

**The Developing Relationship between Public Agencies and
Volunteer Groups for Watershed Monitoring and Stewardship
in the San Francisco Bay Area**

An Issue Paper Based upon a Survey of Agencies and Volunteer Groups

by

The San Francisco Estuary Institute

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Preamble

The citizenry and government in the San Francisco Bay Area demonstrate a growing interest in local and regional environmental health. The interests that motivate the involved public are to a large extent the same interests that gave rise to the missions and programs of agencies involved in the protection of water quality, land use planning, and natural resource management. Agency information needs, as a result, are in most cases very similar to those expressed by the public. For example, storm water management agencies will need to evaluate the effectiveness of best management practices, some of which can be demonstrated with environmental data collected by volunteers.

The scope of Bay Area monitoring programs proposed by government is also increasing, as the complex concepts of watersheds and ecosystems are built into a regulatory framework. Regional monitoring can provide new understanding about the natural variability within and among locations, as required to adjust policy and practices. But the understanding cannot be achieved without an adequate flow of information, and this will require a high level of routine data collection and field work that is unprecedented for this region.

Volunteer monitoring by citizens is a practical and ethical way to provide the field data required to monitor local and regional progress toward environmental health. It is practical because it is cost effective. It is ethical because it connects the public to government through the assessment and care of common resources.

Concurrently with the increased public interest, regulatory agencies have advanced their efforts to identify sources of pollution and other human-caused disturbances of the Estuary and attending streams. Through the storm water discharge permits that are issued by the Regional Water Quality Control Board, Bay Area counties are being required to conduct a variety of data collection programs and special studies which may become elements of comprehensive watershed monitoring.

This issue paper is the first in a series of publications intended to provide some general understanding of how the collection of environmental data can be used to benefit the environmental and economic well-being of the region.

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Summary

In a survey of public agency staff and volunteer monitoring groups which was conducted by the State Water Resources Control Board (State Water Board), the San Francisco Estuary Institute (SFEI), and the San Francisco Bay Volunteer Monitoring Steering Committee, the current level of interest in volunteer monitoring was assessed. Results of this survey show that government and the citizenry strongly support the concept of volunteers monitoring the environment. Survey responses indicate that the great practical and ethical benefits of volunteer monitoring are not realized because of a lack of standard protocols for data collection and reporting and the lack of programs to train volunteers. What exists at this time is an important opportunity to create a regional organization of volunteers that works closely with government partners to assure the kind, amount, and quality of information needed to develop and achieve appropriate environmental goals. The proposed Regional Watershed Network could provide the organization and funding necessary to coordinate and nurture local volunteer monitoring efforts.

1.0 Introduction

A wide range of agencies, with missions and/or programs involving water quality, public health and safety, natural resource management, open space, and parks and recreation, have strong and growing needs for information about the environment to incorporate into management practices. Concurrently, the ability of agency staff to obtain the flow of information necessary for effective, integrated ecosystem management is becoming increasingly limited as financial support shrinks.

At the same time, a growing number of grassroots organizations, school and college instructors, and interested individuals is beginning to collect environmental data for a variety of reasons and interests. These include:

- specific ecological resources (e.g., birds, fish, native plants, terrestrial wildlife)
- environmental education
- local environmental problem solving
- participation in local decision-making

The locations of some of these citizen-based monitoring efforts are shown in Figure 1.

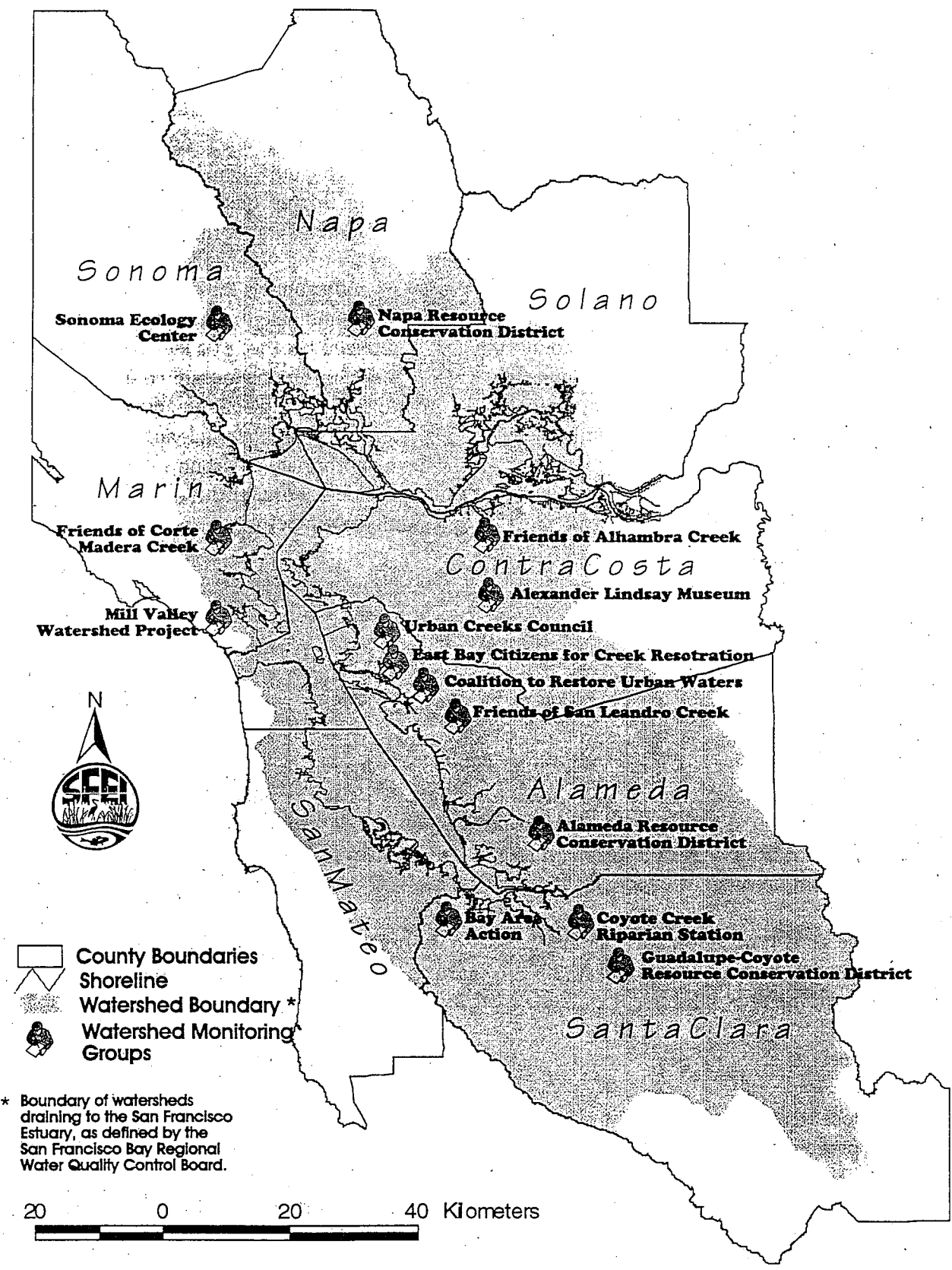


Figure 1. Some Watershed Monitoring Groups in the San Francisco Bay Region. Partial list of organizations in a growing movement.

