish analyses) were established. The standardization of methods among the participants and the QA plan provide a foundation on which to build further regional monitoring efforts.

Another challenge was to develop a database system that allowed access to all of the participants. Historically, each agency has collected and managed its own data. Consequently, there are as many different information management systems in Southern California as there are participating agencies. Furthermore, the agencies had not developed standard protocols or formats for transferring the data among themselves.

Perhaps the greatest challenge was the development of new data analytical techniques to address the type of questions being asked in the SCBPP. When monitoring questions were focused at the local scale, most analyses were based on statistical comparisons of conditions at a single impacted site with conditions at a single reference site. The SCBPP questions required establishing thresholds for each response variable to identify the spatial extent of anthropogenic influence. Because of the scope of the study, these thresholds had to be established on a regional basis. Some of the measured variables had straightforward thresholds based on regulatory criteria (e.g., toxicity tests). Other variables were associated with natural gradients that had to be accounted for in the analyses (e.g., sediment metal and dissolved oxygen concentrations). For biological responses, the complexity introduced by these gradients are compounded by natural variability, and determining the thresholds requires an exercise equivalent to establishing biocriteria (Weisberg *et al*. in press). Development of regional thresholds will provide assessment tools for future monitoring efforts.

PROJECT MANAGEMENT

The SCBPP is a collaborative effort among 12 local, state, and federal agencies (Table 2) and was unique in that its participants included regulators and dischargers with diverse goals and interests. The regulatory agencies redirected portions of the existing compliance monitoring programs and allowed the SCBPP to leverage available resources to develop a regional monitoring program that addressed the needs of all of the participating agencies.

TABLE 2. Agencies participating in the Southern California Bight Pilot Project.

Southern California Coastal Water Research Project
City of Los Angeles Bureau of Sanitation, Environmental Monitoring Division
County Sanitation Districts of Los Angeles County
County Sanitation Districts of Orange County
City of San Diego Metropolitan Wastewater Department, Point Loma Treatment Facility
United States Environmental Protection Agency, Region IX
California Regional Water Quality Control Board, Los Angeles Region
California Regional Water Quality Control Board, Santa Ana Region
California Regional Water Quality Control Board, San Diego Region
California State Water Resources Control Board
United States Environmental Protection Agency, Office of Research and Development, Environmental Monitoring and Assessment Program
Santa Monica Bay Restoration Project

Effective management was a critical component of the success of the SCBPP since it required coordinating the efforts of many groups to produce data that were reliable and comparable. Coordination of the project was the responsibility of SCCWRP. The project was guided by a Steering Committee composed of representatives of the participating agencies and other individuals with technical or programmatic expertise. The Steering Committee ensured that the SCBPP was a multiagency effort and that decisions were reached through consensus. The committee produced standards for monitoring and demonstrated how compliance monitoring programs could be folded into a comprehensive regional monitoring program.

The Steering Committee included a Program Manager (who had overall program responsibility), Quality Assurance Officer (who directed the QA components of the project), a Field Coordinator (who directed the administrative and technical components of field operations), a Laboratory Coordinator (who directed the administrative and technical components of laboratory analyses), an Information Management Officer (who coordinated data reporting and management), and a Data Analysis and Reporting Coordinator (who coordinated data analyses and reports).

The coordinators were supported by technical representatives of the agencies and organizations participating in the SCBPP. The coordinators were responsible for overseeing all technical efforts in their project areas, and for soliciting and compiling the comments of all members of their technical support groups. The coordinators acted as liaisons for maintaining communication and consensus among project participants throughout the development and implementation of the SCBPP. Distributed coordination provided a mechanism to ensure that the interests of all SCBPP participants were recognized and considered; it also created a forum for constructive resolution of conflicts that arose during the project. Finally, distributed coordination of the technical areas of the project ensured that the abilities and expertise of the diverse participants were used to the fullest advantage throughout the project.

CONCLUSIONS

Better technical information is needed on the status and trends of the coastal marine environment off Southern California to guide management and regulatory decisions, to verify the effectiveness of existing programs, to judge the risk of future actions, and to shape policy on marine environmental protection. A comprehensive regional monitoring program can provide this information.

The SCBPP was conducted as a partnership among discharge and regulatory agencies using an established sampling design and standard sampling and analysis methods. A large part of the success of the SCBPP was due to the recognition of the limitations of the existing monitoring system, and the willingness of managers, scientists, and technical representatives in the agencies to reach agreement by consensus. Subsequently, the regulatory agencies have incorporated the SCBPP sampling design and standardized methods into other marine programs in California. The goal of these efforts is to develop an integrated framework for marine monitoring that addresses the cumulative impacts from human activities. The SCBPP is working to incorporate additional participants and elements into a comprehensive, integrated program that combines compliance and regional monitoring with research to provide decision makers with best possible information, and to provide answers to questions the public is asking.

The SCBPP has stimulated and strengthened cooperation among the participating agencies, and it will ultimately improve environmental monitoring, research, and decision making in Southern California. The success of the SCBPP will provide the impetus and the tools for implementing regional monitoring in the Southern California Bight. The future success of regional monitoring, however, will require developing a formal institutional mechanism or memoranda of understanding to integrate existing compliance monitoring programs and their results. Regional monitoring will provide environmental managers with the data they need to evaluate the influence of the various anthropogenic inputs. Ultimately, this will allow managers to select the most cost-effective management strategies (NRC 1990a).

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