

**Learning from Public Participation in Scientific Research (PPSR)
programs in Northern California:**

Examining diverse approaches to develop models and collaborations

Preliminary Findings from the Northern California PPSR Inventory Study

Individual Outcomes



Programmatic Outcomes



Community-Level Outcomes



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Introduction

This project arose from the realization that projects involving public participation in science vary widely, and often work in isolation from each other. These range from ‘citizen science’ projects for which people submit data about birds or plants online, to environmental justice-oriented community-based participatory research, and everything in between. These projects all revolve around members of the public collaborating in some form with scientists to answer environmental science questions. We use the term, Public Participation in Scientific Research (PPSR) to broaden from the concept of ‘citizen science’ – to include this wide array of disciplines, types and levels of participation, and communities involved (see Bonney et al., 2009, for details on PPSR).

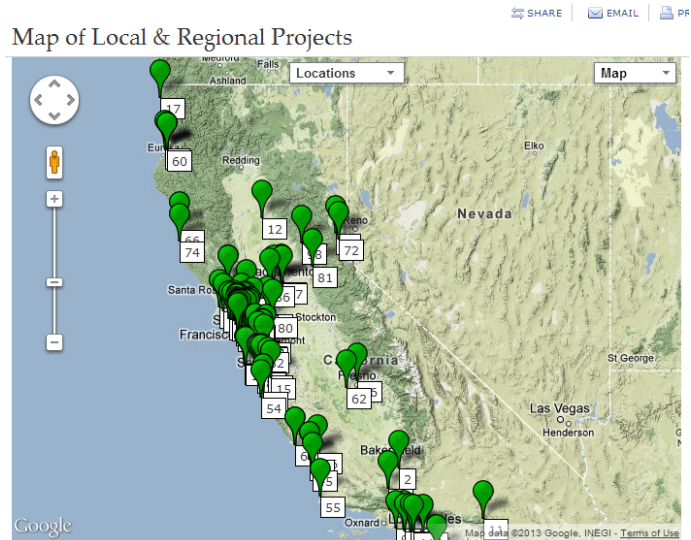
This document contains preliminary data from a research project about the range and types of PPSR projects in Northern California – our intention is to contribute to the conversations at the Northern California PPSR Regional Workshop, while also ‘ground-truthing’ or verifying the data with the practitioners at the Workshop. This feedback from PPSR practitioners will help us identify gaps, areas to focus on, and make sure the results truly reflect experiences in the field.

Northern California PPSR Inventory Study Goals

- 1) Characterize the different types of PPSR programs currently available in Northern California
- 2) Identify essential elements and assets of these programs
- 3) Begin to identify ways to assess outcomes on science learning and environmental stewardship
- 4) Provide opportunities for PPSR programs to collaborate and expand their reach and impact
- 5) Lay the foundation for research on participant outcomes of different types of PPSR projects

Despite increases in ‘citizen science’ as a vehicle to conduct research, promote learning, and engage the public in environmental issues, we lack research and evidence of how particular aspects of engagement in citizen science relate to individual environmental learning and stewardship behavior outcomes, and about citizen science’s broader impact on conservation efforts. Further, although citizen science has great potential as a tool of science engagement and environmental justice, often these worlds remain isolated from each other.

To begin to address these gaps, we set out to create a comprehensive inventory of citizen science projects in Northern California, analyzing program characteristics across diverse projects; and hope to build community of practitioner researchers. Throughout the research process we are engaging PPSR designers, leaders, scientists and participants to guide research priorities and questions about the impacts of PPSR.



From the inventory website, hosted at:

http://ucanr.edu/sites/UCCNP/California_PPSR/PPSR_Projects_Map/

PPSR Project Inventory – Preliminary Findings

Introduction

To begin to understand the range and character of PPSR being done in Northern California, our research team developed the PPSR Northern California Project Inventory. Using web search, recommendations from colleagues and PPSR leaders, we worked to identify as many PPSR projects active in Northern California as possible. To narrow final data collection, projects documented in the Inventory had to (1) address environmental issues in some way, (2) include Northern California-focused activities, (3) meet the definition of ‘Public Participation in Scientific Research’ (PPSR, or “citizen science”) put forth by Shirk et al (2012) – “intentional collaborations in which members of the public engage in the process of research to generate new science-based knowledge.”

We identified over 250 candidate programs and collected data in pre-defined categories on over 140 of them, relying primarily on information published by the project organizers on their web sites and in promotional materials. The questions we “asked” of the information collected were developed by the research team and reviewed by colleagues both implementing and researching PPSR. The questions address three audiences: (1) the interests of current and potential participants, (2) questions generated from PPSR practitioners, and (3) our own research interests in the social and educational impacts of PPSR on its participant other research on citizen science and other forms of PPSR. Finally, to attempt to verify the information, we emailed project contacts to ask for corrections of the information we entered in the database, and invited them to fill out the Practitioner Perspectives Survey.

A web-based search for information has obvious limitations. Organizations do a lot that they don’t put ‘on the web’ – and some programs don’t put anything on the web at all, or don’t update the website frequently. Furthermore, each project has a different audience and unique needs and priorities. While we worked to be consistent, the array of projects in Northern California at times defied easy classification, and answering our initial questions required intensive analysis and interpretation. However, the method allowed us to find a large number of projects and many of the ways projects vary and compare.

For example, we focused on projects, not organizations or programs, to be consistent across the field. However many programs include different models and projects, and organizations change quickly. In some cases, project websites emphasized educational goals, so defining the scientific question, if it was not stated, was difficult. In other cases, it was difficult to determine the duration of participation or involvement, training offered or required, and all the structured ways people participate.

Because of these limitations (and our own as researchers), we see the inventory not as a comprehensive portrait of PPSR in Northern California, but a snapshot – a picture taken from one perspective at one point in time. Parts are still out of focus, some subjects may need to be shifted.

Our purpose in presenting preliminary findings from the inventory to PPSR practitioners is to enlist your help. It’s also to give you a sense of what’s out there so that together we can start asking questions about outcomes. Despite its limitations, the inventory allows us to pull back from the challenges and accomplishments of individual projects to focus on commonalities, potential connections, emerging tools and trends, and diverse strengths of PPSR work in Northern California.

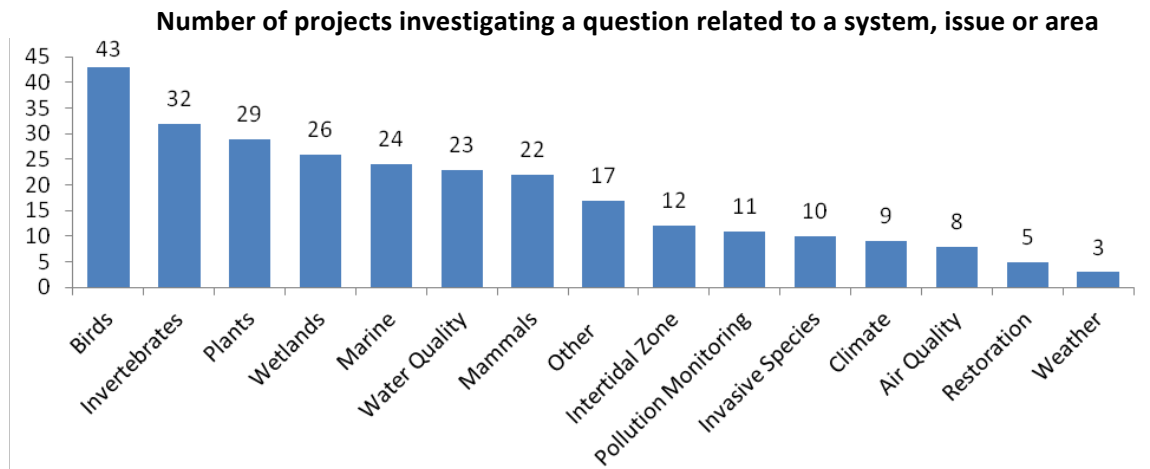
The Basics

PPSR projects in Northern California are starting up, fading and changing continually as they gain or lose funding, finish answering a research question, change personnel, and refine protocols, outcomes, outreach, etc. This project establishes a baseline – a snapshot of programs now – that will change over time.

- There are **130 active Northern California projects currently in the inventory database** (as well as 5 projects that have become ‘inactive’ and are no longer publicly accessible).
- The PPSR Project database is accessible at ucanr.org/sites/UCCNP/California_PPSR/.

System Studied: “What is the system under study?”

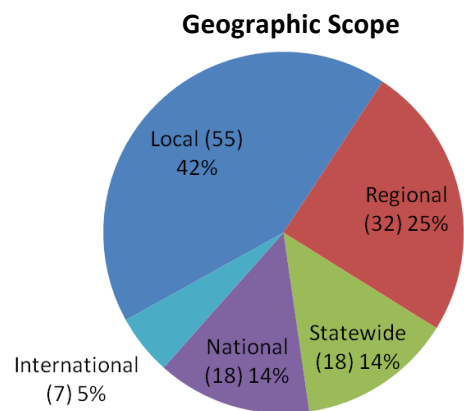
The data here simply shows, at a broad level, what environmental systems, issues or areas projects address. (The inventory also has information “project purpose” – an open-ended field focused on research questions and other immediate goals of the project – but this data is not reported here.)