1.1 The Opportunity

“Coordinated monitoring activities which could be established between the numerous willing agencies and active local volunteer groups have the potential to tremendously increase the flow of information, understanding, and concerns about the ecosystem to both local residents and governmental resource managers.”

From this report

As shown in the surveys presented in this paper, public agency staff routinely express a strong willingness to use data collected by volunteers, but are limited by lack of staff time to coordinate volunteer monitoring efforts and ensure data quality and consistency. Agencies actively monitor a surprisingly wide range of parameters to carry out their public missions, despite the fact that many of these activities are not directly required by their legislative mandates. Local public agency staff play a large role in collecting data about Bay Area watersheds and many clearly consider their role not to be limited to relatively isolated objectives (e.g., permitting, reporting, etc.), but rather to extend into more integrative activities such as watershed management, public outreach and education, and general resource stewardship.

Volunteer groups in the San Francisco Bay region consistently express a desire to help inform local government planning and decision making, assist habitat restoration, and promote environmental stewardship. As a result, many of these community-based organizations are seeking guidance for standard, effective data collection protocols and other tools to assist monitoring activities. These efforts to understand the local environment can both generate invaluable data for ecosystem management and foster a deeper understanding of resource issues, encouraging ongoing public involvement in watershed care and civics. However, working relationships between non-governmental organizations and local and regional government are not well-developed at this time, hindering citizen participation. Also preventing greater cooperation is the lack of appropriate, standardized protocols for data collection, coordinated training of volunteers, and frameworks for effective data management and quality assurance. In addition, there is currently no mechanism for ensuring regional consistency in protocols and procedures to accommodate the exchange of data between groups and the integration of locally collected data into a picture of regional ecosystem health. Perhaps most importantly, and as mentioned by several agency staff, while there is wide recognition that monitoring of the environment is essential, there is generally little consensus among interested parties as to what parameters to monitor, and why.

Some of the benefits of building relationships to allow the sharing and multiple use of collected data were described by survey respondents:

“...[when] the data are available to resource managers and decision makers who need it, we can be more effective working for the public good.”

Coyote Creek Riparian Station, Santa Clara County

"[Exchanging data with other groups] would make the students feel connected to the bigger picture."

Sequoia Elementary School, Contra Costa County

1.2 The Challenge

"Time is always a constraint for any [monitoring] program. However, the additional time required to meet with volunteers is well worth it if their quality of data collection is good."

City of Benicia, Solano County

"Our monitoring program is behind because I am uncertain about what it is I am supposed to be monitoring. The lack of consensus about what parameters adequately characterize a water resource system hinders implementation."

A City in Contra Costa County

The cares and concerns that motivate the interested public are, to a large extent, the same interests that gave rise to the missions and programs of agencies dealing with environmental health, including water quality, land use planning, and natural resource management. The information needs of agencies, as a result, are in most cases very similar to the areas of interest expressed by the public.

As evidenced in the survey, public agency staff envision using volunteer-collected data for many management goals. Many agency staff would particularly like to expand watershed and ecosystem level research and planning, and habitat restoration with the support of volunteers. Agency staff also express a strong interest in their role in the education of their community, collaborative goal-setting, and improved local stewardship.

Volunteer monitoring groups are diverse and active; many are interested in expanding their activities and in exchanging data with other groups and the broader community. However, volunteer groups often have specific needs for technical assistance and funding to be able to provide timely and widely usable data to their communities.

"I have heard [volunteers] require substantial supervision for consistent and reliable data."

Town of Danville, Alameda County

"On our limited budget, we can't afford a lot of time spent on paperwork or inappropriate tasks. We must stay focused on our current projects."

San Francisco Bay Bird Observatory, Santa Clara County

"I would like to see more involvement of school children [in monitoring] through class curriculums."

City of Saratoga, Santa Clara County

"[There is] potential for volunteer monitoring through the Town's Conservation Committee [composed of] residents."

City of Woodside, Sonoma County

1.3 Working Toward a Solution

The State Water Board, SFEI, and local watershed groups are working together to develop a framework to facilitate local watershed stewardship, including education, environmental inventories, and monitoring. As it is currently conceived, riparian stations (located in schools, agency offices, or operating independently as projects of parent organizations) would collect baseline data on watershed characteristics. With technical assistance from SFEI, the State Water Board, the Regional Water Quality Control Boards, and other state and federal agencies, these data would provide the foundation for local resource planning operations. To facilitate the exchange of data and technology and assist in providing ongoing funding, a Regional Watershed Network (RWN) is being formed. The RWN would also be a vehicle to support the integration of local data into a regional picture of watershed condition. Local advocacy and "friends of" groups, in conjunction with local agencies, could then use data to help foster well-planned restoration efforts on a watershed scale.

In their own words, the volunteer groups and public agencies of the Bay Area describe the following needs for effective and useful environmental monitoring:

"... Bay-wide categories of watershed assessment protocols and accompanying quality assurance programs. Conscientious adherence to a neutral, objective program of information gathering."

Napa County Resource Conservation District

"... to know the results of all other monitoring groups with respect to water pollution, etc. ... so that we can focus on things that other groups aren't already doing."

San Francisco Chapter, Surfrider Foundation

"... a qualified coordinator or nonprofit neutral organization."

City of Petaluma, Sonoma County

“... joint training [of agency staff and volunteers] so the agency can inform the public about what it is attempting to accomplish and how that would fit into volunteer group concerns.”

San Mateo Countywide Stormwater Pollution Prevention Program

“... access to others' data so that students could make comparisons.”

Sequoia Elementary School, Contra Costa County

2.0 Overall Survey Results: Current and Potential Environmental Monitoring Efforts in the San Francisco Bay Area

2.1 Background to Survey

To discover the current and potential role of environmental monitoring in local watershed stewardship and resource management, the State Water Board, SFEI, and the San Francisco Bay Volunteer Monitoring Steering Committee developed, distributed, and analyzed a survey of environmental monitoring activities among volunteer groups and agencies in the San Francisco Bay Area. Two survey forms were developed: the “Citizens Monitoring Survey” and the “Survey of Agency Needs.” The surveys were designed to (1) measure the level of interest among agencies for volunteer support of monitoring activities, (2) identify volunteer organizations that need technical or logistical support for their activities, and (3) investigate how to link communities and decision-makers at the local level. The surveys were sent in early 1995 to 276 staff members at agencies with mandates relating to the environment--such as resource management, water quality-regulatory, open space/parks/recreation, land use--and 107 volunteer groups or persons interested in collecting environmental data in the region.

Results were compiled based on the completed and returned surveys (representing 43 agency staff and 15 volunteer monitoring group leaders), and additional phone calls and direct contacts. All quantitative data are based directly on the returned survey forms, which are available for further use or analysis through the State Water Board. Potential biases in this sample include the use of a stormwater mailing list for the agency mailing. However, the survey responses appear to reflect a wide range of government programs, as a number of completed surveys were received from resource management, land use, parks and recreation, and public health and safety agencies, as well as agencies with a water quality orientation. The volunteer group survey was mailed to the Bay Area portion of the subscription list of *The Volunteer Monitor* (a national newsletter issued twice per year). This mailing received a relatively low rate of response. Follow-up phone calls and in-person discussions with about 10 volunteer groups who received, but did not return, the survey suggested that the length and appearance of the survey limited responses.

