Assessment of the Information Need for Protection of the Bay's Living Resources and Habitats

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Prepared for the Santa Monica Bay Restoration Commission

Technical Advisory Committee, Habitat Subcommittee

BY:

Raphael Sagarin, Jayson Smith, Janel Augello

UCLA Institute of the Environment

La Kretz Hall, Suite 300

Los Angeles, CA 90095-1496

sagarin@ucla.edu

Introduction

Over the course of the last 25 years, there has been a dramatic shift among key stakeholders toward viewing the value of the Santa Monica Bay and its watersheds in terms of the full range of the services it can provide. Unfortunately, the assimilation of data necessary to make informed decisions has lagged behind the shift in public perceptions. Just as at the national level, where the primary conclusion of the Heinz Center's comprehensive report on the state of the nation's ecosystems was that data were not available to assess most ecosystems (www.heinzctr.org), decisions by policymakers and advocates in the Bay are hampered by inadequate information about the Bay's natural resources. Santa Monica Bay is entering a period when policymakers and other stakeholders will have to face crucial decisions on controversial issues such as responses to TMDL mandates, development in an increasingly lucrative real estate market, and the consideration of no-take marine reserves. Moreover, external forces such as oceanographic regime shifts and anthropogenic climate change will likely impart dramatic changes to the oceanography, habitats, populations and composition of living communities of the Bay, as has been demonstrated in southern and central California. Without adequate data on the habitats and natural resources of the Bay, these decisions may be made in ignorance or may be postponed indefinitely. Moreover, it may be impossible to separate the effects of local and regional anthropogenic impacts that local parties have some control over from natural and global environmental change.

There are, however, many data on Santa Monica Bay habitats and living resources collected by scientists and consultants, students, resource managers, commercial interests and through SMBRC projects, but they have not been compiled and are often in formats

that are not suitable for rapid assessment. Here we report on our efforts, in collaboration with the Santa Monica Bay Restoration Commission (SMBRC) Technical Advisory Committee Habitats Subcommittee, to compile as complete a picture as possible on the research that has been done within Santa Monica Bay, and to connect this picture with the growing concern over a number of threats and vulnerabilities to the Bay's living resources. Because work is ongoing in the Bay, and because research topics change in response to scientific trends, government regulations, and the needs of the community, our results should be considered to part of a "living document" which we hope will be continually maintained and updated by the SMBRC and the scientific community. Moreover, as active researchers with a range of interests related to the Bay we hope that this effort will become the first step in an ongoing relationship between ourselves and the SMBRC.

Methods

Several techniques were used to find articles, reports, databases, and studies conducted within the Santa Monica Bay. Thorough searches were conducted using several searchable databases (Table 1) including a) standard library online databases such as Biosis, b) school specific library online databases such as UCLA Library Catalog, c) journal publishing company online databases such as JSTOR, d) agency online databases such as for the National and California Sea Grant, and e) the internet scholarly search engine "Google Scholar" (http://scholar.google.com). Google Scholar is a relatively new web search engine that specializes in scholarly literature, including peer-reviewed articles, books, theses, and reports with work published pre-1800s to present. Google

Scholar differs from other library databases such as Biosis as it searches for key words from anywhere in the text as opposed to only within the title and abstract. Google Scholar then ranks the relevance of the article based on how often it has been cited in scholarly literature.

In addition to online searchable databases, we also manually browsed through several libraries and periodicals (Table 1) including a) journals that specialize in studies conducted within southern California such as the Southern California Academy of Sciences Bulletin, and b) libraries, documents, and annual reports from local agencies such as those from the Southern California Coastal Water Research Project. Personal communication with agencies, professors, and other researchers working in the area (Appendix I) proved vital in filling in gaps where bibliographic databases proved inefficient.

For online searches, we used the term “Santa Monica Bay” or used the names of specific sites within the Bay to find appropriate articles and reports (see Table 2 for specific site names, and Appendix II for site coordinates). Only a small number of specific site names resulted in discovery of a significant number of reports. These include the Hyperion Outfall, King Harbor, Malibu, Manhattan Beach, Marina del Rey, Palos Verdes, Point Dume, Redondo Beach, White’s Point Beach, and White’s Point Outfall. In addition, a search was conducted using the term “Southern California Bight” in hopes to include studies conducted within the Santa Monica Bay but in which the specific region or site was not listed in the key words within the title or abstract of the report. These studies were browsed to ensure that the study included sampling from within the Bay. Due to time constraints, finding articles in this manner was difficult.

Work was considered appropriate if sampling was conducted within the boundaries of the Santa Monica Bay (Fig. 1), below the tidal level in the marine ecosystem. Bays and marinas were considered within the Bay while estuaries and other watershed regions were not included. The southern boundary of the Santa Monica Bay was considered to be Point Fermin on the south corner of the Palos Verdes Peninsula just upcoast from the Long Beach/Los Angeles Harbor. The northern limit was located at the Ventura and Los Angeles County borderline just upcoast from the Leo Carillo State Beach. The bay was considered to include areas offshore to 500 m in depth. However, in some cases, an offshore study did not provide a depth but were included if they were conducted on the Santa Monica Basin.

Appropriate citations were archived in the bibliographic software program Endnote v9 (Thomson, http://endnote.com). Endnote is a searchable database that organizes collected citations and articles. Endnote contains a suite of reference types such as journal articles, reports, government documents, and online databases, each with standardized input fields such as title, author, data, organization, etc. Several additional customized fields were added to the Endnote database including encompassing area, Santa Monica Bay site name, general taxa, habitat/community, pollutant/chemical, oceanography, and substrate. The specified terms listed under the customized fields are given in Table 2. An additional combined field was created from the general taxa field and the habitat/community field so that a matrix of taxa by habitat could be created. Citations were either manually added to the database or imported from searchable library databases (e.g. Biosis). Depending on the searchable library database used, the imported data and field values varied. In cases where articles or reports were available in either pdf format

or as a Word document, these files were attached to the citation within the Endnote program.