Data note: Many projects are involved in more than one issue area and some issue areas overlap (for example “mammals” and “marine”, or “climate change” and “intertidal zone”). Potentially relevant issues, like climate change, are not listed unless specifically mentioned in the project or organization’s purpose or project question.

Issue Areas per Project	
Range	1 - 9
Mean	2.1
Std.Dev.	1.5

Geographic Scope: “What is the geographic scope of the project's data collection?”

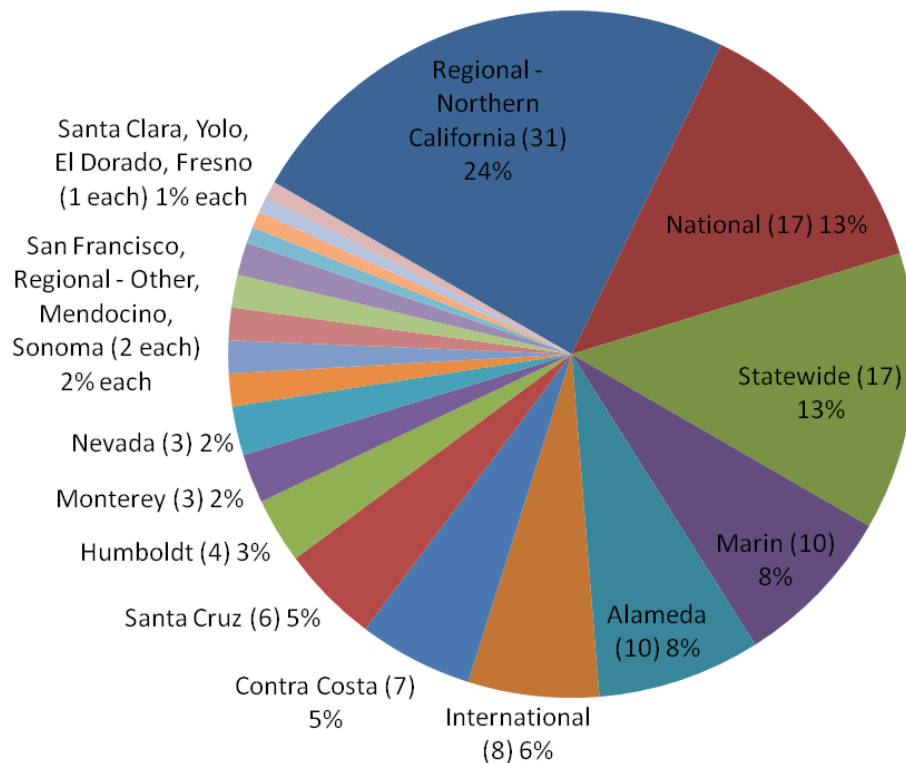


Data note: Classification reflects a project’s *primary* objective. If a project’s primary focus was within one county, it was listed as a “local” project. There are a high number of programs that have multiple sites – these are listed as ‘regional’ if these sites span more than one county. Because we worked to capture California-focused projects, this chart may also underestimate the number of international and national projects that have active participants in Northern California. If such projects had strong California partners or were based in California, they were included in the inventory.

Region: “County in which volunteer activities are based”

Projects in the inventory show a concentration of local and regional programs in North and the East Bay, with a strong focus on marine and wetlands. We identified fewer projects in the Central Valley and north eastern counties of California. As mentioned above, there may be active programs in these areas that our search did not identify due to limited search terms, no information on the web about the programs, a narrow definition of PPSR, etc. In some cases, projects were excluded from the inventory because although they did restoration, education, and some degree of field data collection, it was not clear that the data were used for research or management decision-making. This does create a bias in the inventory toward long-term projects associated with organizations or institutions that can support a developed web-infrastructure. Left out may be shorter-term projects and those that rely on word-of-mouth outreach and organization, or those that may not describe themselves in terms of *citizen science*, *citizen monitoring*, *participatory research*, *PPSR*, etc.

Regional Distribution, by County, of PPSR Projects in Northern California



Data note: If a project is active in more than on county, it was classified as “regional.” This doesn’t fit all projects perfectly and it under represents the number of projects in some areas. For example, many projects active in San Francisco projects are classified as “regional” because they also reach Marin or the East Bay. This means that even though the chart below lists 2 projects in San Francisco and 8 in Marin, some of the 31 regional projects may also be active in these regions.

Mentioned in “geographic scope,” some national and international projects active in CA may be missing, and we hope to fill those gaps. For example, the Christmas Bird Count is listed as “national,” but may have strong local partners and impact. These programs can be responsive to local issues and may have powerful tools for mobilizing communities.

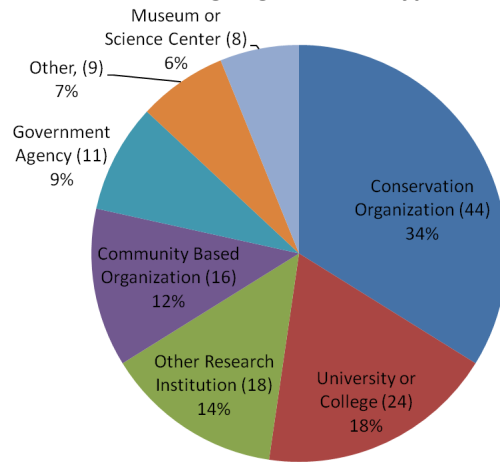
Organization Type: “What type of organization sponsors or organizes the project?”

One early discovery made early in inventory research is that administration of PPSR projects gets complex. Partnerships, multi-agency initiatives, and what we are calling “nested projects,” make PPSR exciting and effective, but make classification difficult. We also discovered that our initial categories, designed to capture who was motivating and coordinating participatory research, left gaps and overlaps. Despite this, the inventory data begins to reveal ways in which institutional priorities and support play a role in *when* and *how* PPSR gets done.

Data Note: Here are some examples of projects listed in each of these categories. *Conservation organization:* Audubon, Watershed Project, Watsonville Wetlands Watch, Reef Check, Farralones Marine Sanctuary Association. *Local Community-Based Organization:* Bug People, BioCurious, Surfrider Santa Cruz; there is obvious overlap with “conservation organizations” – some projects, like Friends of Five Creeks and South Yuba River Citizens League might be considered “conservation orgs,” but are listed as CBOs because of local focus and/or concerns outside ‘conservation’.) *Government Agency:* East Bay Regional Parks, Marin Water, Monterey Bay Marine Sanctuary, State and National Parks and Forests. *Museums:* California Academy of Science, Monterey Bay Aquarium. *Other:* Bay Area Early Detection Network, California King Tides Initiative, IBM Research, Mendocino High School, Central Coast Vineyard Team; these tend to be projects that are organized by networks with no single institutional host, or school or for-profit organizations that fall outside other categories. *Other research institute:* iNaturalist, PRBO, Adventurers and Scientists for Conservation, Golden Gate Raptor Observatory, Global Community Monitor.

Agencies that work with specific audiences, like NRCS, water districts, RCDs, Winegrowers associations, local and regional parks, etc. may be hosting events and small projects in which community members with vested interests (like land owners or residents), but who are not professional scientists, are monitoring properties, including their own. These projects are largely absent from the inventory, though they may have much to teach or learn from other PPSR projects.