Apparently some groups, such as schools and watershed awareness organizations who are involved in limited but significant monitoring activities, considered their contributions too small or local to report in the detailed manner which the survey requested. A simpler survey might reach these volunteer groups more successfully and is being considered as a follow-up in the future to better assess potential watershed activity and support.

2.2 Current Monitoring of the Bay Area Ecosystem

A variety of questions were posed to agency staff and volunteer group leaders to investigate the status of current monitoring activities and agency-volunteer relationships, and to explore attitudes supporting or precluding the development of monitoring and stewardship partnerships. The responses to these questions are summarized in the form of several question and answer exchanges.

2.2.1 Monitoring By Government Agencies

Q. Are agencies monitoring the environment right now?

A. Yes. Monitoring of physical, chemical, biological, and general watershed parameters (Table 1) is being done at all levels of government, including city, county, regional, state, and federal.

Q. Why are agencies collecting these data?

A. The most prevalently cited reason for current monitoring activities is stormwater permitting, which was specified by nearly half (20 of 43, or 47%) of the survey respondents. Flood control, nonpoint source pollution assessment, problem identification, and general decision making are also major reasons for current monitoring efforts--each was cited by about one-third (30-35%) of the respondents.

Q. What types of agencies are doing monitoring?

A. Agencies that responded to the survey could be grouped into the following categories:

- natural resource management (e.g. U.S. Fish and Wildlife Service, California Department of Fish and Game, Resource Conservation Districts)
- water quality (e.g. Regional Water Quality Control Boards, county stormwater pollution prevention programs)
- public health and safety (e.g. Vector Control Districts, Flood Control Districts, Water Agencies)
- land use (e.g. Bay Conservation and Development Commission, cities and counties)
- parks and recreation (e.g. Regional Park Districts, marine refuges)

Some overlap exists between these categories; however, each agency category has some distinct and specific information needs related to their respective missions, and many in each category have identified needs for environmental data from volunteers. Current monitoring and interest in volunteer support were well-documented for all categories of

Table 1

Summary of Survey Parameters

	Number of Volunteer Organizations Currently Monitoring	Number of Agencies Currently Monitoring	Number of Agencies that have:	
			Current Volunteer Support	Potential Volunteer Support
Physical Parameters				
Water Temperature	6	6	1	14
Rainfall	3	13	3	11
Substrate Characteristics	2	4	1	7
Secchi Transparency	0	Parameter not on Agency Survey		
Flow	3	10	2	12
Stream Typing	2	2	1	7
Channel Characteristics	4	4	0	10
Percent Canopy	2	3	1	11
Other	2	0	0	1
Total	24	42	9	73
Chemical Parameters				
pH	5	7	1	12
Nitrogen	2	5	1	9
Ammonia	2	4	1	9
Phosphorus	0	4	1	8
Dissolved Oxygen	5	6	1	11
Alkalinity	0	4	0	8
Salinity	0	5	1	9
Total Dissolved Solids	2	4	1	10
Metals	0	8	0	8
Trace Elements	0	3	0	7
Organics	0	7	1	7
Pesticides	0	7	0	6
Sediment				
Total Suspended Solids	0	4	0	9
Turbidity	2	6	0	13
Other	0	0	0	1
Conductivity	3	3	0	9
Other	0	0	0	0
Total	21	77	8	136
Flora Parameters				
Riparian Vegetation	5	6	4	9
Aquatic Vegetation	4	3	1	8
Other	1	3	2	2
Total	10	12	7	19

	Number of Volunteer Organizations Currently Monitoring	Number of Agencies Currently Monitoring	Number of Agencies that have Current Volunteer Support	Potential Volunteer Support
Fauna Parameters				
Macroinvertebrates	3	4	3	12
Fish	3	4	2	10
Birds	4	11	8	15
Other	2	1	1	2
Total	12	20	14	39

Bacteria Parameters				
Coliform Bacteria				
Total	1	6	3	5
Fecal	1	4	2	5
Biological Oxygen Demand	0	1	1	6
Other	0	0	0	0
Total	2	11	6	16

General Parameters				
Debris Clean Up	5	16	8	15
Photo Surveys	3	7	2	8
Pipe Surveys	2	7	2	7
Watershed Mapping	4	5	2	7
Land Use	3	7	1	4
Water Diversion	3	1	1	3
Stream Obstructions	3	9	4	8
Bank Stability Evaluation	4	10	2	7
Erosion	2	13	2	7
Other	1	2	1	1
Total	30	77	25	67

Overall Totals	99	239	69	350
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monitoring--physical, chemical, bacterial, floral and faunal, and general watershed-related parameters--at all levels of government and among agencies with a variety of missions or orientations.

Q. Who's monitoring what and why?

A. From the information thus far collected, several general trends for using both monitoring data and volunteer support for data collection are apparent:

(1) agencies in all the above categories collect environmental data for problem identification, educational or outreach efforts, land-use planning, and habitat restoration activities.

(2) as would be expected, city and county level programs for water quality and public health and safety do monitoring as part of efforts toward stormwater management, enforcement, NPS pollution assessment, beneficial use assessment, and flood control. However, as these agencies often have land management and resource protection responsibilities as well, they also monitor for purposes such as baseline determination of resources and ecological condition, resource planning, watershed planning, park management, and habitat restoration.

(3) natural resource management, parks and recreation, and land use agencies monitor primarily for baseline determination of resources and ecological condition, resource planning, watershed planning, park management, and habitat restoration. These agencies use monitoring for general research purposes much more than the above group. But many of them also monitor for beneficial use assessment.

(4) agency staff would like to use data collected by volunteers for all of the above objectives.

General interests in monitoring data may be effectively inferred by agency type, as discussed above, but at the same time, the scope of agencies' monitoring activities and their interests in volunteers do not appear to be rigidly defined by agency type. At this stage in the development of volunteer monitoring, these attributes are likely determined by the goals and objectives of specific agencies in local communities, personal experiences of staff, and relationships to local volunteer organizations.