The bibliographic program Endnote was used to archive and manage all reports, articles, and databases regarding work conducted within the Santa Monica Bay. This program was chosen because (1) it is a prefabricated bibliographic library database; (2) it is relatively inexpensive (~$200); and (3) is user friendly. Endnote is a well-established bibliographic database with appropriate citation types and with numerous fields with important information required to create a bibliography. Additional records such as keywords, notes, and abstracts can also be stored in the reference information. In addition to the reference data, the library contains indexes that are used for easy and efficient searching and sorting. Endnote is also compatible with several search engines so that articles found from online library databases, such as BIOSIS, can be directly exported into the Endnote program. Endnote is compatible with Microsoft Word and other word processing software so that citations can be inserted into working manuscripts and reports. These in-text citations can then be easily translated into a bibliography that can be formatted manually or by using formatted references from over 1300 predefined bibliographic styles for the leading journals. Endnote is formatted for use with either Windows or Macintosh users. Although many of the information fields within the references can be tailored for personal needs (e.g. Site location of study within the Santa Monica Bay was added as a customized field), customization is not user friendly nor seamless in the program. For example, if the Endnote field “Custom 1” is renamed to be “Santa Monica Bay Site Location”, the custom name does not change in all program attributes. If the user were to attempt to use the Endnote program searching attribute, the

user could not search within “Santa Monica Bay Site Location” field as only the predetermined field names (“Custom 1”) are available. With some amount of knowledge and a few directions (e.g., a list of what the “Custom” fields were used for, see Appendix III), these issues can be overcome. Instructions for copying the Endnote database from one machine to another are given in Appendix IV.

Several other programs were investigated to determine the best option to store the citation data in the long-term. The best software options are customizable databases such as Microsoft Access or an Oracle database program. These programs included a great deal of customizing and knowledge of manual program coding. Customizing a database such as this would take a great deal of time and effort and was beyond the expectations of this project. These database programs can be very useful and beneficial for more specific and efficient customizing of fields. In addition, Microsoft Access is cheaper (~$100) and usually already owned and used by most researchers (it is, however, not available for Macintosh at this point). This avoids the problems associated with potential users needing to purchase and learn a new program. In addition, once the database has been created, it can be much more user-friendly than Endnote with the use of drop-down menus and easy to follow steps to add or search the available references.

Results and Discussion

Our database currently contains 1753 complete bibliographic references, of which 1152 have been summarized and their contents analyzed. New references were added throughout the year long contract period as other investigators became aware of our project or as obscure references were brought to our attention. Nevertheless, the rate of additions greatly declined despite continued searching and inquiries, suggesting that our

database is comprehensive, if not exhaustive, of the available literature on Santa Monica Bay. Not all studies directly concerned the living resources of the Bay. Of 1152 studies summarized, 771 (67%) examined living organisms.

Type. The majority of studies are Reports, typically from agencies and consulting firms, followed by published journal articles, and in much smaller numbers, books, theses and conference proceedings (Table 3). That the majority of these sources are unpublished or not indexed in online electronic databases speaks to the value of the database we compiled for people interested in Santa Monica Bay research.

Historical. Studies as a whole (Fig. 2) and grouped by time periods (Table 4) show a continual increase in numbers with time, with a stepwise increase in numbers in the 1970's. There is likely to be some bias in this sample due to the greater likelihood of newer studies to be archived and found in electronic databases. However, a large part of the increase is also likely due to environmental regulations and general concern about the environment beginning in the early 1970's which led to both mandated studies and increased numbers of researchers in the area.

Places. Most studies are cataloged generally as having been conducted in Santa Monica Bay (Table 5). Of those where specific place names are mentioned, there appears to be a tendency towards studies in locations where regulations or environmental remediation require monitoring or assessment. Thus, Palos Verdes, outfall locations and sites associated with coastal power plants have the greatest numbers of studies in the database (Fig. 3). Of the 209 studies from White's Point or White's Point Beach (combined on the map), 131 specifically address a generating station or publicly owned treatment works (POTW). Of the 95 studies at Redondo, 33 are related to generating

stations or POTW, and some of the remaining studies may be related, although this is not specifically mentioned in the summary or abstract of the study. Of the 68 studies at El Segundo Beach, 26 are related to generating stations or POTW and 28 are related to the refinery.

Physical factors, substrates, and living resources. Numbers of studies broken down by focal physical factors, substrates or living resources are given in Tables 6-9. Some care should be taken in interpreting these results as there are differences in the detail provided in the studies we analyzed. Thus, for example, one report may have listed all the specific oceanographic data that were measured, while another might only report having studied "upwelling". Likewise, studies may have listed each species of fish encountered, or simply noted that "fish" were studied.

In order to gain a better picture of studies in the Bay, in addition to these one-dimensional enumerations, we analyzed studies of pollutants and studies of living resources in two-dimensional matrices. The pollutant matrix (Table 10) considers the 20 most common pollutants studied parsed out by the type of study. Thus, we can separate studies that identify sources of pollution from those tracking the fate (concentrations in water or tissues) from those identifying effects of pollution (e.g., on population numbers or organismal condition of affected species). The habitat by taxa matrix (Table 11) enumerates studies conducted in different habitat types by the general taxa that were studied.

These matrices are particularly useful for identifying pollutants, taxa or habitats for which little research has been done. For example, given the proximity of the Bay to the

ports of Long Beach and Los Angeles, we are surprised are the small number of studies on invasive species.

Risks and Vulnerabilities The approach of enumerating records is useful for identifying data gaps, but it has several limitations in the analysis of risk and vulnerability. These limitations generally stem from biases in the distribution of work that has been done (e.g., a large proportion of studies on the Hyperion outfall may reflect funding opportunities or regulatory measures, rather than true threats to the Bay), differential quality or detail of the work, and historical contingencies (e.g., a large amount of past work on sewage outfalls may not be relevant to present conditions in the Bay). Another source of bias is introduced by potential threats where there are simply no data or reports to populate the database. The most obvious example of this is the lack of studies on non-consumptive uses of the Bay, such as diving and whale watching (see Appendix I: Contact List, for list of unsuccessful attempts to find these data). In other areas of the country, whale watching in particular has become a resource management concern as whales may be adversely affected by whale-watch boats. We have no way to assess these effects, if any, in the Santa Monica Bay.

An attempt to assess threats and vulnerabilities was made by ourselves with the Habitats Subcommittee. This began with development of a list of potential stressors to living resources in the Bay based on the expertise of the Subcommittee. We asked Subcommittee members to list 5-10 priority areas that their experience suggested were essential for understanding risks and vulnerabilities in the Bay (Table 12). We also reviewed existing regulations, management actions and other efforts aimed at protecting

living resources and connected these activities to the list of stressors based on the stated goals of the activities. At this point this assessment is incomplete for several reasons:

1. There is some disagreement among the Habitats Subcommittee over the scope of regulatory actions that should be considered in assessing how well the Bay's resources are protected. Should they include broad Federal legislation (e.g., Endangered Species Act) or only very specific local regulations (e.g., operating permits for facilities)? Should local non-regulatory activities such as beach clean-ups and public education campaigns be included, and if so, how can these be evaluated?
2. The study authors made one attempt to classify each class of living resource according to the potential stressors and the potential for existing management actions to adequately protect the resource. In many cases this was necessarily a subjective determination based on the authors' expertise. It is clear through discussions with the Habitats Subcommittee that each member would have a different evaluation, although not all members of the Subcommittee weighed in on this activity. We felt that it would be premature to publish these evaluations until a wider range of experts and stakeholders were given an opportunity to weigh in.
3. There is considerable scientific uncertainty as to the effects of stressors on living resources. For example, what is the potential effect of invasive species on deep demersal environments? Are there indirect effects of coastal construction or dumping on demersal environments? While our database can show that no studies have been done locally on some of these questions, even a wider search of the

literature may find many cases where we simply have no data relevant to the question.