Distribution of PPSR projects by coordinating organization type

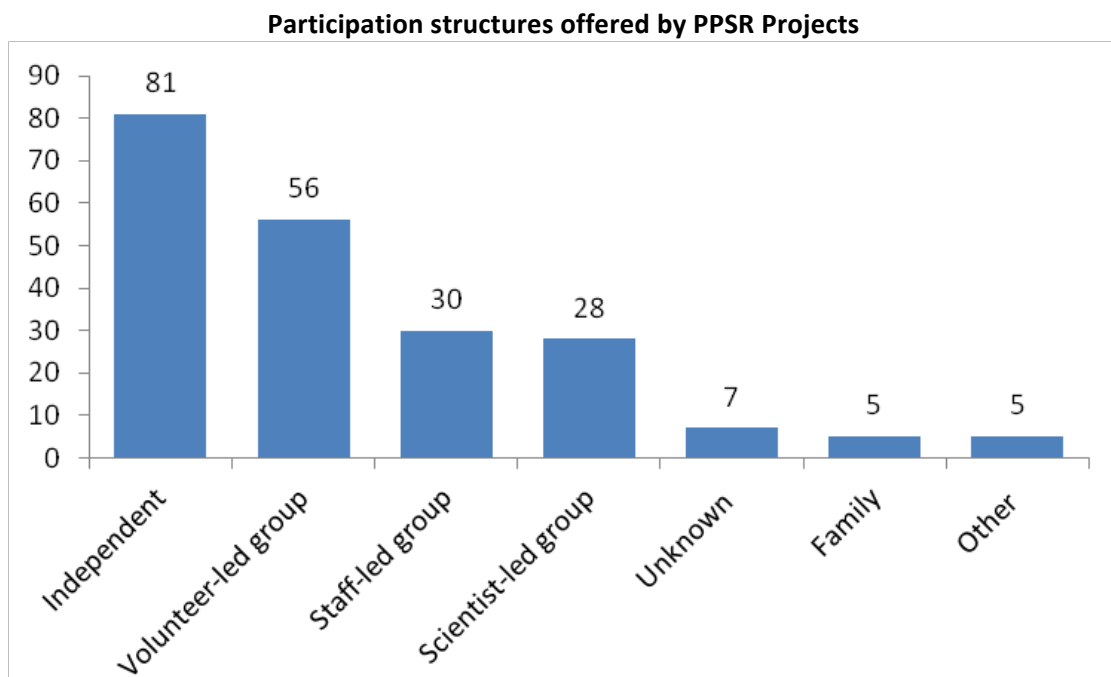


‘Nested projects’: Many local and regional organizations have connections to volunteers and naturalists, but often lack close links to active researchers, rigorous protocols, time for data processing and analysis, advocacy structures, etc. These organizations can host events, collection sites or training for established projects – a partnership which can benefit all involved. By nesting a local project or event within a larger PPSR program and taking advantage of existing tools and structures, organizations provide opportunities for education, contribution to science, and social learning to their community members. Examples include East Bay Regional Parks hosting CA Phenology Workshops, Davis BioBlitz contributing to iNaturalist, local Audubon organizing Celebrate Urban Birds events, etc.

Participation

Participation Structures: “Will the participant primarily work independently or in groups?”

Research and experience have shown us that ways of participating in a project may be very important to understanding who shows up (and doesn’t), what motivates participants, what kind of data can be collected, and what kind of learning and action results from participation. For example, in a study of a regional BioBlitz we saw that a primary motivator for some was social interaction with like-minded peers, for others it was the chance to learn from experts. Other projects attract participants who can work on their own schedule, sometimes in their own backyards.



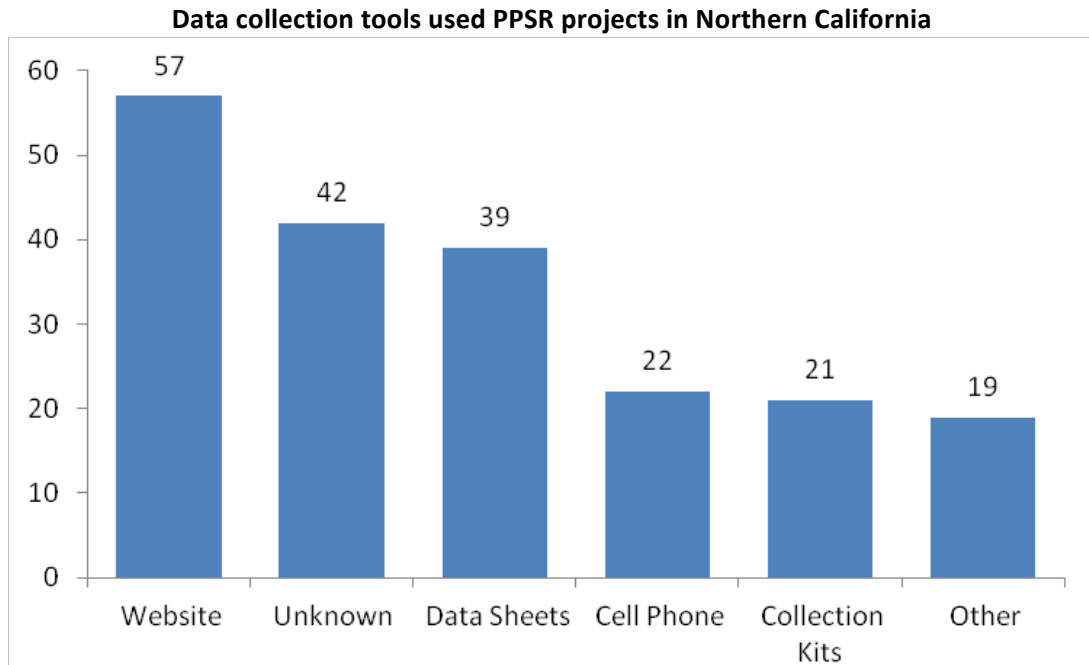
Data Note: Many projects support more than one group format (A participant you may collect data alongside an expert at a community event (“expert-led”), then also be able to collect on his or her own (“independent”). Therefore, in the inventory multiple structures might be selected for a single project. However, this is one of the questions that was very difficult to answer based on web data. These are rough estimates. In some cases, it was clear that data collection was done independently, or in small teams (like Hawk Watch). In other cases, categorization was based on implied format (for example, reference to being with a scientist, or a school group that talked about staff facilitation).

Participant activity: “What is the participant’s main task, job or activity?”

Like “participation structures” what participants actually *do* in a project and what tools they use to collect and analyze data affects quality of data and experience. Descriptions of participant activities in each project are accessible in the online inventory, but have not yet been analyzed for differences and common themes. Also in the inventory are “other activities,” which highlight opportunities for increased involvement in a project, organization or campaign, “training” and

The data here focus simply on the tools used for data collection. The inventory showed that the use of website and mobile device for data collection and input is high among projects in Northern California.

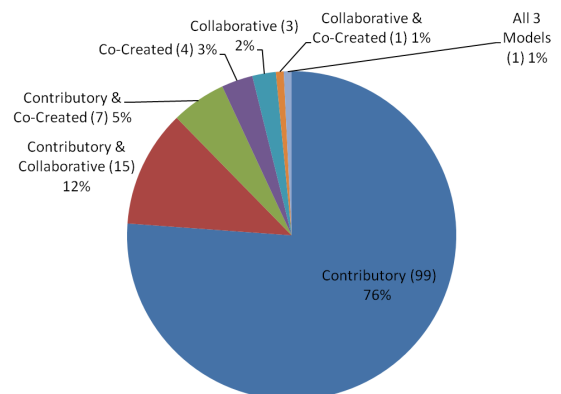
Among other benefits, these tools can standardize data collection, build a common repository for multiple individuals and organizations to contribute to, allow for integration of education, protocol guidance and observation, and provide opportunity for casual or opportunistic participation. However, these tools can be difficult to use, expensive to build and revise, and may in some cases break a direct link to professional researchers and scientific or community questions underlying research.



Data Note: A project may employ more than one tool. Therefore the number of tools is greater than the number of projects. There are also many “unknowns.” These are projects that did not specify protocols or details of volunteer activities on the web. They either require going to a training or organized event, or at least getting in touch with coordinator first to get acquainted with tools, methods, etc.

Involvement in the scientific process

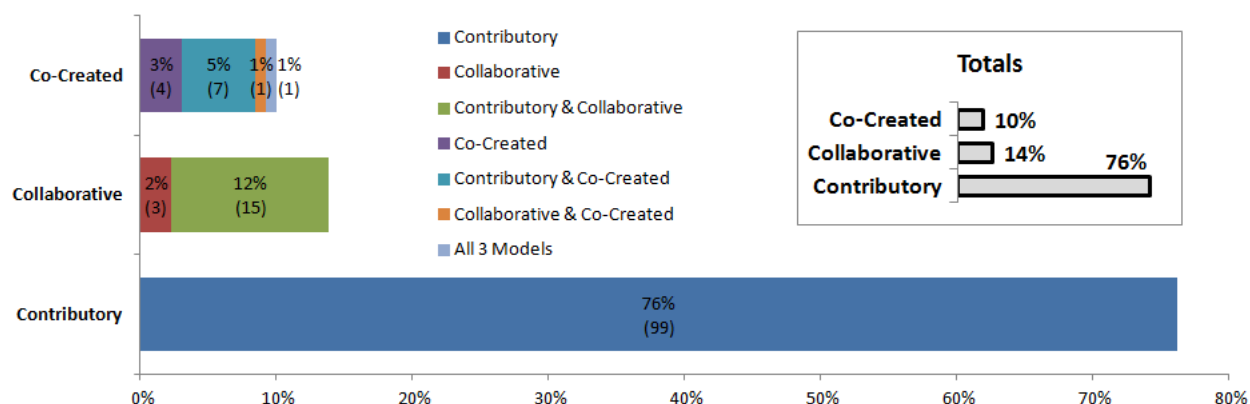
We classified projects, based on the information provided on websites, into the three Models of PPSR defined by Bonney et al. (2009) and Shirk et al. (2012) because this allowed us a glimpse of how intensively the public is involved in the scientific process in Northern California (based solely on PPSR projects and our web-based inventory). These models are consistent with research in many fields regarding participation in science and monitoring. “*Contributory* projects are generally designed by scientists and for which members of the public primarily contribute data. *Collaborative* projects, which are generally designed by scientists and for which members of the public contribute data but also help to refine project design, analyze data, and/or disseminate findings. *Co-Created* projects, which are designed by scientists and members of the public working together and for which at least



some of the public participants are actively involved in most or all aspects of the research process” (Shirk et al. 2012). Surprisingly (or not) we found that many projects seem to incorporate more than one of the 3 PPSR models, that is, some participants primarily contributed data, while others participated in many stages of the scientific process, reflecting a more Collaborative model. This complicates the Bonney et al. (2009) models and highlights a potential strength of projects – the ability for participants to contribute at many levels and steps of the scientific process.