2.2.2 Monitoring By Volunteer Groups

Q. What parameters are volunteers monitoring now?

A. Only eleven groups responded with detailed descriptions of their monitoring programs. More monitoring efforts are likely taking place, but these may be somewhat less organized. Within this sample of volunteer efforts, at least one group was monitoring each general watershed parameter (photo survey, pipe survey, watershed mapping, land use, water diversions, stream obstructions, bank stability evaluation, and erosion

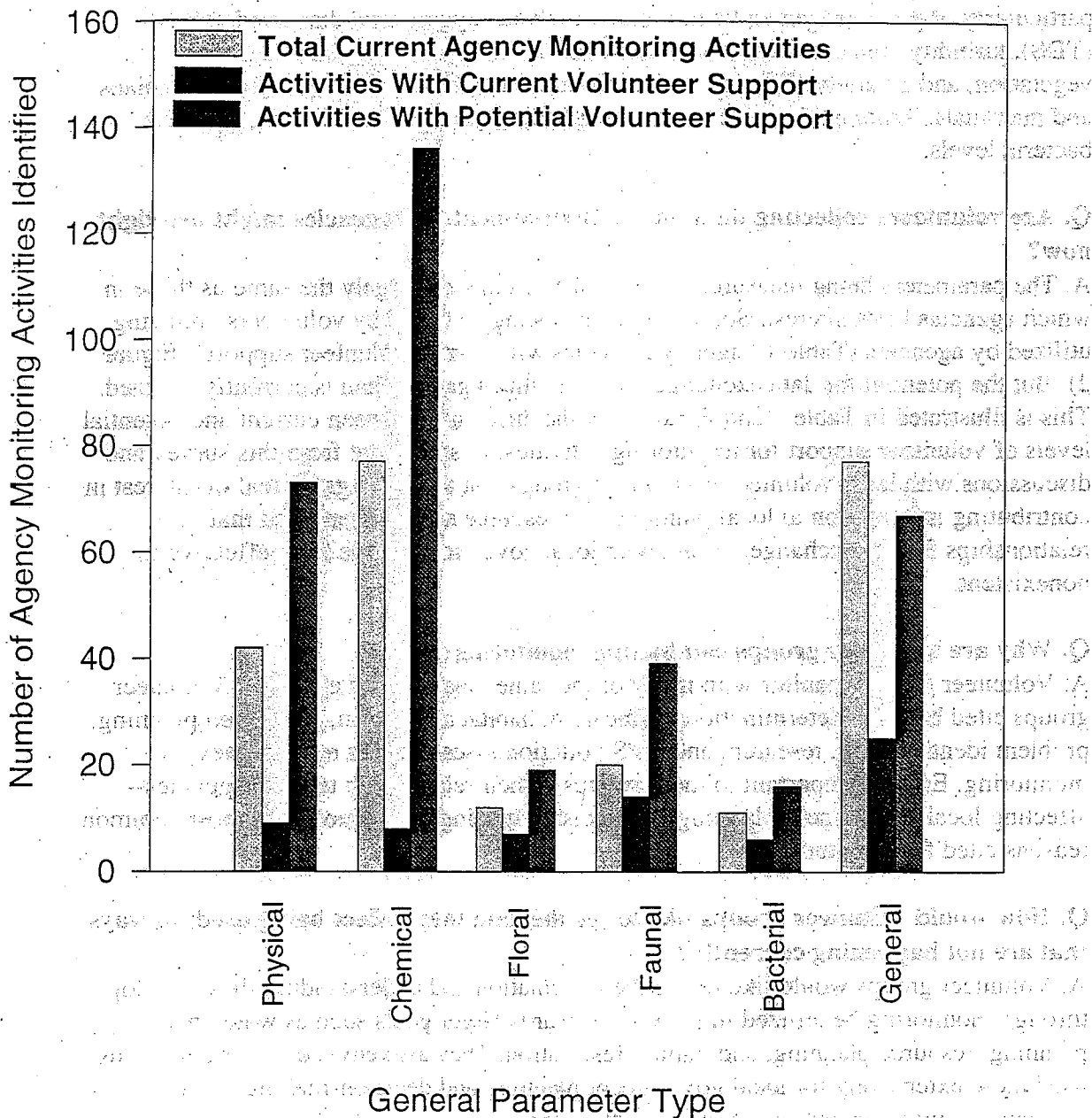


Figure 2. Current agency monitoring activities; activities with current volunteer support; and activities identified by agency staff as having the potential for volunteer support. A monitoring activity is the measurement of a specific parameter (e.g. pH, water temperature; see Table 1) on an ongoing basis. Data represent activities reported in surveys completed by 43 agency staff.

monitoring; Table 1). Physical parameters being measured include water temperature, rainfall, substrate characteristics, flow, stream typing, channel characteristics, and percent cover of riparian canopy. A number of chemical measurements are being conducted, particularly of pH, nitrogen and ammonia, dissolved oxygen, total dissolved solids (TDS), turbidity, and conductivity. Volunteers are measuring riparian and aquatic vegetation, and a variety of fauna, including macroinvertebrates, fish, birds, amphibians, and mammals. Among this survey, a few responding groups are measuring coliform bacteria levels.

Q. Are volunteers collecting data on the environment that agencies might use right now?

A. The parameters being measured by volunteer groups are largely the same as those in which agencies have interest. Some of the data being collected by volunteers are being utilized by agencies (Table 1: "agency activities with current volunteer support"; Figure 2). But the potential for data exchange is clearly much greater than is currently realized. This is illustrated in Table 1 and Figure 2 by the difference between current and potential levels of volunteer support for monitoring activities. It is apparent from this survey and discussions with local volunteer monitoring groups that there is a great deal of interest in contributing information to local planning and resource management, and that relationships for the exchange of data with local government range from effective to nonexistent.

Q. Why are volunteer groups conducting monitoring efforts?

A. Volunteer groups monitor with many of the same objectives as agencies. Volunteer groups cited baseline determinations, education, habitat restoration, watershed planning, problem identification, research, and NPS pollution assessment as reasons they are monitoring. Equally important to these groups is their relationship to local agencies-- affecting local government planning and decision making were among the most common reasons cited for monitoring.

Q. How would volunteer groups like to see the data they collect being used, in ways that are not happening currently?

A. Volunteer groups would like to see the information and understanding they develop through monitoring be utilized much more towards larger goals such as watershed planning, resource planning, and habitat restoration. They also envision their data being used more extensively for local government planning and decision-making, local ordinances, enforcement, research, and education.

2.3 The Potential of Agency-Volunteer Relationships for Monitoring and Stewardship

Q. How much do agencies currently use volunteer-collected data about the environment?

A. While volunteer-agency relationships for environmental monitoring are widely varied depending on agency type and parameter, the current extent of these relationships is dwarfed by the potential opportunities identified by agency staff (Figure 2). For each general parameter category, the number of monitoring activities which agency staff identified as opportunities for volunteer relationships is approximately equal to or larger than the total number of current agency activities. It is apparent that more well-developed partnerships between local agencies and citizens have the potential to expand the total amount of monitoring activities conducted in the Bay Area substantially. Perhaps most importantly, collected data would be widely shared and utilized by increasingly informed and communicating citizens and agency staff.

Q. How much more monitoring could be done with the interest in volunteer support documented among agencies in the survey?

A. A potential severalfold increase in total monitoring is shown by the interest in volunteer support expressed by agency staff contacted in this survey. With well-coordinated volunteer efforts, agencies appear willing both to increase the intensity of their ongoing efforts to monitor and to expand the scope of monitoring data that are collected. Agency staff expect to use the wider and more robust understanding of the environment that would result from volunteer monitoring to inform their management and planning efforts. Agency employees also expressed a strong desire to contribute to the education of the communities they serve and see volunteer monitoring as an excellent way to facilitate this sort of communication. Volunteer support could also be expanded from assessment and monitoring activities to restoration activities, implementing lifestyle changes, policy involvement, and broader educational activities.

Q. Would this increase in information about the environment be generated from activities agencies are currently engaged in or completely new efforts?