One approach for moving forward is illustrated in Figure 4. In this approach, potential stressors and applicable management activities (determined through discussion among experts, such as the habitats subcommittee) are related in a matrix to habitat and living resource targets. For each cell of the matrix individual experts determine how the stressor acts upon the target (directly or indirectly) and if management actions are directed at the target. In all cases there is an option to state that the effect of the stressor or the relationship of management actions to the stressor is unknown. By combining matrices filled in this way from several individuals, areas of general consensus, general disagreement or lack of information can be identified. The database can be used to identify studies that might provide more information or may demonstrate the effects of past management action.

Recommendations

The tool that we provide here will greatly increase in value as it becomes available to other researchers and concerned citizens in the region. We recommend that our Endnote database be converted to a customized Microsoft Access database with a user-friendly “front end”. Endnote was chosen knowing that conversion to an Access or other database program could be conducted easily as the Endnote library can be exported as a tab-delimited text file. A database designer could be contracted on a relatively short-term basis to construct the database and populate it with the existing records we have

compiled. Ideally, this Access database should be searchable, but not modifiable, on a public website. A form could be included for users to upload bibliographic information and reprint files to SMBRC for inclusion in future database versions that could be updated every 6 or 12 months. In this way, the database could become a valuable resource to the community without a large amount of effort or expenditure on the part of SMBRC.

This website could be a simple text interface or could include an interactive mapping component using the place names and coordinates we have provided in Appendix II. A model for this type of interactive website is provided by the Sanctuary Integrated Monitoring Network (SIMoN) of the Monterey Bay National Marine Sanctuary (http://www.mbnms-simon.org/).

This database should be a launching point for a more thorough discussion of threats and vulnerabilities. Critically, no one person or organization should be responsible for identifying threats or stressors, nor evaluating the potential effects of regulations and management activities to ameliorate these stressors. Rather, an iterative process through a series of meetings among experts and stakeholders is necessary so that the full range of stressors and management actions are considered and a fair assessment of likely future trends can be made. The database we provide can help in identifying where substantial work has been done, but because of the potential biases mentioned above, it cannot substitute for expert opinion from a range of sources to ensure that the living resources of Santa Monica Bay are studied, and if necessary, adequately protected.

Finally, we recommend that our efforts be replicated with a focus on the watersheds feeding the Santa Monica Bay. A sound ecological view of the Bay recognizes that the

condition of the Bay is dependent upon activities in the watersheds. Thus, a complete understanding of threats and vulnerabilities in the Bay will depend on knowing what information has been compiled on the habitats, living resources and physical environments of the watersheds.

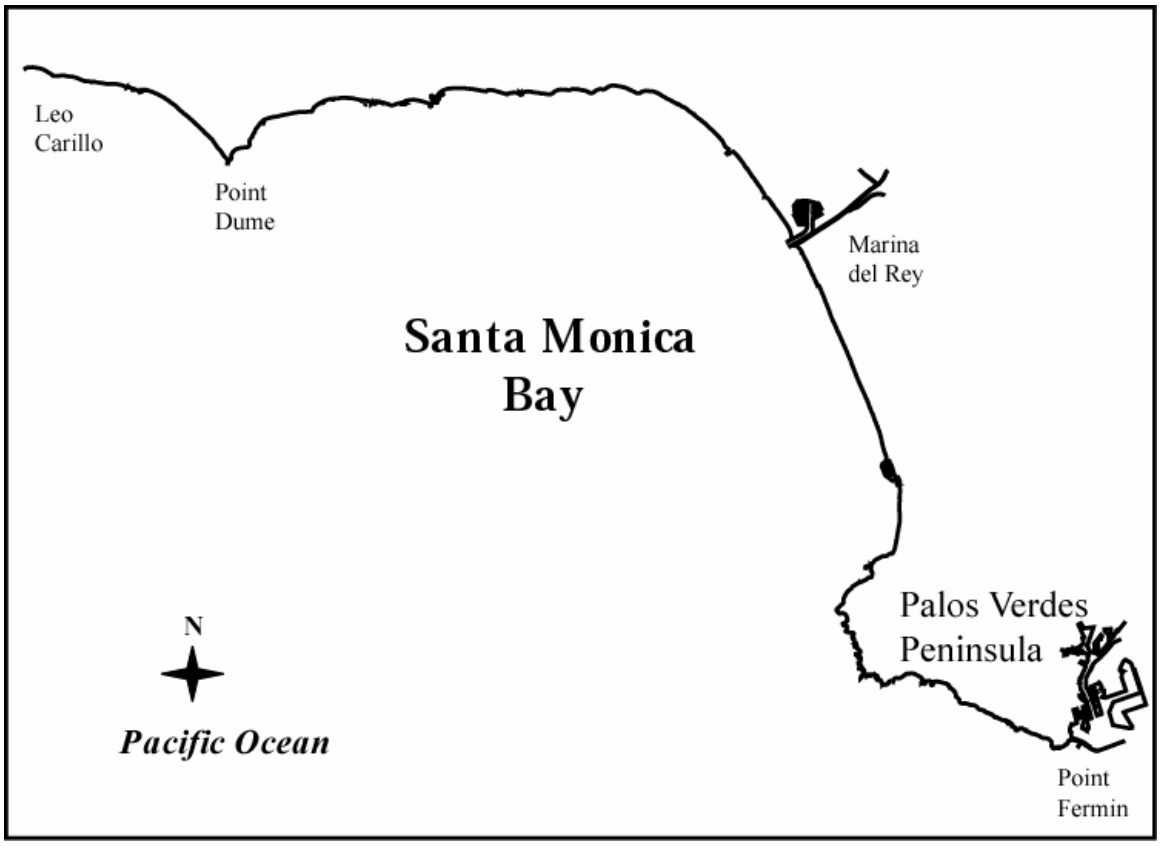

Figure 1: Map of Santa Monica Bay showing key place names defining the search area for this study.