Also, like participants that may move from contributory into collaborative roles, programs evolve – a project may start out as Collaborative, involving a core group of participants in protocol development, for example, but then move to a Contributory model for new volunteers coming in.

Importantly, and in particular, Co-Created projects like those focused on environmental health and justice are often structured such that ‘projects’ – that is, specific data collection and analysis campaigns – shift with some frequency. This points to an important point that needs more investigation, about the relationship between organizations and their individual and several PPSR projects.



The above graph portrays the quantity of each of the project models in another way. Projects may be listed in more than one ‘level’ if, for example, most volunteers engage in ‘contributory’ level, but engagement at ‘collaborative’ level is significant and institutionalized in some way. Of note is that we found and classified Collaborative projects as including projects that have as a significant component in which data is shared with volunteers and they are encouraged and/or trained to engage in their own question-asking and investigation. This is true for projects like LiMPETs) where those question might not be taken up frequently by the project or scientists themselves. Facilitating this process allows project leaders to adapt to volunteer-driven changes in monitoring techniques, (for example, Hawk Watch), new sub-research questions, future studies, or to independent action by the volunteers. While not common, this process and structure have huge potential for seeing ways different project models can inform each other. Similarly, we classified as Collaborative projects that allow for user-generated missions or projects, etc. (like Project Noah, iNaturalist). Projects like these fall into gray areas, since they are really programs made of hundreds of projects that may allow a variety of entry points for participants. This may mean organizations are looking for ways to engage participants in many substantive ways, and recognizes that educational outcomes may increase at deeper levels of engagement.

Similarly, note that even Contributory projects can have extremely high levels of engagement and citizen investment. Projects like BeachWatch (which do have small Collaborative elements), capitalize on their volunteers’ connection to ‘place’ and have very high retention. Projects like ReefWatch, Grunion

Greeters, iNaturalist, etc. have dedicated and faithful communities that keep volunteers engaged and committed. These longer-term contributions, even without institutionalized collaboration, can lead to volunteer-driven science. On the other hand, Contributory projects might also engage volunteers in dissemination, advocacy, discussion forums, public outreach, etc., as secondary activities. Co-created – sometimes can be ‘contributory’ and ‘co-created’, such as the South Yuba River Citizens League, in which the project overall was driven by local citizens, but participation by new volunteers will likely be a Contributory model. Therefore, examining stages of the scientific process and the three models of PPSR are only a first step in looking at impacts on participants. In Northern California, we found that projects complicate the 3 models typology, but these gray areas are ripe for investigation, and are signs that projects have multiple forms of engagement, long histories with room for volunteer growth, and are in flux, responding to volunteers, new science and technologies and community needs.

Expanding PPSR

Past studies show that young people and communities of color are often underrepresented in most PPSR work. Data from our inventory also reflects this, but only based on state focus on project websites. The inventory’s preliminary data (below) show that projects with some youth focus are similar to the entire group in distribution along PPSR model: most are of the Contributory model, and very few are Co-

Projects involving:	# of projects	% of all projects
Youth	36	28%
Communities of Color	12	9%

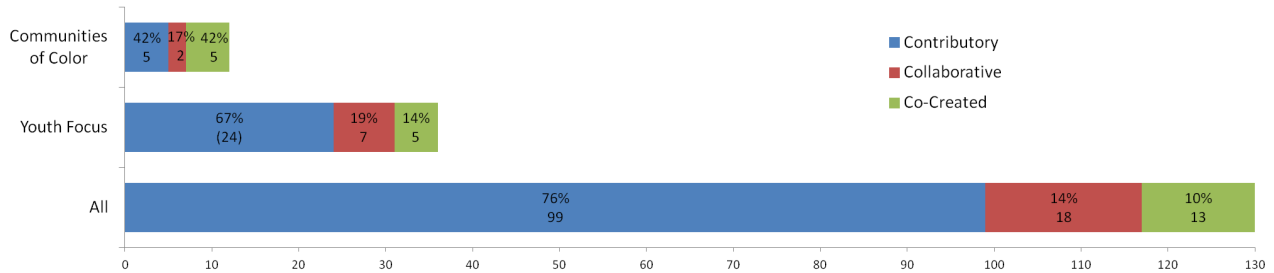
Organization Type	Youth	Communities of Color
Community Based Organization	6	5
Conservation Organization	10	1
Government Agency	6	1
Museum or Science Center	2	1
Other	3	1
Other Research Institution	4	3
University or College	5	0
Grand Total	36	12

created. However, a slightly greater percentage of programs that engage youth have components that fit the Collaborative model. In many cases, this means providing data back to youth participants so they can engage in analysis and question posing, or asking participants to engage in advocacy or outreach – dissemination of findings – of some kind. Opportunities for youth included:

- School focused programs (LiMPETS, Journey North, GLOBE, Project Tierra)
- Projects that involve family and community
- National programs with kid-friendly resources online
- Some ‘citizen science’ project not included because no clear use of data or scientific ‘question’

This inventory data also show that projects focused on engaging communities of color may really differ in the ways people participate in science. A significant number employ a ‘contributory’ model, but the percentage of “co-created” projects is much higher than for projects in general – those in which participants seem to play a role in defining questions, developing hypotheses, and analyzing or interpreting data – is high, nearly four times that in projects overall. This makes sense for CBOs investigating environmental justice questions that involve communities of color disproportionately impacted by environmental problems.

Number of programs focused on youth and communities of color, by model of participation



Data Note: A project was listed as focused on youth or engaging communities of color if these audiences were mentioned in materials, mission, or reflected in pictures, description of the organization and community, etc. published on the web site. This methodology clearly relies on tenuous assumption and provides only a rough estimate of how many projects may be engaging these populations – deliberately or not. Work also needs to be done to identify projects that may not call themselves PPSR, citizen science, monitoring, etc. The preliminary findings also shows us that organizations, especially those working with youth and working on environmental justice issues, may have short term projects hosted within longer term campaigns or community-based organizations. Using the “project” as a unit of analysis, and excluding projects that did not have a clear research aspect, may therefore have systematically under-counted these projects.

Also note that the data for “all” projects includes those projects engaging youth and communities of color.

What is not here

Not included here is analysis of information gathered in response to the open-ended questions below. Your feedback and feedback received from the Northern California PPSR Regional Workshop will guide analysis of data. We will be seeking thoughts on how well this data represents the experiences of those engaged in PPSR (as organizers, researchers and public participants) and what priorities for analysis and subsequent action are strongest in our region.

Open-ended fields in the inventory

- Project Purpose (taken from project materials): What is the scientific research purpose or environmental question this project addresses?
- Participant Activities: Briefly describe the participant's main task, job or activity? If 'data collection, what kind of data will participants collect?
- Other Participant Activities: What other research activities can participants be involved in, if any? Are there social events, other projects, workshops, outings, etc. mentioned? If none, leave blank.
- Time Commitment: What is the time commitment involved in volunteering? (once a year, monthly, weekly, specific dates, etc.). If "other," please elaborate in the Other Information section below.
- Volunteer Qualifications: Do you need to have particular qualifications/ skills/ equipment? If so, what is required and what is preferred?
- Volunteer Training: Is there training provided? Include the times, dates, duration, and topics covered if possible.
- Cost to Participant: Is there a fee/cost to participate? If none, leave blank.
- Participant Compensation: Is any volunteer compensation mentioned (gear, recognition, party/event, stipend)?
- How will the findings be used?: What will happen in the end - How is the data/ findings/analysis cataloged and reported to the public and/or researchers?
- Other Information

PPSR Practitioner Survey – Preliminary Findings

Introduction

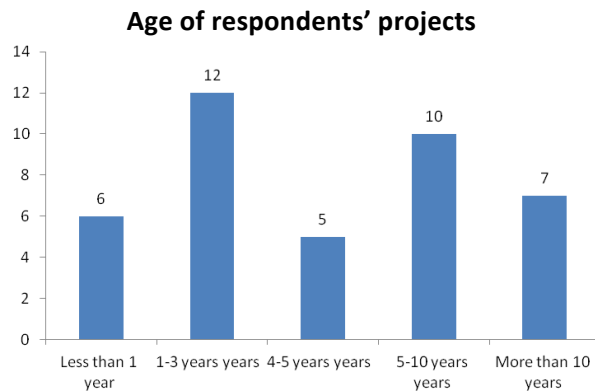
After learning as much as we could from the web-based information on 140 PPSR Projects in the Inventory Project, we set out to learn more deeply from project leaders about how their projects run, their goals and questions, and strategies and practices they feel are successful. We sent an online survey to all the project leaders listed in our inventory, and over approximately 2 months (Sept-Oct. 2012) received 44 responses. We hope to hear back from more project leaders inspired by the PPSR workshop!