A. By making use of volunteers it is clear that there is the potential for both an increase in the intensity and frequency of current monitoring and a substantial expansion of the scope of ecosystem parameters that are commonly measured.

Q. How do agencies envision volunteer-collected data being used?

A. Agency staff intend to use information from volunteers for all the same reasons that they have instituted monitoring programs themselves. These include goals related to pollution prevention and to watershed and resource planning, protection, and restoration. They also plan to use volunteer data to inform the identification of problems, local government planning, and general decision making. The most well-established current uses of data from volunteers are habitat restoration, problem identification, resource planning, local decision making, research, nonpoint source pollution assessment, baseline determination, and watershed planning, which were each cited by 20-30% of the agencies

queried. Perhaps most significantly, agencies clearly regard public outreach and involvement as an important part of their roles in the community, as nearly half (21 of 43) of the responding agency staff cited "education" as one of the reasons that they would make use of volunteers.

Q. What sorts of activities would volunteer assistance enable agency staff to initiate that they do not currently do?

A. Volunteers could help agencies begin to do more integrated ecosystem or watershed-level planning and to initiate habitat restoration. While agency staff showed interest in support for all types of monitoring, including activities related to both general pollution prevention and to resource protection and management, volunteer involvement would particularly expand the amount of information used for resource management and restoration. The survey demonstrated a large interest in using volunteer data to initiate research, baseline determinations, watershed planning, and habitat restoration efforts that are not currently possible.

Q. Aren't a lot of agencies opposed to citizen involvement in data collection?

A. Out of this sample of 43 Bay Area agency staff, far more agency staff responded positively than negatively to potential volunteer support. For every single specific parameter queried, substantially more "yes" responses were received than "no's." Additionally, many more agency employees expressed tentative interest (by marking "?") than replied negatively, indicating that there is an even larger potential group of agency staff with an interest in working with volunteers which is not included in the totals discussed above.

Q. What about the agencies that aren't open to volunteer assistance?

A. We found that most of the negative responses to support for each parameter came from agencies that responded "no" to all parameters. In general, both yeses and no's were indicated across the board, suggesting that the limitation lies in the acceptance of, or "comfort level" with, the *general concept* of volunteer monitoring, rather than in specific concerns regarding monitoring tasks. By focusing on the agency staff who responded "yes" to many parameters, a tremendous amount of monitoring activity describing ecosystem health which is directly utilized by involved agencies could be initiated in an efficient and cost-effective manner. The success of these efforts is likely to initiate growing interest among the agency staff who are currently less comfortable with volunteer monitoring. There is currently an extremely accessible and well-identified potential for growth.

3.0 Current and Potential Relationships between Agencies and Volunteer Monitoring Groups by General Parameter Type

To further characterize current agency monitoring activities and the status of relationships between volunteers and agency staff to monitor, and in order to evaluate the potential growth of these relationships, the results of the survey of agency staff were classified on the basis of general categories of parameters. This information is presented below in separate sections focusing on chemical, physical, bacterial, floral and faunal, and general watershed assessment parameters. The specific parameters in each of these categories are listed in Table 1.

3.1 Chemical Parameters

3.1.1 Current Monitoring Efforts by Agencies

Thirteen of 43 (30%) responding agency staff are currently monitoring water chemistry. Those monitoring are doing a substantial amount: an average of almost 6 parameters each. Most of this activity is being done for city and county level programs in flood-control and storm water management.

3.1.2 Current Volunteer Support

Only one of 43 responding agencies is utilizing volunteer support for monitoring of chemical parameters. However, that one, Napa County Resource Conservation District, makes use of volunteers for 8 of the 16 parameters listed.

3.1.3 Potential Volunteer Support

Although chemical monitoring is commonly considered to be a problematic activity for volunteer involvement, there were three times as many yes (Y) responses as no's (N) to potential volunteer support for monitoring of specific chemical parameters. Additional interest was expressed by question marks, which received as many responses as no's did. Notably, interest in involving volunteers in aquatic chemistry measurements was expressed by parks and open space agencies as well as city and county flood control and storm water management programs.

Agency staff responded most commonly with either all yeses or all no's to potential volunteer support for monitoring of different water chemistry parameters. In fact, nearly all (41 of 43) of the no responses came from 6 respondents whose surveys with regard to water chemistry contained a total of 41 no's and only three yeses. On the other hand, twelve agency staff responded with only yeses. A substantial portion of the total interest was associated with the eleven staff (26%) whose responses to volunteer support were "overwhelmingly" positive (≥ 4 Y and Y/N ratio ≥ 4) for all chemical parameters. These staff were interested in support for an average of 11.5 parameters.