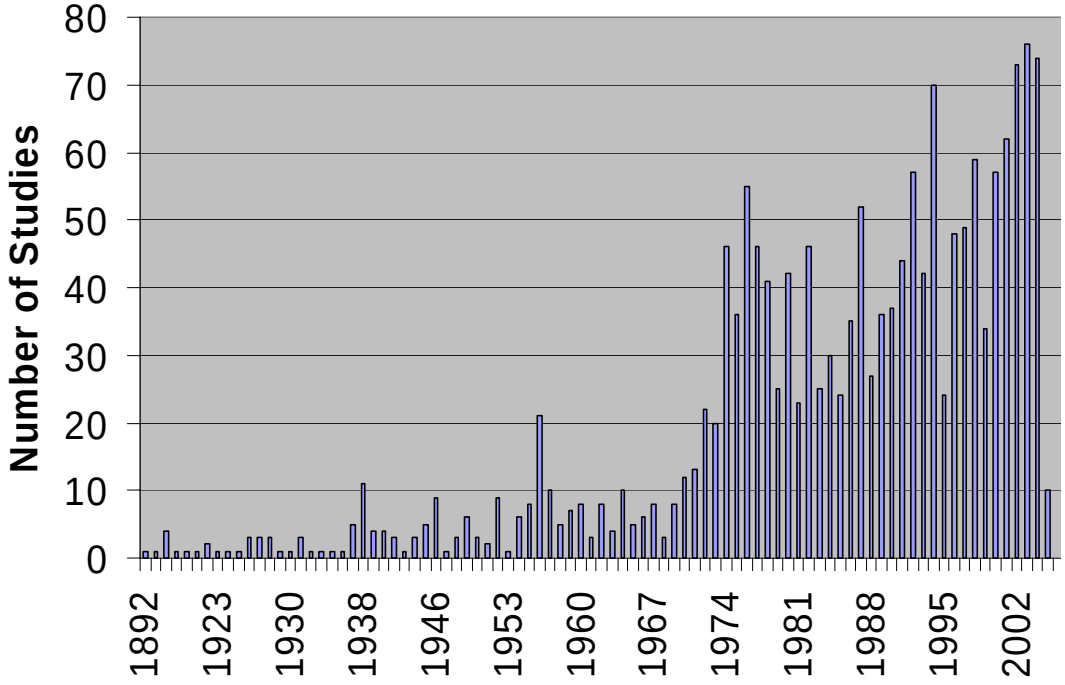

Figure 2. Number of Studies by Year in Database

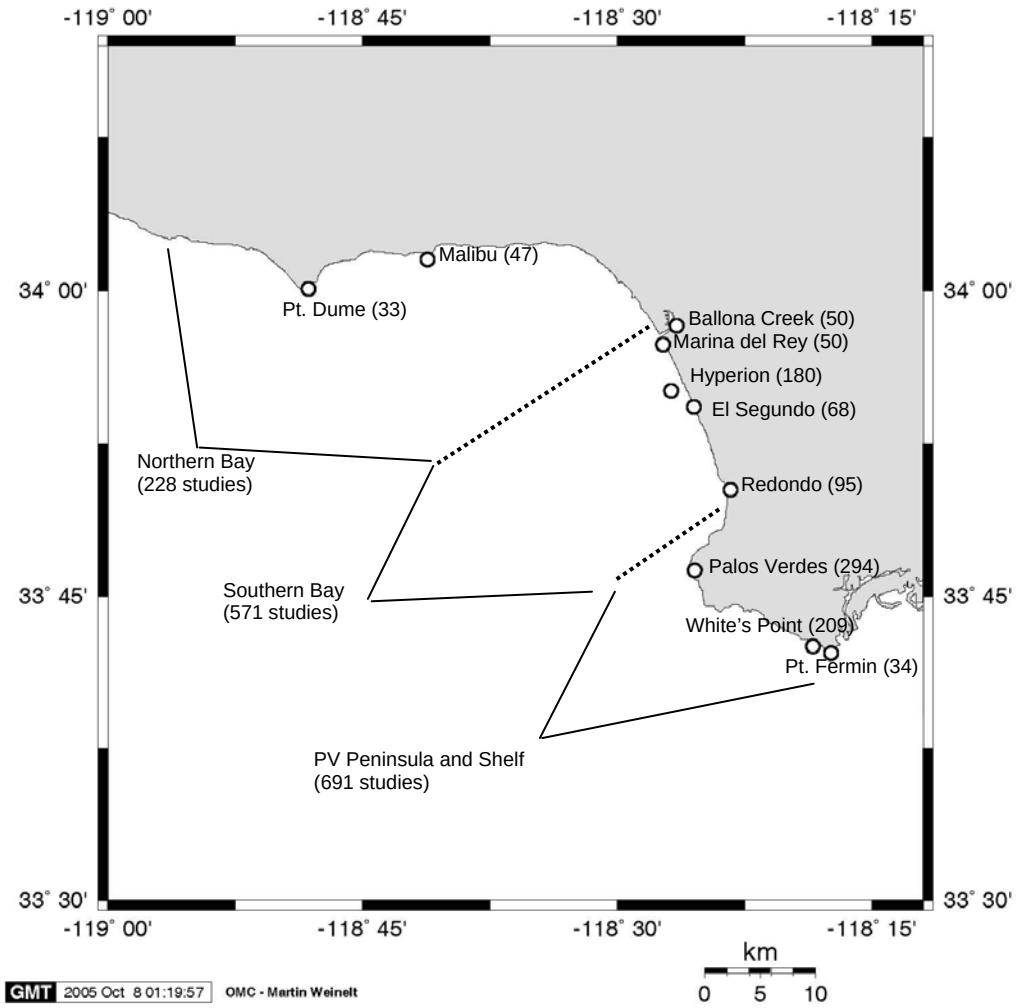

Fig. 3 Most commonly studied sites in the Bay with number of studies in parentheses. Number of studies pooled by regions of the Bay are listed to the left. Only studies in which specific place names were mentioned are in the totals shown.