➤ 44 PPSR project leaders – designers, director, coordinators and scientists – responded to the PPSR Project Leader Survey, **40 from projects active in Northern California.**

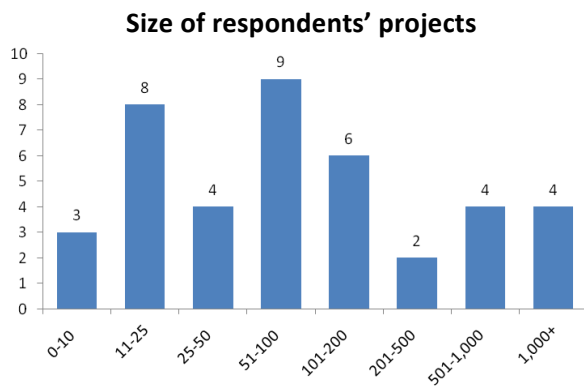
The Basics

The survey asked project leaders about their projects and organizations. This data was also linked to data from the inventory, allowing us to look at the distribution of survey respondents by organization type, region, and other aspects.

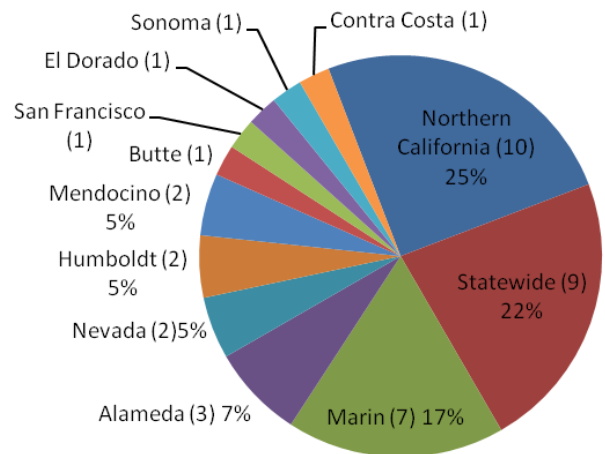
Organization type (primary org only)	# of orgs
Other (see Other Information below)	2
Other Research Institution	8
Community Based Organization	4
Conservation Organization	13
Government Agency	5
University or College	5
Museum or Science Center	3
Total	40



# of organizations per project, including partners	projects
1 Organization / Project	28
2 Organizations / Projects	7
3 Organizations / Projects	4
4 Organizations / Projects	1



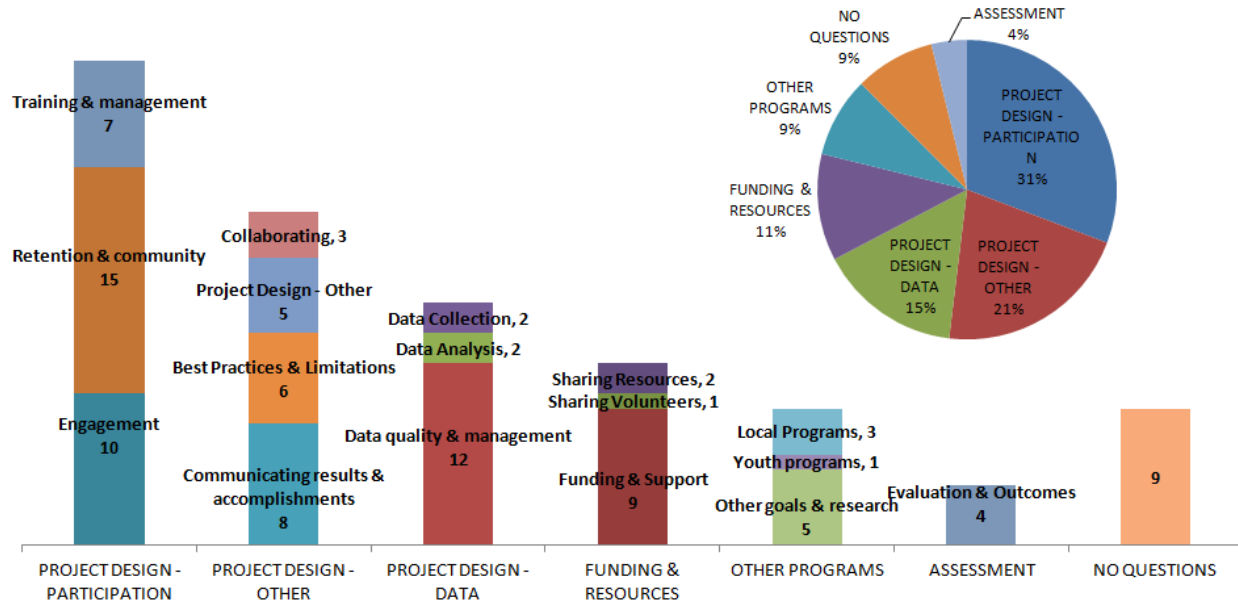
Distribution of survey respondents by project region



What PPSR Leaders Want to Know

“Please list the kind of information you’d like to know about other citizen science programs that would be most helpful to you in your work?”

Types of information that survey respondents said would be helpful, by number of times mentioned



ASSESSMENT

Evaluation & Outcomes

- How do you evaluate skills of volunteers?
- How do I build in more metrics for measuring what volunteers have learned and retained

FUNDING & RESOURCES:

Funding & Support

- What types of support (eg staff, community, fiscal) do they believe is most necessary for a successful project
- Funding and fundraising strategies
- Recommendations for funding?;

Sharing Volunteers

- potential partnership/volunteer sharing could happen

Sharing Resources

- What materials/resources/etc they would be willing to share
- Sources of funding?

PROJECT DESIGN – PARTICIPATION:

Participant engagement

- Internet tools for engaging people;
- Strategies to get volunteers committed to a project;

- Volunteer recruitment success stories
- What are additional successful ways to engage youth and young adults to take action on environmental issues?;

Participant retention & community

- What are some good ways to retain these trained volunteers for the next round of surveys
- how to maintain participation; and keep volunteers interested would also be helpful;
- what is the best way to build a network of volunteers

Participant training & management

- What are some good ways to manage large amounts of volunteers to make sure everyone has the information needed to participate?;
- Training and encouraging volunteers to acquire advanced skills;

PROJECT DESIGN – DATA:

Data quality & management

- Database management
- analysis and cleaning of datasets where the quality varies
- How do you QC your data?
- Does anyone systematically evaluate the quality of their volunteers by category

Data Analysis

- Who analyzes data
- Data interpretations;

Data Collection

- how they utilize or don't utilize electronic data-loggers or hand devices
- While technology is moving to online apps is there a way to quickly record;

PROJECT DESIGN – OTHER:

Communication of findings

- [how to] share information with people that are not using the internet and without the resource strains of duplicating?
- how data are dispersed or shared;

Accomplishments

- Communication and promotion of program and accomplishments

Other Best Practices & Limitations

- Strategies, tools; and lessons learned from existing projects;
- what are the limitations of using citizen scientists
- How do you balance the PI's time, or the professional's time with volunteers?

Other Project Design

- How to design and organize research projects that are easy for a group of people to participate in on their own time
- how they safeguard data;

Collaboration

- How to link your work to other projects to magnify the impact;

OTHER PROGRAMS

Other goals & research

Focus/subject/target species of other projects;

Research goals - to see if ours align

Programs – Locations

Local organizers (not UC, but grassroots)

location - I am especially interested in other [nearby] groups.

[other] Youth advocates (both UC and non-UC);

Key Practices

“What project activities or strategies have been most important to your program’s success?”

Project leaders’ responses to this open-ended question covered aspects of PPSR project implementation from participant training and experience, to community building, to outreach and publicity, to strategic development and expert involvement. The list reflects a focus on participant experience – connection to the project, in-depth training, encouraging responsibility, etc. – as well as on use of specific activities and tools, strong relationship with other organizations and the media, and strategic program development. Below the chart are examples of “activities and strategies” in each of the practice areas listed. They form an initial look at the best practices in our region reported by project leaders. Our understanding of these practices and the values they represent will continue to evolve with feedback from leaders and thinkers in PPSR.



Communication & community: *building participant community - stay in touch, host events, get to know participants*

- Personalized maps and data access methods, as well as regular news and feedback on the website.
- Community outreach and trust building. In underserved communities this is especially important.
- Regular interaction with monitors. All of these activities serve to keep people interested and excite the public about collecting scientific data. It also helps to make sure everyone understands what species they are looking for.

Educational opportunities: *providing in-depth and ongoing education and training opportunities for participants*

- Providing training and checking-in with volunteers helps them to feel engaged and appreciated.
- Training workshops have fostered interest in the project, and a certain amount of familiarity.
- The most important activity we do to engage our volunteers is hold three training days

Organization & strategy: *clarifying goals, analyzing projects, staying organized, and taking care of details*

- Being proactive is essential to having a successful volunteer base, but also to save time in the long run. Various other reasons to be preparing ahead of time include gaining plant collection permits, access to private and protected lands, etc.
- Being organized; defining volunteer job descriptions clearly and being realistic about the time commitment; having a clear question and goal from the beginning.