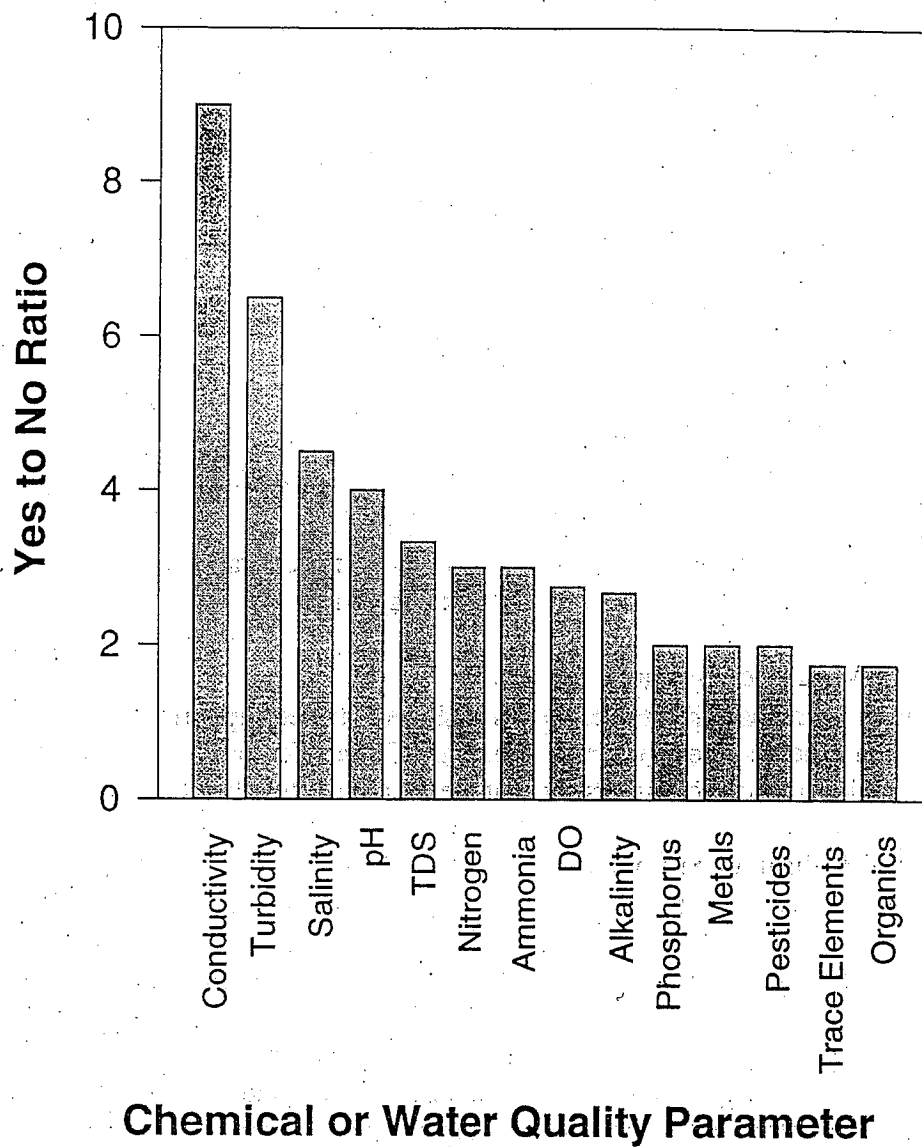


Figure 3. "Comfort level" of agency staff with regard to the use of volunteer data for different water quality monitoring objectives. Comfort level is the ratio of yes to no responses regarding potential volunteer support. Additional agency interest in volunteer support which was indicated by question marks (see section 3.1.4) is not shown. Abbreviations: TDS, total dissolved solids; DO, dissolved oxygen.

As would be expected, there is more concern among agency staff regarding volunteer involvement for measures of trace contamination than other water quality parameters. However, all water quality parameters, even trace contaminants, received nearly twice as many positive as negative responses to potential volunteer support. The ratio of yes to no responses may be an indicator of the existing "comfort level" with specific chemical parameters. As shown in Figure 3, the involvement of volunteers in collecting data for most water quality monitoring objectives appears to be overwhelmingly accepted. Agency interest in volunteer support for even the activities with the lowest "comfort level," such as trace elements and organics, is much more positive than negative.

3.1.4 Implications

These data indicate the importance of targeting the approximately one-third of agency staff who are doing the vast majority of water chemistry monitoring. These staff have the greatest potential need for volunteer involvement because they presumably have identified needs for collected data. Furthermore, a focus on 25% of the agencies queried here could initiate volunteer-agency relationships involving 126 monitoring activities, indicating a large and receptive user group for citizen-collected data.

Most of the agencies contacted are not monitoring water chemistry at all. Use of volunteer-collected data may enable these agencies to begin using monitoring results to inform their activities, indicating a much larger potential market for successful data exchange and utilization.

Volunteers have almost no current role in collecting agency data on water chemistry. Only twelve percent of the water chemistry operations reported by agency staff were occurring with volunteer assistance. However, all of this activity occurred within one organization, Napa County Resource Conservation District, which has volunteer involvement for 9 of the 15 chemical parameters listed. This successful example of a citizen-based monitoring program shows a huge potential for volunteer involvement in the monitoring of chemical parameters.

General interest in volunteer support was high among agency staff, as indicated by an overall yes to no ratio of 3. This value is particularly high when one considers the lack of current involvement. In addition, there were a large number of question mark responses. Question marks probably reflect interest in working with volunteers, with some existing concerns, and are a fairly positive result in terms of potential relationships between volunteer groups and agencies. Negative results came almost exclusively from respondents who said only "no," and from a very few staff. All "no" responses to volunteer support for parameters including such standard and straightforward measures as pH, turbidity, and conductivity probably indicates a general concern about citizen collection of water quality data or no recognized needs for more data, rather than specific thinking about individual parameters.

The survey documented interest among agencies for volunteer data on all chemical parameters; only one agency is currently receiving support from volunteers. Just

responding to the interest expressed by agencies in this survey would nearly double the total amount of monitoring serving agency needs, dramatically increasing both the scope and frequency of monitoring.

3.2 Physical Parameters

3.2.1 Current Monitoring Efforts by Agencies

Some assortment of physical parameters describing creek condition are being monitored by 42% (18 of 43) of the responding agencies. These seventeen agencies are measuring an average of 2.5 parameters each, ranging from 1 to 7. Parameters most commonly measured are rainfall (13) and flow (10; Table 1). Monitoring of water temperature (6 agencies), substrate and channel characteristics (4 each), percentage canopy (3), and stream typing (2) is also ongoing. Most of this monitoring is being done by counties (59% of total activities), although a number of cities (5) are monitoring rainfall.

3.2.2 Current Volunteer Support

About one-fifth of these monitoring activities (21%) are being supported by volunteers. Support is spread widely: only one category (channel characteristics) had no current support indicated, yet only rainfall and flow received more than 1 response indicating volunteer involvement.

3.2.3 Potential Volunteer Support

Interest among agencies in volunteer support for monitoring was high for all parameters listed, ranging from 13 to 18 positive responses for each parameter. The ratio of "yes" to "no" responses for potential support of physical parameters was 5.6, meaning nearly six times as many agencies would like volunteer support than wouldn't. As in the case of water chemistry parameters, there was a tendency towards all "yes" or all "no" responses; only 3 of 20 respondents for this category had a mix. Twelve of the 43 (28%) agencies queried regarding potential volunteer support responded "overwhelmingly" yes to each parameter (≥ 4 Y and ≤ 1 N), with an average of 5.8 yes parameters each. Agency staff who responded "overwhelmingly" yes to support for physical parameters were the same staff (with one additional one) who indicated similar responses to support for chemical parameters.

3.2.4 Implications

Forty-three current agency activities to monitor physical parameters were identified. While only nine of these had current volunteer support, agency staff were interested in volunteer involvement on 73 activities. This represents an opportunity for an eight-fold increase in citizen involvement, which would nearly double total monitoring activity within responding public agencies. Much of this increase in citizen-government collaborative activity could be accomplished very efficiently, by focusing on the 28% of the agency staff who expressed overwhelmingly positive interest in volunteer involvement.

3.3 Bacterial Parameters

3.3.1 Current Monitoring Efforts by Agencies

Current monitoring of bacterial parameters by agencies is relatively limited, with only 11 total activities documented by the survey.

3.3.2 Current Volunteer Support

However, volunteer involvement appears to be crucial to the bacterial monitoring that is currently taking place, as more than half (6 of 11) of these activities were being conducted with the assistance of volunteers.

3.3.3 Potential Volunteer Support

Agency staff indicated that they were strongly interested in using volunteer data for thirteen new activities and possibly interested in 10 more activities. This tripling of the amount of bacterial monitoring on Bay Area creeks would represent a quadrupling of the involvement of volunteers in assessing the bacterial condition of local creeks. This does not count additional opportunities indicated by agencies for improving the quality or quantity of current monitoring activities.

3.3.4 Implications

Of the forty-three agencies queried, just seven are currently measuring bacterial parameters, with an average of 1.6 bacterial parameters per agency. With the potential involvement of volunteers identified in this survey, 15 agencies could be measuring an average of 2.3 bacterial parameters. This would double the number of involved agencies and increase by 39% volunteer monitoring activities within these agencies. Four times as many members of the public would be involved in monitoring the epidemiological status of their local creeks and would be interacting with relevant government agencies who actively receive their data.

3.4 Floral and Faunal Parameters

3.4.1 Current Monitoring

Of the 43 agencies queried, nine (21%) are currently monitoring floral parameters, and 11 (26%) have current monitoring programs involving fauna.