Stressors: Targets:	Regulations	Artificial Reef	Deep Demersal	Demersal Hard Bottom	Demersal Soft Bottom	Fouling Community	Harbor, Bay, Lagoon
Commericial Fishing	1	N/A	D	D	D	N/A	N/A
Recreational Fishing	2	D	?	D	D	N/A	D
Impingement/Entrainment	3	I	I	I	I	I	I
Collecting/Harvesting	2	D	N/A	D	D	D	D
Monitoring Studies	4	D	D	D	D	D	D
Loss of top predators	1, 2, 5, 6	D	D	D	D	D	D
Invasive species	9	D	?	?	?	D	D
Algal Blooms	Uncertain	D	?	I	I	D	D
Climate Change	Uncertain	D	?	D	D	D	D
Point Source	7	D	N/A	D	D	D	D
Non-point source	7	D	?	D	D	N/A	D
Contaminated Sediments	7	D	?	D	D	N/A	D
Dredging	?	D	N/A	D	D	N/A	D
Dumping	?	?	?	?	?	D	D
Coastal Construction	8	D	?	?	?	D	D
Beach Engineering	8, 9	N/A	N/A	N/A	N/A	N/A	I

NOTES: Regulations
1. Commercial Fishing Ban (DF&G)
2. Recreational Fishing Regulations (DF&G)
3. Operating Permits
4. Scientific Collection Permit (DF&G)
5. Endangered Species Act
6. Marine Mammal Protection Act
7. CWA Section 304a
8. CZMA
9. Informal agreements

Key	
D	Direct impact
I	Indirect impact
N/A	Not applicable
?	Potential effect of stressor unknown
	Stressors not applicable or not expected to have significant effects
	Some management actions have been applied to this target, some data available
	Effectiveness of management action unknown, few data available
	No existing management actions or existing actions unlikely to mitigate stressors

Figure 4: Example approach for assessing risks and vulnerabilities from experts. The first column is a consensus list of potential stressors. The second column lists regulations, management actions, or informal activities applicable to the stressors. Subsequent columns list habitat and living resource targets of the stressors (only a subset are illustrated here). For each cell in the matrix a determination is made if the stressor acts directly or indirectly or if it has an unknown effect. Cells are color coded by the degree of data and management actions that have been applied to the target. Individual experts can code their own matrix which will be compared to other individual matrices to search for areas of consensus or large disagreement. The results shown are illustrative only, they do not represent results of a full discussion of risks and vulnerabilities.

Table 1: Sources searched

ONLINE SEARCHABLE DATABASES:

Standard Library (Years of coverage)	School specific library	Journal publisher	Agency	Other
Biosis (1969-Present)	CSU, Fullerton	JSTOR	MMS	Google Scholar
Dissertation Abstracts (1861-Present)	CSU, Long Beach	SpringerLink	National/CA Sea Grant	
Environmental Science & Pollution Management (NA)	CSU, Los Angeles		NOAA	
ISI Web of Knowledge (1900-Present)	Scripps Institute of Oceanography		SMBRC	
Melvyl (<1800-Present)	U of Southern California		USGS	
MOFR:Marine Biology (1960-Present)	UC, Irvine			
Zoological Record (1985-Present)	UC, Los Angeles			

MANUALLY BROWSED LOCATIONS:

Journals	Agency Libraries, Reports
CalCOFI Reports	MBC Applied Environmental Sciences
California Department of Fish and Game Bulletin	Southern California Coastal Water Research Project
Southern California Academy of Sciences Bulletin	

Table 2: Custom fields and terms used to describe studies in the database

Encompassing Area	Santa Monica Bay Site Location			Habitat	General Taxa	Pollutant/Chemical		Oceanography	Substrate
California	Abalone Cove	Latigo Cove	Redondo Canyon	Artificial Reef	Algae	Ammomium	Thermal	Chlorophyll a	Artifical Reef
Pacific coast	Agua Amarga Cove	Latigo Point	Redondo Pier	Deep Demersal	Birds	Antimony	TOC	Circulation Patterns	Bedrock
Santa Monica Bay	Amarillo Beach	Lechuza Point	Resort Point	Deep Pelagic	Fish	Arsenic	Toxicity	Conductivity	Boulder
Southern California Bight	Angel's Gate	Leo Carillo	Robert H. Meyer State Beach	Demersal Hard Bottom	Invertebrates	Artifical Structure	Trampling	Convergence Zones	Clay
Worldwide	Ballona Creek	Little Dume	Rocky Point	Demersal Soft Bottom	Mammals	Atmospheric aerosols	Urban run-off	Currents	Cobble
	Big Rock Beach	Long Point	Royal Palms County Beach	Fouling Community	Nonindigenous	Atmospheric depositions	Viruses	Density	Gravel
	Bit Rock	Lunada Bay	Rustic Canyon	Harbor	Plankton	Bacteria	VOC	Dissolved Oxygen	Mud
	Bluff Cove	Malaga Cove	San Pedro	Kelp Forest		BOD		El Nino	Sand
	Broad Beach	Malibu	San Pedro Escarpment	Rocky Intertidal		Cadmium		Freshwater inundation	Sea Floor Mapping
	Brookside Canyon	Malibu Beach	Santa Monica	Pelagic		Carbon		Hydrography	Sediment
	Cabrillo Beach	Malibu Bluff State Park	Santa Monica Basin	Sandy Intertidal		Chlorinated Hydrocarbons		Oceanographic Fronts	Silt
	Cabrillo Marine Reserve	Malibu Creek	Santa Monica Bay			Chromium		pH	
	Carbon Beach	Malibu Lagoon State Beach	Santa Monica Beach State Park			Cyanide		Salinity	
	Carbon Canyon	Malibu Pier	Santa Monica Canyon			DDT		Secchi Disc	
	Chevron Refinery	Malibu Point	Santa Monica Municipal Pier			Debris		Suspended Particle Matter	
	Corral Canyon	Malibu Riviera	Santa Ynez Canyon			Dieldrin		Tectonics	
	Crystal Cove	Manhattan State Beach	Sequit Point			Disease		Tidal change	
	Dan Blocker State Beach	Marie Canyon	Shoreline Park			Dredged Material Disposal		Upwelling	
	Dead End Beach	Marina del Rey	Short Bank			Environmental Contamination		Water temperature	
	Dockweiler Beach	Neptune Cove	Solange Point			Generating Station Entrainment		Wave/Swell	
	Dry Canyon	Nicholas Canyon County Beach	Solstice Canyon			Harvest			
	Dume Canyon	Pacific Pallisades	Steep Hill Canyon			Industrial Discharge			
	Dume Cove	Palawan Liberty Ship	Sullivan Canyon			LAB			
	El Matador Beach	Pallisades	Sunken City			Mercury			
	El Nido	Palos Verdes	Sunset Beach			Metals			
	El Pescador State Beach	Palos Verdes Cove	Surfrider Beach			MTB			
	El Segundo Beach	Palos Verdes Point	Temescal Canyon			Nitrogen			
	Encinal Canyon	Palos Verdes Shelf	Topanga Canyon			Nutrients			
	Escondido Beach	Paradise Cove	Topanga Lagoon			Oil			
	Escondido Canyon	Paseo de la Playa	Topanga State Beach			Organic Halides			
	Flat Rock	Paseo del Mar	Torrance County Beach			Oxygen			
	Flat Rock Point	Pena Canyon	Trancas Beach			PAH			
	Gillis Beach	Pepperdine	Trancas Canyon			Pathogens			
	Haggerties Dive Site	Piedra Gorda Canyon	Tuna Canyon			PCB			
	Hermosa Beach	Playa del Rey	UCLA mooring			Pesticides			
	Hyperion Outfall	Point Dume	US Coast Guard Reservation			Phosphorus			
	Inspiration Point	Point Fermin	Vanderlip Park			Radionuclides			
	Kellers Shelter	Point Vicente	Venice Beach			Sedimentation			
	Kincaid Ranch	Portuguese Bend	Walnut Canyon			Selenium			
	King Harbor	Puerco Beach	White's Point County Beach			Sewage discharge			
	La Costa Beach	Puerco Canyon	White's Point Outfall (JWPCP)			Sludge			
	Las Flores Beach	Pulga Canyon	Will Rogers Beach			Stormwater discharge			
	Las Flores Canyon	Ramirez Canyon	Winter Canyon			Sulfide			
	Las Tunas State Beach	Rancho Palos Verdes	Zuma Beach			Suspended Solids			
	Latigo Canyon	Rat Beach	Zuma Canyon			Tar			
		Redondo Beach							