Collaboration: *partnering with agencies, universities and organizations to increase relevance, capacity and resources*

- Intense & consistent follow-up w/ our 'on the ground' community partners
- Collaboration with [another institution] – shared responsibility, shared recruitment of volunteers. This has increased our expertise, our capacity, and the relevance of the data collected.

Lead-off training: *providing strong training and introductory events early on to improve engagement and skill*

- Nature walks to see the butterfly during it's brief spring flight - people connect after making this first moment
- We have an annual training for new volunteers, a refresher training for current volunteers, a breakfast the morning of the first monitoring event

Share results: *sharing our results with participants, community members and the public*

- Our ability to report back to the volunteers on bird numbers over time has been important.

Independence & responsibility: *preparing participants to work independently and allowing them to lead*

- providing a variety of projects and giving volunteers a great deal of responsibility

Media & publicity: *targeting outreach, advertising successes through multiple media*

- Dissemination through local meetings and the local paper.
- Posting signs about the project and where to send data to around local communities, schools and nature areas.

Tech resources: *using digital and online tools to reach out to, update, and train participants*

- Development of iPhone app. Facebook and social participation. Media exposure through youtube videos, news articles.
- Development of online education courses.

- GPS data is valuable in many ways.

Events & workdays: *creating special events for data collection, work and training to make participation easy and fun*

- Developing activities that help engender a sense of community amongst the volunteers. Eg. pot luck picnics, cafe/bar meetups, beach cleanup days, etc. Essentially any group activity outside our core survey work.
- We found that field days where the volunteers are invited to assist the botanists and educational classes/programs have helped the dedicated volunteers expand their knowledge of the flora (which, in turn, makes them more productive volunteers).

Data access: *allowing participants, agencies and/or the public access to our data*

- Sharing the data with the land or agencies responsible for resources and with the volunteers that collected or in some way contributed to the program has been the most successful. This makes the program meaningful to the volunteer participants, inspires new volunteers and sometimes results in positive action.

Feedback from participants: *soliciting participant feedback to improve our program and protocols*

- feedback and interaction with contributors.
- We have several mechanisms early-on to giving new volunteers chances to ask question and to hear about the details they are getting into.

Expert-involvement: *involving experts in field days and training events to engage volunteers and improve data quality*

- Trips led by CNPS staff have been successful in bringing out volunteers.
- Field days led by professional or amateur botanists/biologists: allows for collecting of specimens and relatively accurate IDing of species.

Peer-to-peer training: *enabling participant-to-participant training to build connection and lighten staff load*

- Mandate that new volunteers speak with old volunteers; volunteers can talk about things they would never think to ask staff.
- we always have a subset of volunteers who know the protocols and can demonstrate them, so bringing on new volunteers isn't a burden

Advisory board: *getting guidance from an advisory board of scientists or community members*

- we are strengthening our scientific credibility and have assembled a science advisory panel with 9 biologists and ecologists to help assess protocols, ask questions, identify and discuss possible trends in our dataset.

Other:

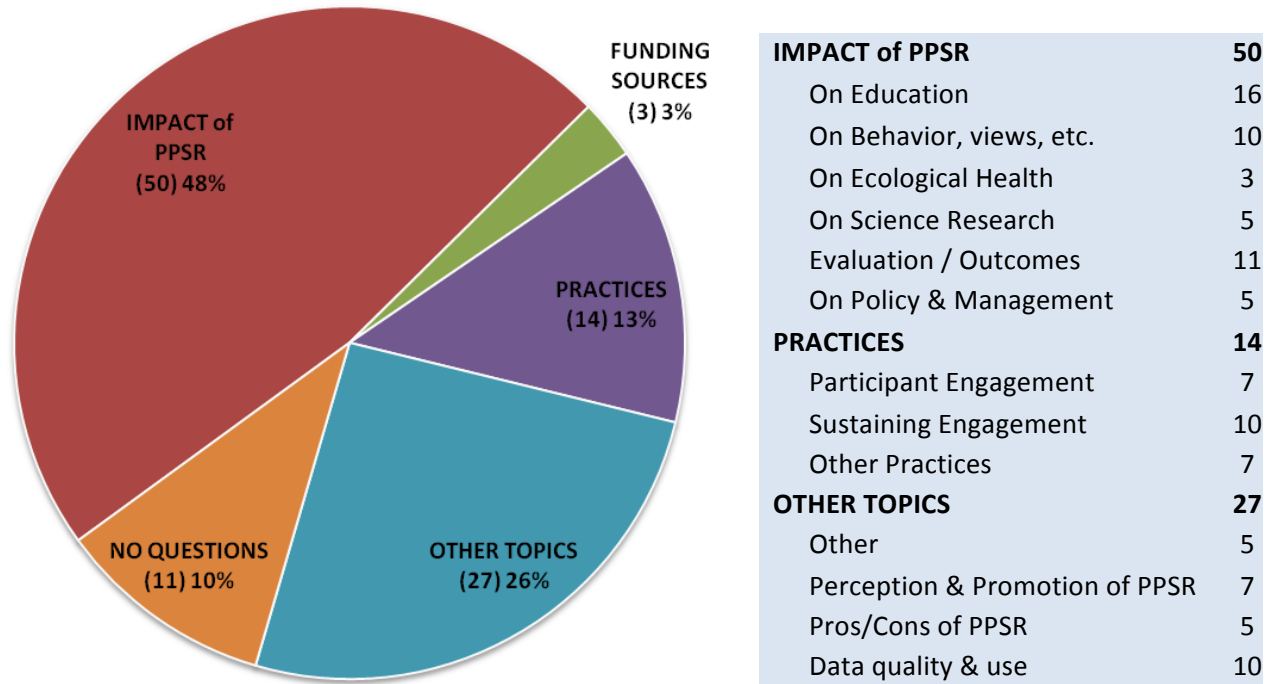
- writing grant proposals,
- becoming a community voice,
- being selective about participants,

Data note: As you will notice, a number of the activities and strategies mentioned by project leaders as important to the success of their programs fall in into more than one category. During analysis, these comments were separated into separate aspects before being assigned to a category. Therefore, the number of activities and practices documented exceeds the total number of project leaders that responded.

Questions about Impact

“What questions do you have about the impacts of citizen science that you would like to see addressed as part of a research project (educational? scientific? community-level outcomes? others?)?”

Respondent questions about impact, by category



In the survey, the questions that project leaders would like to see addressed with future research were classified into a few large categories, including (not surprisingly) those prompted in the question itself. The project leaders were also coded by whether they reflected interest in impact on participants (at the individual level), program and program development, community, or general/ unspecified impact. While most ‘education impact’ questions were at the participant level, and most others were unspecified, there were a large number of “evaluation & outcomes” questions at the ‘community-level,’ such as, “aside from reaching pre-established goals, how can a ‘win’ be measured on a community-level?,” “Definitely community-level outcomes, particularly in terms of effects on attitudes and behaviors of local people,” “indirect = friends/family of volunteers and ‘educated’ students,” and “community-level, with particular emphasis on education and community outcomes.” Below are other examples of questions in each category:

Questions about the impacts of PPSR...

On Education

- Assess the educational impact of projects
- what can you NOT learn through citizen science projects effectively?
- It would be interesting to learn what volunteers get out of citizen science projects. Do they learn more?
- Does it really increase science literacy?
- informing about the immediate marine issues

- How well does citizen science prepare individuals for professional work in the field?

On Behavior, attitudes, views, etc.

- [Do they] become more engaged, become a more active volunteer as a result of citizen science.
- Do citizen scientists carry their experiences into the community
- How does participation in citizen science programs impact the volunteer's thought process and daily actions/decision-making?
- level of participation
- evaluate the impact of their experience on their wellness? Are they better for being CS'ers?
- how do they influence those around them
- Are they changing the views of the community in regards to the study?

On Ecological Health

- are we fostering population stability for our target species?
- Conservation effects

On Science Research

- How do you evaluate contribution to science?
- How many papers published with PPSR results?
- I'd like to know if there are more examples comparison studies with professional researchers;

Evaluation / Outcomes

- I would like to have a \$ value placed on these projects: how much is my or other activities worth?
- we need to get more publications out looking at the effectiveness of citizen science? how effective is it?
- How are CS participants and communities evaluated from a demographic perspective?
- community level outcomes for many projects.
- Aside from reaching pre-established goals, how can a 'win' be measured on a community-level
- I would like to know more about projects, with honest evaluations of what they did and didn't achieve

On Policy & Management

- Impact on environment (new policies / protections);
- How can citizen science project change or inform transportation policy?
- any other citizen science data being used to aid in management decisions

Questions about PPSR Practices & Processes...

Participant Engagement

- How can we engage the public
- What compels citizen scientists to participate in projects
- What are the best ways to get community involvement in a local citizen science project?

Sustaining Engagement

- Citizen Scientist Retention: You train them and how do you keep them coming back?
- How to keep them interested for long-term support?