3.4.2 Current Volunteer Support

More than half of the agency activities to monitor floral (5 of 9) or faunal (14 of 20) parameters are already receiving volunteer support.

3.4.3 Potential Volunteer Support

Eight additional agencies responded "yes" to volunteer support for floral monitoring, three already receiving support wanted more, and three others expressed interest with question marks. For faunal parameters, half of the 14 agency activities receiving

volunteer support have more need for volunteers, and 32 additional, currently nonexistent activities desired by agencies could be supported by volunteers.

3.4.4 Implications

The relationship between volunteers and agencies for the monitoring of plants and wildlife (including macroinvertebrates) is well-established and essential to more than half of the current agency monitoring. There is additional interest among agencies in a tremendous expansion of these volunteer data collecting activities.

3.5 General Watershed Assessments

3.5.1 Current Monitoring Efforts by Agencies

Of the 43 agencies queried, 13 are involved in erosion monitoring, 10 are examining bank stability, and 9 examining stream obstructions. Between 5 and 7 agencies are involved in monitoring focusing on land use, watershed mapping, pipe surveys, and photo surveys. Sixteen agencies are doing debris cleanups.

Cities are doing most of this monitoring (48 of 77 activities), in contrast to other parameters, which are largely monitored by counties.

3.5.2 Current Volunteer Support

Nearly one-third (25 of 77) of the current watershed assessment activities are undertaken with the assistance of volunteers. Approximately half of the identification of stream obstructions and debris cleanup currently performed by agencies is done with the assistance of volunteers.

3.5.3 Potential Volunteer Support

For general watershed parameters, currently 18 agencies are measuring an average of 3.4 parameters. With the interest in volunteer support identified through this survey, 26 agencies could be measuring an average of 4.4 parameters. In addition, 35 continuing activities would have increased intensity.

By developing the potential volunteer-agency relationships identified here, the number of agencies doing debris cleanups would increase by about 50% and current activities would also be more robust.

3.5.4 Implications

Activities which address general watershed assessment are fairly widespread and receive considerable volunteer support already. The scope and usefulness of these activities could expand substantially with the development of the possible volunteer group-agency relationships identified in this report.

4.0 Current Constraints to Successful Monitoring of the Bay Area Ecosystem

In the following quotations, agency staff and volunteer monitoring leaders describe some of the requirements for effective relationships between volunteers and agencies for successful environmental monitoring:

"A willingness to talk about the goals and expectations of monitoring efforts and to reach a mutual agreement about the goals and expectations [are needed]."

City of Pleasant Hill, Contra Costa County

"Better planning and preplanning with volunteers of activities [is needed]."

City of Pittsburg, Contra Costa County

"Grant applications are too long, too detailed, and [have] too little chance of success. We have tried for years."

United Anglers of Casa Grande High School, Petaluma

"Volunteers [need to be] part of an organized program like the "Baykeeper" program. Otherwise the data could be manipulated."

City of Santa Clara, Santa Clara County

"Implementation of Quality Assurance [QA] protocols including QA assessment feedback loop to improve the monitoring; strong leadership; training; and . . . [knowing] the timeframe in which data can be expected . . . are essential."

Santa Clara Valley Water District

"[We need to] know that volunteers are using proper scientific techniques in monitoring and reporting data."

San Mateo County Planning Division

"Referral from a recognized volunteer referral agency [would facilitate agency-volunteer relationships]."

Sonoma County Water Agency

Responses to the questions posed to determine the constraints to further partnerships between parties active in ecosystem monitoring and stewardship elaborate on these themes and are described below.

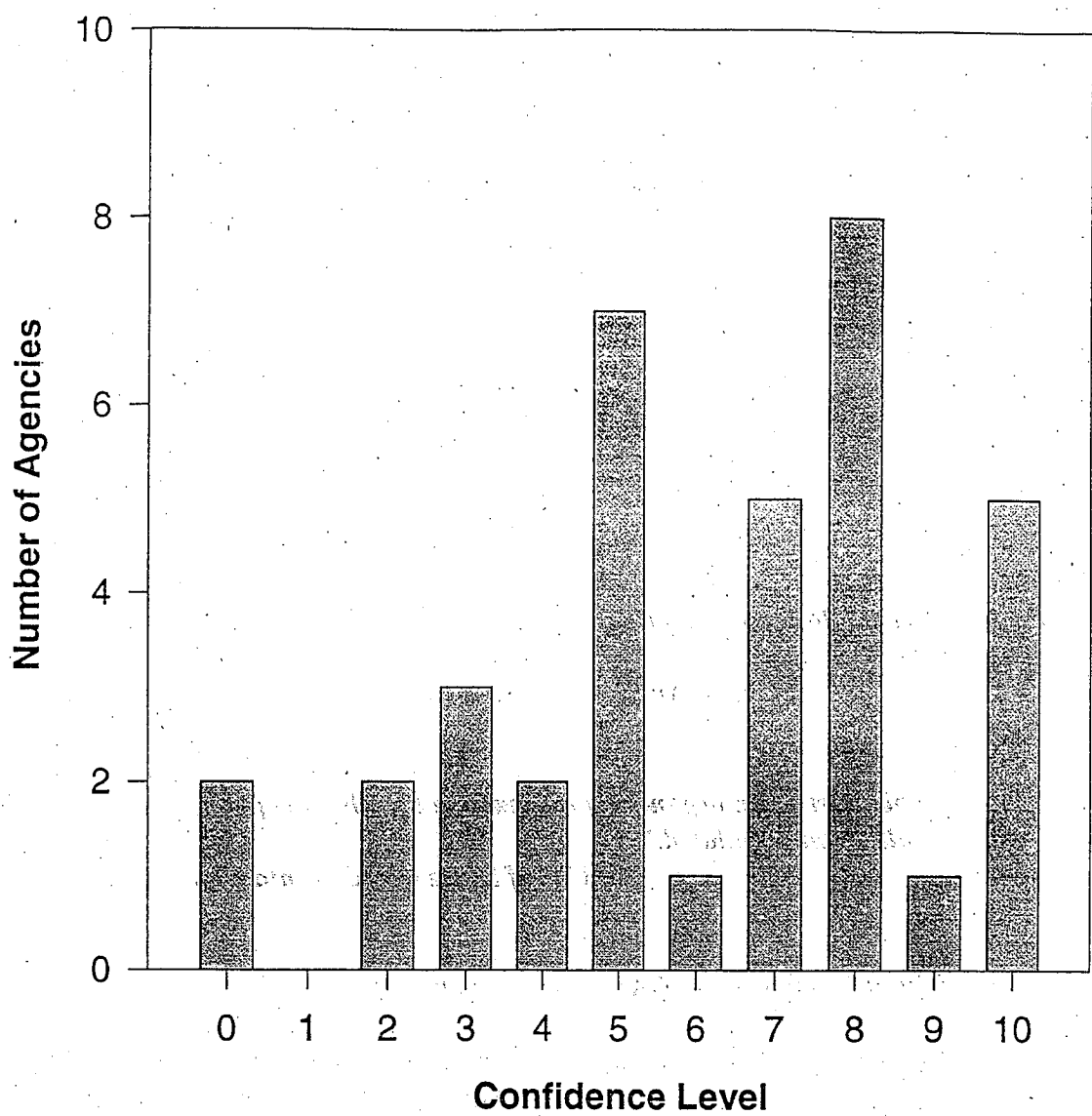


Figure 4. Level of confidence in volunteer-collected data expressed by agency staff. Higher values reflect higher levels of confidence.