Table 3: Number of studies by type

Reference Type	Number of Studies
Report	804
Journal Article	670
Book	71
Thesis	67
Conference Proceedings	51
Map	37
Book Section	26
Online database	15
Audiovisual Material	5
Legal Rule/Regulation	2
Hearing	1
Edited Book	1

Table 4: Number of studies by decadal ranges

Year Range	Number of Studies
1890-1899	7
1900-1909	0
1910-1919	2
1920-1929	15
1930-1939	28
1940-1949	35
1950-1959	72
1960-1969	63
1970-1979	316
1980-1989	340
1990-1999	464
2000-2005	352

Table 5: Number of studies from different Santa Monica Bay sites

Site	n	Site	n	Site	n	Site	n
Abalone Cove	18	**Hyperion Outfall**	**180**	Mother's Beach	2	San Pedro Shelf	1
Ashland	2	Inspiration Point	3	Nicholas Canyon County Beach	1	Santa Monica Basin	26
Avenue I	1	Kincaid Ranch	1	Pacific Palisades	4	**Santa Monica Bay**	**447**
Ballona Creek	50	King Harbor	33	Palawan liberty ship	1	Santa Monica Beach State Park	12
Big Rock Beach	5	La Costa Beach	1	**Palos Verdes**	**294**	Santa Monica Canyon	10
Bluff Cove	2	La Piedra	2	Palos Verdes Point	3	Santa Monica Canyon Creek	1
Broad Beach	1	Las Flores Beach	5	Palos verdes shelf	18	Santa Monica Municipal Pier	4
Cabrillo Beach	12	Las Tunas State Beach	8	Paradise Cove	15	Scattergood Generating Station	23
Cabrillo Marine Reserve	1	Latigo Canyon	3	Pico	1	Sea Level Beach	1
Carbon Beach	1	Latigo Cove	1	Playa del Rey	13	Short bank	3
Castlerock Beach	1	Latigo Point	1	Point Dume	33	Sunset Beach	3
Chevron Refinery	16	Lechuza Point	1	Point Fermin	34	Surfrider Beach	6
Corral Canyon	1	Leo Carillo	11	Point Vicente	16	Topanga Canyon	7
Dan Blocker State Beach	1	Little Dume	2	Portuguese Bend	14	Topanga State Beach	3
Dockweiler Beach	9	Long Point	2	Pratte's Reef	3	Torrance County Beach	5
Dume Canyon	1	Lunada Bay	11	Puerco Beach	1	Trancas Beach	3
El Matador Beach	1	Malaga Cove	10	Pulga Canyon	1	Venice Beach	22
El Pescador State Beach	1	Malibu	5	**Redondo Beach**	**95**	White's Point County Beach	40
El Segundo Beach	68	Malibu Beach	47	Redondo Canyon	17	**White's Point Outfall**	**169**
Escondido Beach	2	Malibu Creek	28	Resort Point	1	Will Rogers Beach	7
Flat rock	12	Malibu Lagoon State Beach	10	Robert H. Meyer State Beach	1	Winward	1
Free Zuma	1	Malibu Point	2	Rocky Point	3	Zuma Beach	8
Haggerties Dive Site	1	Manhattan State Beach	15	Royal Palms County Beach	16		
Hermosa Beach	27	Marina del Rey	50	San Pedro	11		

Notes: Each study may have been conducted at several sites, so total number here will exceed number of individual study records in the database. The 5 most common sites are highlighted in bold.

Table 6: Number of studies on different physical factors

Factor	n
Water temperature	114
Salinity	41
Currents	37
pH	34
Chlorophyll a	30
Dissolved Oxygen	26
Conductivity	21
Transmissivity	20
Swell	14
Wave	14
Suspended Particle Matter	12
Tectonics	11
Hydrography	8
El Nino	7
Upwelling	7
Secchi Disc	5
Tsunami	5
Density	4
Circulation Patterns	3
Freshwater inundation	3
Oceanographic Fronts	3
Tidal change	2
Convergence Zones	1
Internal waves	1

Table 7: Number of studies in different substrate types

Substrate	n
Sediment	205
Sea Floor (mapping)	34
Sand	28
Artificial reef	14
Clay	14
Silt	12
Gravel	7
Mud	3
Bedrock	3
Boulder	1

Table 8: Number of studies on the most common organisms reported by common name

Organism	n
Various fish	177
Various invertebrates	144
Various infauna	61
Dover sole	49
Kelp	43
Bacteria	33
White croaker	27
Zooplankton	25
Various algae	23
Purple sea urchin	23
Pacific sardine	22

Table 9: Number of studies on the most common organisms reported by scientific name

Organism	n
Microstomus pacificus	48
Macrocystis pyrifera	42
Strongylocentrotus purpuratus	26
Mytilus californianus	21
Sicyonia ingentis	18
Genyonemus lineatus	18
Paralichthys californicus	16
Paralabrax clathratus	16
Citharichthys sordidus	15
E. coli	13
Engraulis mordax	13