Other Practices & Processes

- How can different projects (based out of different organizations) best work together to create larger conservation and/or research outcomes?

- How can you go from simple data collection to statewide policy change?
- What are the natural evolutionary phases of a CS project
- How do we best bring research goals and community needs/interest together?
- What type of tools are citizen organizations using to collect data?

Questions about how to fund or support PPSR work...

- Are there funding sources that could be used to pay for such projects?
- Why sustainable agency funding is not available when these types of efforts are so effective

Questions about other topics in PPSR...

Other

- Is citizen science sustainable as a long-term research model?
- Which term is preferred citizen science or public participation in scientific research?

Perception & Promotion of PPSR

- How do we raise awareness and promote the importance of citizen science?
- How is citizen science gaining respect in the scientific community?
- Do professional scientists appreciate the work that citizen scientists are doing?
- Do CA schools and/or the next gen science standards value citizen science?

Pros/Cons of PPSR

- I have heard more people saying we will just get volunteers to do that but there are some downsides in having volunteers gather research.
- What are the pros/cons to using volunteers versus trained professionals (aside from the obvious?); What are the successes and failures of PPSR?
- What is the cost-effectiveness of citizen-science projects vs. projects conducted by paid staff

Data quality & use

- How is data collected through citizen science programs being utilized
- How reliable is the information gathered from citizen scientists?
- Do researchers have the need [for CS data]?
- What are some good strategies to minimize error or variability?
- What happens with their data? (does it go into a black hole?)
- Is [data] communicated to the public?

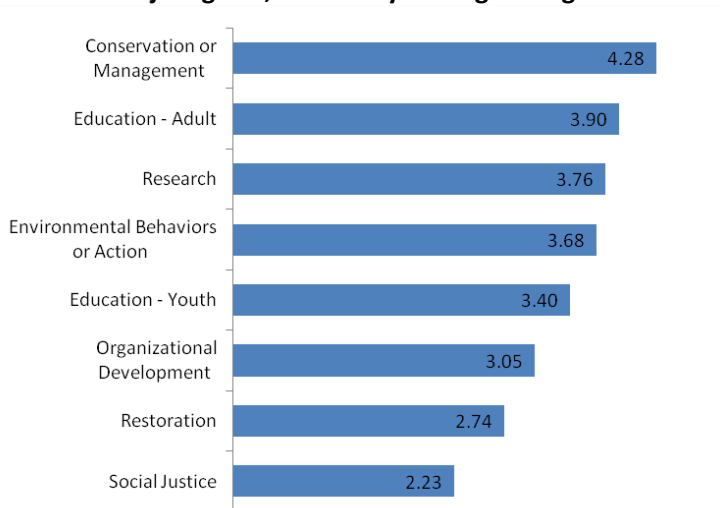
Project Goals

“Please indicate which of these goals are important to your project, if at all”

To understand what kinds of goals project leaders prioritized, we asked both open-ended and “Likert-type scale” questions.

Date note: In the Likert-type scale question, project leaders rated each of 8 general categories of goals as *Not important, Somewhat important, Not sure, Very important, or Most important*. In analysis these were assigned values of 1-5. Based on these values, the average ‘weight’ across all goals was 3.38. The data indicate that most projects work toward multiple goals.

Project goals, ranked by average ‘weight’



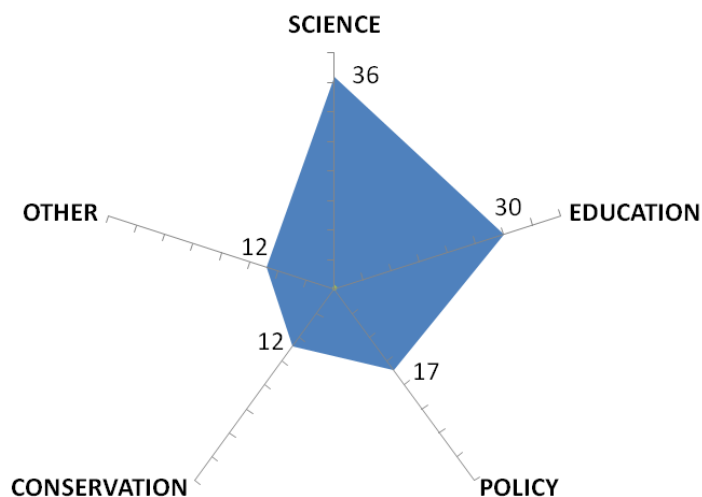
“Please list your project's primary goals”

In response to the open-ended question, respondents listed a wide range of goals, showing again that many PPSR projects work toward scientific as well as environmental and social goals. Contrasting with the Likert-type scale data, this shows Conservation & Restoration to be a slightly lower priority goal, compared to science research and education.

Data note: The summary table shows that organizations that mention Research and Education often have more than one goal in these categories. Examples of respondent goals categorized under each goal type follow.

PPSR Goals, by category

weighted by how many project leaders mentioned each



Goal Type	# respondents that mentioned this goal	# goals in this category	Avg. # goals/project in this category
Scientific Research	36/ 82%	54	1.5
Education & Training	30 / 68%	49	1.6
Conservation & Restoration	12 / 27%	14	1.2
Other	12 / 27%	14	1.2
Policy & Advocacy	17 / 39%	17	1.0
Overall	44 / 100%	148	3.4

Examples of respondent goals, listed by category:

SCIENCE

Scientific research: Species (20 goals) - *research that targets a particular species or set of species*

- How is Sudden Oak Death different by region/weather
- Estimate the population of a near threatened bird species
- Learn more about the behavioural patterns, biology, and ecology of the Sacramento Valley red fox
- Track shorebird use of study area
- Annual daily monitoring of fall raptor migration through ground counts, banding studies, radiotracking, and cell phone tracking studies

Scientific research: Conditions (34 goals) - *research that looks at multiple indicators in an area or type of ecosystem*

- Long-term database of intertidal ecology
- Document new and historical rare plant occurrences throughout California.
- Generate a public database for marine observations.
- What lives in urban natural areas
- Measuring PM and diesel pollution
- Identify pollution sources and potentially illegal activities (spills, wetland fill, diversions, discharges),

EDUCATION

Education – Science content (22 goals) - *education efforts related to science literacy or the project's target issue, region or system being studied*

- For students to have the opportunity to participate in and learn from citizen science research.
- raise awareness about the impacts of flooding events and potential impacts of future sea-level rise.
- Increase understanding of how plants change through the seasons;
- Community to become familiar with this resource
- To promote careers in the conservation field, and what a refuge is about.
- To introduce children and their families, especially underserved families, to their local outdoor spaces

Education: Engagement & training (20 goals) - *education efforts tied to preparing participants to use protocols or otherwise implement activities related to the project*

- Train citizen scientists in the use of entomological technologies and techniques
- Empower citizens to monitor their own air
- Connect people to nature through technology
- Engage these citizen scientists in real, high value conservation research that has a positive impact on this species

Education: Action (7 goals) - *education efforts toward preparing participants to act OUTSIDE direct project activities - either in their communities, in organization's other work, or independently, in the issue area*

- Introduce people to available disease control strategies
- Inspiring volunteers to continue and to share knowledge gained with newer volunteers and with the public.

POLICY

Policy & Advocacy (17 goals) -- education, advocacy, etc. efforts targeting community members or public NOT directly involved with the project

- Facilitate international collaborations (especially between Native Californians and Indigenous Australians) designed to promote public engagement and education about indigenous land use practices and how these can inform contemporary resource management systems and conservation efforts
- Communicate information to other stakeholders and members of the public.
- Help generate a conservation management plan.
- Inform policy, management, and financial investment in reducing road-kill
- Empower citizens to put pressure on local decision makers
- Disseminate information to public educational institutions and the general public.

CONSERVATION

Conservation & Restoration (12 goals) – *work to protect or restore ecological health to a habitat, system or area*

- Connect two disjunct breeding colonies of *Collophrys viridiris* (The Green Hairstreak)
- Reduce detrimental interactions of people with wildlife (and habitat)
- Pollinator conservation
- Protect sea otter habitat
- Inspire the conservation of California raptor populations.