Q. What concerns do volunteer groups have about working with agencies?

A. Attitudes among volunteer groups towards agencies are widely varying. Some volunteer groups provide extensive data to local agencies on a regular basis and have effective working relationships with agency staff. These groups had no concerns about relationships with government. Other groups (5 of 15) expressed concern about working with agencies, mentioning in particular that additional paperwork for protocol standardization or possible funding was not worth the time. There were some problems with access to waterbodies associated with agency jurisdictions.

Q. What is the overall level of confidence in volunteers among agency staff?

A. The survey asked agency staff to define their confidence that volunteers could provide their agency with useful data. Overall response was much more positive than negative (Figure 4). Only 25% (9 of 36) of public agency staff gave a negative rating (4 or lower), while more than 50% (19 of 36) voiced a strong level of confidence (7 or higher). There was no limitation to high level confidence by government level or focus, as high (8-10) levels of confidence were stated by all types of agencies. This strong level of confidence is particularly noteworthy given that volunteer activity is not widespread currently and coordinated training and data management are not available.

Q. Why don't agencies use citizen-collected data now if they need them and there is a fairly high level of confidence in volunteer monitoring?

A. Agency staff express a need for QA/QC procedures, protocols, standard training and referral from a recognized referral organization, and a centralized clearinghouse to manage data. They do not have time to handle these tasks themselves but they are ready and willing to use the data if it is available in a usable form. These are many of the same needs stated by volunteer groups.

Q. What about the constraints?

A. Issues surrounding data quality and reliability were mentioned most often as constraints to the use of volunteer data, with time being identified as the next most important constraint. Agency staff both experienced and inexperienced in working with volunteers feel that time will always be a constraint to the volunteer-agency relationship, but if data quality is high then the time is extremely worthwhile. In addition, agencies have found unexpected and significant benefits from collaborations with local volunteer monitoring efforts, such as greater local support for agency plans and an actively supportive constituency when agency funding is in jeopardy. Other often-mentioned possible constraints such as liability, safety, financial limitations, access to water resources, and inappropriateness for regulatory enforcement information were mentioned by fewer than 10% of the agencies and do not appear to be major constraints.

Q. What do volunteer groups need to expand the usefulness of their efforts?

A. Volunteer groups state that they could use more standardized, effective protocols for measurements and assistance connecting their efforts to government uses for data. They would like a regional monitoring network to facilitate data exchange between groups, which is almost non-existent now, and make funding opportunities available.

5.0 Possible Solutions: The Plan for a Regional Watershed Network

To meet the needs which have been described by volunteer groups and agency staff for integrated local and regional monitoring and stewardship efforts, SFEI, the State Water Board, and the Volunteer Monitoring Steering Committee have initiated the development of a regional watershed network. The main components of this plan to support growing efforts toward local and regional ecosystem health are described in this section.

The San Francisco Bay Regional Watershed Network is still in its formative stages. Grant applications have been submitted which will, if funded, allow all of the various groups within the Bay Area working on watershed management and monitoring issues to form a cohesive network which will support the following activities:

- ◆ **A forum through which technical support can be given to emerging groups.** Technical support will include provision and training in non-profit administration and fundraising; education and training in the organization and implementation of inventory, monitoring, education, conservation and restoration programs; provision of guidelines for conservation planning including model creek protection ordinances; and support for these organizations to have suitable access to Geographic Information Systems and relevant data layers.
- ◆ **A regional fund to collect and distribute money and in-kind donations of equipment, supplies, and services designated for watershed activities.** This fund will be established to process funds raised through collaborative efforts of larger, more established groups to support emerging groups; to support ongoing watershed programs; and to continue related research and development activities.
- ◆ **A process for ongoing communication between watershed groups.** This function would allow for sharing of data and information on a regular basis. The process would include establishment of a homepage on the Worldwide Web and may involve an annual or biennial watershed monitoring and education conference.
- ◆ **An identified procedure by which working groups can be convened to address specific areas of concern when the need arises.** As citizen involvement in watershed activities becomes more established, new areas of concern will be identified. Working groups will be convened to identify appropriate responses and provide methods of implementation
- ◆ **Regular contact with government agencies,** for the purpose of facilitating communication so that watershed groups can assist the government agencies in achieving their goals.

- ◆ **A coordinating body** whose purpose is to simultaneously reduce inter-group competition, increase information exchange, increase visibility, and also increase fundraising potential for watershed stewardship activities.

6.0 Conclusions: the Status and Potential of Monitoring Efforts and Agency-Volunteer Relationships in the San Francisco Bay Area

The results of this survey and additional discussions with diverse volunteer monitoring groups in the region indicate that volunteer monitoring activities are growing and are highly diverse. The environmental parameters being measured by volunteer groups are largely the same as those measured by agency staff.

Agency staff are currently active in monitoring a wide range of ecosystem parameters. These activities extend well beyond the relatively narrow range of proscribed regulatory or operational missions defined by enabling legislation. Agency staff also express strong interest in the educational role of their institutions, seeing coordinated monitoring with volunteers as an ideal way to foster dialogue and communication. The diverse and ongoing monitoring activity by agencies, in combination with their strong interest in public outreach, suggests that there is an important and growing relationship between local stewardship efforts and local agencies. The tremendous interest in applying volunteer-collected data to environmental decision-making shows that the opportunity for relationships involving residents in local ecosystem investigation and civic activities is large. *Coordinated monitoring activities which could be established between the numerous willing agencies and active local volunteer groups have the potential to tremendously increase the flow of information, understanding, and concerns about the environment to both local residents and governmental resource managers.*

While agency funds to carry out the environmental monitoring necessary to protect and enhance natural resources may become further limited, public will for ecosystem health appears to be on the rise. As local and regional agencies take on more responsibility for environmental health, the developing relationships between agencies and volunteer groups will become increasingly important, both to provide the flow of information essential to effective ecosystem management and to encourage civic involvement. However, both agency and volunteer group staff state that the growth of these relationships is limited by several primary factors, including coordinated training, consistent data collection protocols, ease of data exchange, and standardized data management by an impartial entity. Many other factors, such as limited agency staff time, financial liability, and general confidence in volunteer-collected data do not appear to be limiting factors.

It is clear that a much greater consensus about the goals for local watershed monitoring and stewardship is possible through the growing relationship between active volunteer groups and public agency staff. Agency staff would like the opportunity to explain their

information needs to volunteer groups. Volunteer groups, in turn, are interested in making sure the data and understanding they develop affects policy. Members of both groups express the need to plan together to establish common goals before data are collected. Shared goals are likely to greatly facilitate the collection of appropriate and useful data and lead to more successful management and stewardship of ecological resources.

The flexible partnership of the proposed Regional Watershed Network appears likely to be able to address many of these needs and to facilitate the development of locally-based centers for environmental data collection and civic participation in resource assessment and stewardship.