Table 10: Number of studies by most common pollutants and focus of research

Top 20 Pollutants	Physical Fate (e.g.sediments; water column)	Biological Fate (e.g. tissue levels)	Source	Effects	Total # of Studies*
Wastewater Discharge	174	112	18	109	**413**
Metals	127	94	16	79	**316**
DDTs	98	74	17	61	**250**
PCB	96	65	12	58	**231**
Bacteria	48	14	10	17	**89**
PAH	38	23	6	26	**93**
Nitrogen	50	10	3	15	**78**
Oil	33	12	4	13	**62**
Oxygen	45	32	0	32	**109**
Generating station entrainment	33	39	1	39	**112**
Stormwater discharge	25	6	7	13	**51**
Chlorinated Hydrocarbons	29	14	7	7	**57**
Toxicity	14	8	3	28	**53**
Sedimentation	31	5	5	10	**51**
Thermal	34	33	0	33	**100**
BOD	22	5	3	5	**35**
Nutrients	22	5	4	5	**36**
Ammonium & Ammonia	20	3	3	4	**30**
Mercury	17	10	2	6	**35**
TOC	19	8	1	11	**39**
TOTALS	**975**	**572**	**122**	**571**	**2240**

Notes: A single study may fit into several categories so totals listed at bottom of columns or end of rows will be greater than the number of individual reports in the database

Table 11: Number of studies by general taxa and habitat

Taxa	Algae	Bacteria	Birds	Fish	Invertebrates	Mammals	Nonindigenous	Plankton	Reptiles	Seagrass, misc plant	**Total**
Habitat	-	-	-	-	-	-	-	-	-	-	-
Artificial Reef	1	0	0	9	5	0	0	0	0	0	**15**
Deep Demersal	1	1	0	11	13	0	0	1	0	0	**27**
Demersal Hard Bottom	14	0	0	76	81	0	0	0	0	0	**171**
Demersal Soft Bottom	5	20	0	253	214	0	2	6	0	0	**500**
Fouling Community	0	1	0	0	6	0	2	0	0	0	**9**
Harbor, Bay, Lagoon	0	2	5	47	25	1	3	2	0	0	**85**
Kelp Forest	49	1	2	25	33	1	0	1	0	0	**112**
Pelagic	3	45	24	186	51	20	0	69	3	0	**401**
Rocky Intertidal	24	13	6	20	71	1	0	1	0	0	**136**
Sandy Intertidal	2	19	7	12	11	2	0	0	0	2	**55**
Total	**99**	**102**	**44**	**639**	**510**	**25**	**7**	**80**	**3**	**2**	**1511**

Notes: numbers are based on studies in database which were sufficiently summarized to provide information on *both* taxa and habitat

Table 12: Potential stressors identified by Habitats Subcommittee

Commericial Fishing
Recreational Fishing
Impingement/Entrainment
Collecting/Harvesting
Monitoring Studies
Loss of top predators
Invasive species
Algal Blooms
Climate Change
Point Source
Non-point source
Contaminated Sediments
Dredging
Dumping
Coastal Construction
Beach Engineering

Appendix I. Electronic Resources

Electronic files provided to SMBRC as appendices to this report include:

- Endnote Version 9 Software and manuals
- Endnote Database of all sources
- RTF format file listing all references in the Endnote database (Summary and Full versions)
- Bibliographic report for El Segundo, White's Point, and Redondo highlighting studies conducted for generating stations, POTW, or refineries
- Contact list of people and organizations contacted for this study

Appendix II. Latitudes and Longitudes in degrees and decimal minutes for sites encountered in this study

Place Name	Latitude	Longitude	Notes
Abalone Cove	N33 43.97	W118 23.04	*
Agua Amarga Canyon, Palos Verdes Estates	N33 46.09	W118 25.14	
Amarillo beach	N34 01.46	W118 42.19	
Angels Gate Park	N33 42.46	W118 17.43	
Ballona Creek	N33 57.37	W118 27.29	
Big Rock Mesa, Malibu	N34 01.63	W118 37.56	
Big Rock, Malibu	N34 01.66	W118 42.83	
Big Rock Island	N34 02.09	W118 36.34	
Bit Rock	N33 47.46	W118 24.38	
Bluff Cove	N33 47.33	W118 24.32	
Broad Beach	N34 01.86	W118 51.61	*
Cabrillo Beach	N33 42.33	W118 16.54	
Cabrillo marine reserve			
Carbon Beach	N34 02.20	W118 39.28	
Castle Rock Beach	N34 02.26	W118 33.48	
Corral Beach	N34 01.59	W118 43.55	
Crystal Cove	N33 45.67	W118 25.34	*
Dan Blocker State Beach, Malibu	N34 01.50	W118 44.86	*
Dead End Beach, Malibu	N34 01.49	W118 44.09	*
Dockweiler Beach	N33 55.20	W118 26.03	
Dume Cove, Malibu Riviera	N34 00.17	W118 48.05	
El Matador State Beach	N34 02.17	W118 52.58	
El Pescador State Beach, Malibu	N34 02.20	W118 53.30	
El Segundo Beach	N33 54.90	W118 25.84	*
El Segundo Power Outfall 001	N33 54.30	W118 25.50	@
El Segundo Power Outfall 002	N33 54.27	W118 25.50	@
Escondido Beach, Malibu	N34 01.28	W118 46.03	
Flat Rock Point	N33 47.49	W118 24.29	
Flat rock	N33 47.47	W118 24.37	
Gillis Beach, Playa Del Rey	N33 57.10	W118 27.00	*
Haggerties Dive Site	N33 48.30	W118 24.28	*
Hermosa Beach Pier	N33 51.41	W118 24.14	
Hyperion One-Mile Outfall (001)	N33 55.095	W118 26.844	#
Hyperion Five-Mile Outfall (002) (north-Y)	N33 54.718	W118 31.709	#
Hyperion Five-Mile Outfall (002) (south-Y)	N33 54.039	W118 31.636	#
Hyperion Seven-Mile Outfall (003) [closed]	N33 55.622	W118 33.183	#
Hyperion Water Treatment Plant	N33 55.34	W118 25.58	
Inspiration Point	N33 44.12	W118 22.09	
Kellers shelter	N34 02.09	W118 40.31	
King Harbor	N33 50.45	W118 23.56	
La Costa Beach	N34 02.16	W118 38.29	
Las Flores Beach	N34 01.96	W118 37.92	

Place Name	Latitude	Longitude	Notes
Las Flores Canyon	N34 02.13	W118 38.08	
Las Lomas Canyon termination at PCH, Pacific Palisades	N34 02.01	W118 32.83	*
Las Tunas Beach	N34 02.21	W118 35.34	
Latigo Point	N34 01.21	W118 45.49	*
Lechuza Beach	N34 01.54	W118 52.36	
Lechuza Point	N34 02.04	W118 51.42	
Little Dume, Malibu	N34 00.16	W118 47.33	*
Long Point	N33 44.11	W118 23.51	
Lunada Bay	N33 46.12	W118 25.30	
Malaga Cove	N33 48.15	W118 23.40	
Malibu	N34 01.54	W118 41.15	
Malibu Bluffs	N34 01.55	W118 42.08	
Malibu Lagoon	N34 01.58	W118 40.51	
Malibu Pier	N34 02.10	W118 40.33	
Malibu Point	N34 01.51	W118 40.56	
Malibu Riviera	N34 00.02	W118 49.22	*
Manhattan Beach, El Porto, 45TH St.	N33 54.32	W118 25.59	*
Manhattan Beach Pier	N33 53.01	W118 24.49	
Marina Del Rey	N33 58.30	W118 26.49	
Neptune Cove			
Nicholas County Beach	N34 02.30	W118 54.54	
Pacific Palisades	N34 02.53	W118 31.35	
Palisades Beach	N34 01.23	W118 30.43	
Palos Verdes Peninsula	N33 46.15	W118 22.43	
Palos Verdes Cove	N33 47.73	W118 24.71	*
Palos Verdes Point	N33 46.26	W118 25.41	
Paradise Cove, Malibu	N34 01.15	W118 47.03	
Pepperdine University, Malibu	N34 02.26	W118 42.33	
Playa del Rey	N33 56.56	W118 26.44	
Point Dume State Beach	N34 00.10	W118 48.18	
Point Fermin	N33 42.18	W118 17.38	
Point Vicente Lighthouse	N33 44.31	W118 24.38	
Point Vicente	N33 44.28	W118 24.39	
Portuguese Bend	N33 44.08	W118 21.41	
Puerco Beach, Malibu	N34 01.53	W118 43.04	
Rancho Palos Verdes	N33 44.40	W118 23.13	
Rat Beach	N33 48.12	W118 23.38	
Redondo Beach State Park	N33 49.45	W118 23.25	
Redondo Canyon			Subtidal
Redondo Beach Municipal Pier	N33 50.23	W118 23.32	
Resort Point	N33 46.01	W118 25.25	
Resort Point Cove	N33 45.55	W118 25.21	
Robert H. Meyer Memorial State Beach	N34 02.09	W118 53.71	*
Rocky Point	N33 48.20	W118 24.80	*
Royal Palms State Beach	N33 43.11	W118 19.40	
San Pedro Breakwater	N33 42.36	W118 17.01	

Place Name	Latitude	Longitude	Notes
Santa Monica	N34 01.10	W118 29.28	"populated place"
Santa Monica Basin			Subtidal
Santa Monica Bay	N33 56.06	W118 28.00	
Santa Monica State Beach	N34 00.25	W118 29.34	
Santa Monica Canyon			Subtidal
Santa Monica Pier	N34 00.49	W118 30.10	*
Scattergood Generating Station Outfall	N33 55.21	W118 26.13	+
Scattergood Generating Station Outfall	N33 54.86	W118 26.00	+
Scattergood Generating Station Outfall	N33 54.96	W118 26.27	+
Sea Level Beach	N34 01.89	W118 51.82	*?
Sequit Point, Leo Carrillo State Beach	N34 02.36	W118 56.13	
Shoreline Park, Rancho Palos Verdes	N33 43.06	W118 20.36	*
Short bank			
Solange Point	N33 45.94	W118 25.53	*
Southern California Bight			
Sunken City	N33 42.03	W118 17.48	*
Sunset Beach, Pacific Palisades	N34 02.08	W118 33.36	*
Surfrider Beach	N34 01.78	W118 40.64	*
Temescal Canyon & PCH	N34 01.86	W118 32.36	
Topanga Lagoon	N34 02.11	W118 35.05	*
Topanga State Beach	N34 02.19	W118 34.53	
Torrance County Beach	N33 48.38	W118 23.26	
Trancas Beach (aka Broad Beach)	N34 01.59	W118 50.54	
Tuna Canyon US Coastguard Reservation			
UCLA Mooring	N33 55.900	W118 42.937	
Venice Beach	N33 58.35	W118 27.56	
Venice Fishing Pier	N33 58.39	W118 28.09	
Venice Pier	N33 59.07	W118 28.36	
White Point Beach	N33 42.52	W118 18.47	
White's Point Nature Preserve, San Pedro	N33 42.53	W118 19.09	
Will Rogers Beach State Park	N34 02.01	W118 31.50	
Zuma Beach County Park	N34 01.09	W118 49.54	
Zuma Beach, Malibu	N34 01.12	W118 50.93	*
Zuma Canyon			Subtidal

All latitude-longitude points obtained from http://geonames.usgs.gov/, except * from http://www.californiacoastline.org/?, # from Kay Yamamoto of Hyperion, @ from Alex Sanchez of El Segundo Generating Station, + from Fazi Mofidi of Scattergood Generating Station. ? Unclear if this site is synonymous with "Sea Level Drive"

Appendix III. Interpretation of Custom Fields in Endnote database

Reviewed Item: General Taxa (e.g. Birds, Mammals, Invertebrates, …)
Custom 1: Encompassing Area (e.g. Santa Monica Bay, SCB, California, …..)
Custom 2: Santa Monica Bay Sites (e.g. Palos Verdes, White's Point Outfall…..)
Custom 3: Habitat (eg. Demersal Hard Bottom, Rocky intertidal, …..)
Custom 4: Organism Scientific Name (e.g. *Pisaster ochraceus*)
Custom 5: Organism Common Name (e.g. Ochre Sea Star)
Custom 6: Pollutant/Chemical (e.g. DDTs, Nitrogen)
Custom 7: Oceanography (e.g. Water temperature, salinity, …)
Accession #: Substrate (sea floor mapping, sediment, ….)
Notes: Study Description
Author Address: Author Organization
Reprint Edition: Combined field with four letter code for habitat and taxa

Appendix IV. Instructions for copying Endnote libraries.

All the records of Santa Monica Bay studies are contained in an Endnote "library" called "SMB-Converted". This library has a huge helper folder, called "SMB-Converted.Data" that must go with it to preserve the formatting of custom fields for Santa Monica Bay as well as the electronic pdf and Microsoft Word files of papers that we were able to acquire electronically. Both the Endnote library file and the folder should be copied together if you want the library on a different machine. If you do not care about having the electronic copies of the papers, you can just copy the "SMB-Converted.Data" folder with the "rdb" folder inside it. This will be a considerably smaller amount of data to copy.

One known problem in opening Endnote libraries that were copied from a CD is that they are in "read-only" mode on the CD and may be locked. This can be changed by copying the files onto your hard drive (rather than trying to open them from the CD) and right-clicking on the Endnote file icons. Select Properties and uncheck the checkbox next to "Read-Only"

Other known errors are addressed on the EndNote website: http://endnote.com/support/