OTHER

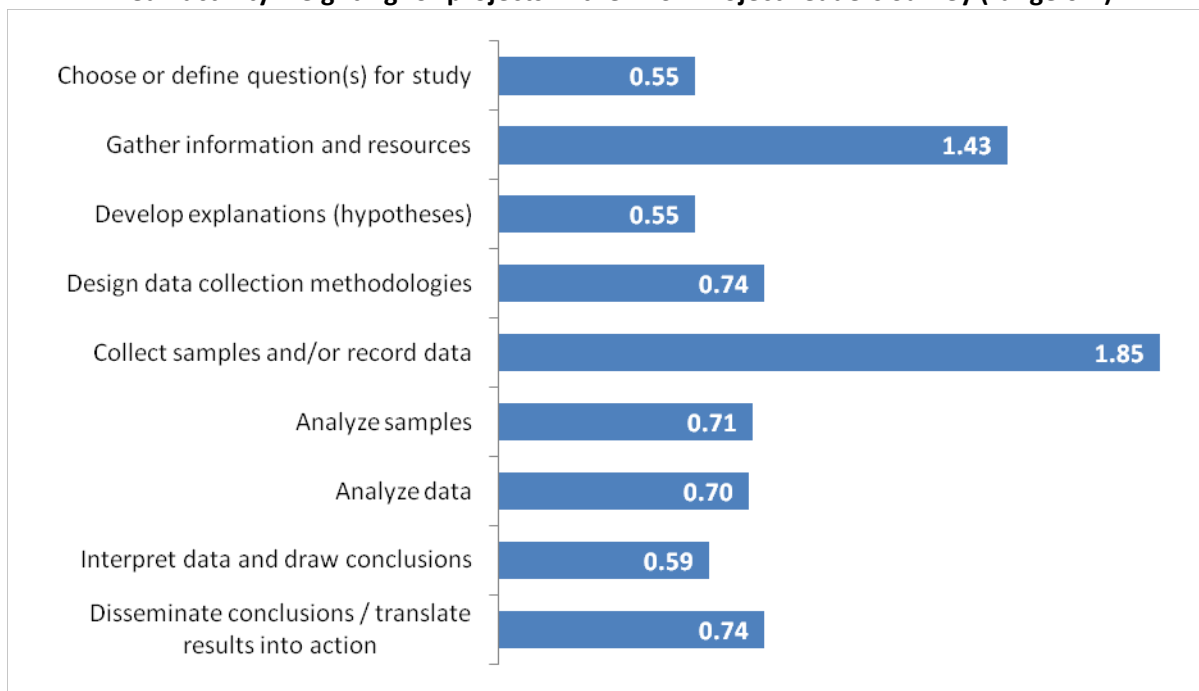
Other goals & objectives (12 goals)

- Assist in early detection of mass mortality events;
- Facilitate international collaborations (especially between Native Californians and Indigenous Australians) designed to promote public engagement and education about indigenous land use practices and how these can inform contemporary resource management systems and conservation efforts
- Establish an early detection network for invasive species.
- Design scientifically credible studies

Participant activities

Because we suspect that science learning, and other outcomes for participants, is partially due to the ways in which people participate in the scientific research process, we asked project leaders to select the stages of the scientific process in which people participate in their project.

Mean activity weighting for projects in the PPSR Project Leaders Survey (range 0-2)



Data Note: “Activity weighting” represents the relative number of project participants that engage in a particular activity. We asked for each activity, 0 = no participant; 1 = some participants; 2 = all or most participants. In the survey, mean “activity weighting” across these ‘stages in the scientific process’ is 0.87. Also, it is important to note that the high weighting on “gather information” may reflect ambiguity in the survey wording. Some respondents may have interpreted this as ‘gather data,’ not a pre-data collection stage of research and resource development, as it is described in Bonney, et al. (2009).

Projects

	No Volunteers	Some Volunteers	All/Most Volunteers	[blank]
Choose or define question(s) for study	27	10	7	
Gather information and resources	6	14	24	
Develop explanations (hypotheses)	25	15	4	
Design data collection methodologies	17	21	5	1
Collect samples and/or record data	0	7	37	
Analyze samples	19	19	4	2
Analyze data	20	19	5	
Interpret data and draw conclusions	23	16	4	1
Disseminate conclusions / translate results into action	21	12	10	1

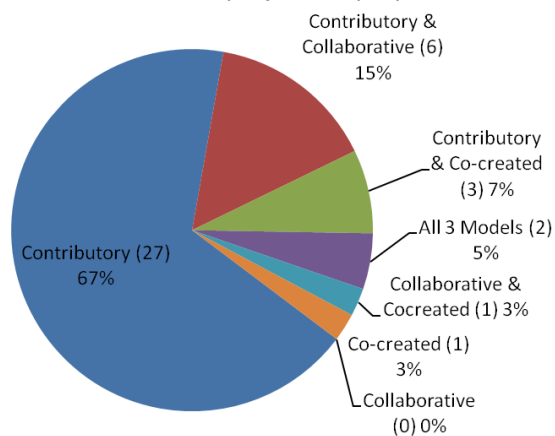
Mean activity weighting by type of organization type

Organization Type	# of organizations in survey	Mean activity weighting
Other	2	11
Other Research Institution	8	11
Community Based Organization	4	10
Conservation Organization	13	7
Government Agency	5	6
University or College	5	6
Museum or Science Center	3	5
Grand Total	40	8

Data Notes: We found that more than half of projects had no volunteers participating in the research stages of “Defining questions”, “Develop Hypotheses”, and “Interpret Data.” Almost all projects had volunteers collecting data, and many had volunteers gathering information (though again this latter may be from unclear wording in the survey). This is consistent with the national trends in citizen science that focus activities for participants on data collection rather than earlier or later stages of the research process. This is an evolving issue and question in the fields of science and environmental education, as we consider that more involvement in the inquiry process, and in determining the question and interpreting the results, may play an important role in both science learning and environmental stewardship actions related to the project. This evolution may be indicated in the additional finding that nearly half of the projects had *some* (not ‘all or most’) participants, involved in “designing collection protocols”, “analyzing samples after collection”, and analysis of data. This shows the potential for a multi-level structure for participants to choose how intensively they want to be involved.

Classification of projects from the Survey into the 3 Models of PPSR

We also used this to categorize programs, where participation in multiple stages in scientific process can indicate whether a project employs a “contributory,” “collaborative” or “co-created” model.

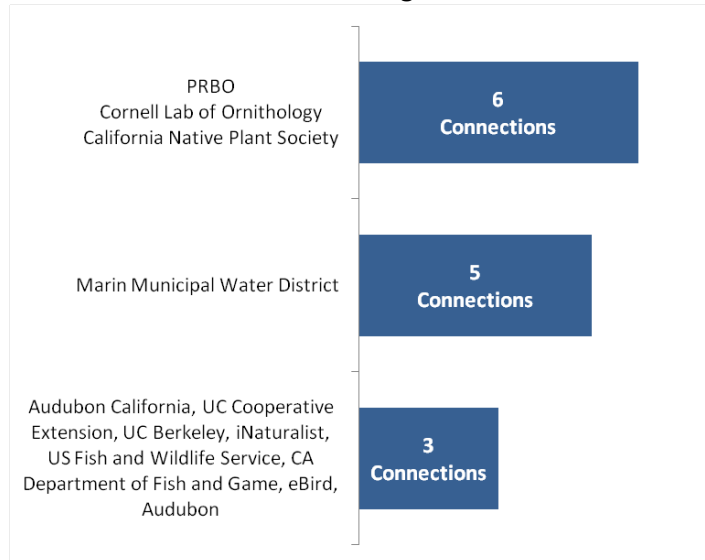


Northern California Networks

“Please tell us 5 key organizations or people have influenced your work in citizen science/PPSR (whether they are focused on citizen science/ PPSR or not)?”

Responses to this question showed that a wide variety of people and institutions are influencing PPSR in Northern California. From the 35 respondents who answered this questions, 115 different organizations were mentioned. The project inventory above provides a look at what Northern California’s PPSR network and collective impact might look like – from the web. This initial network data shows another perspective – from those working actively in PPSR. Connections range from local projects and organizers, to national institutions and agencies, to international authors and activists.

Most influential organizations



Here are a few of the influences mentioned, in no particular order:

- Paul Maslin, CSU Chico, Big Chico Creek Ecological Reserve
- Erick Burres, Clean Water TeamState Water Resources Control Board
- Golden Gate Raptor Observatory
- eBird, Cornell Lab of Ornithology
- Melissa Miller, CA Department of Fish and Game
- Julia Parrish, University of Washing/ COASST
- Megan Isadore, River Otter Ecology Project
- Rick Bonney, Cornell Lab of Ornithology
- Global Community Monitor
- Hilton Kelley, environmental activist
- Margie Richard, environmental activist
- Audubon Canyon Ranch
- Paul Hawken, author
- Carter Faust Golden Gate Raptor Observatory
- PRBO
- Trena Noval, artist & teacher
- Laura Dabbish, Carnegie Mellon University, Human-Computer Interaction Institute
- Community Forestry and Environmental Research Partnerships Program, UC Berkeley
- Center for Ecosystem Survival
- Jim Carlton, Mystic Seaport
- Ushahidi
- Terry Gosliner and Alison Young, California Academy of Sciences
- Gretch Lebuhn, San Francisco State University
- Adventurers and Scientists for Conservation
- National Fish and Wildlife Foundation
- Kid Zone Museum
- Five Creeks Restoration group
- Wild Equity
- Xerces Society
- Georgetown Divide Resource Conservation District
- Western Education Summit (WES), Youth watershed work
- Center for Land Based Learning
- USGS
- iNaturalist

Data note: Where individuals were listed, the organizations with which they are affiliated were added to the organization list. Individuals and subprograms were analyzed separately, but none had greater than 2 connections. Number of connections per response ranged from 0-10, with the mean number for connection (not including respondents who left the question blank was 4.5).

What is not here

Additional questions from the PPSR Project Leader Survey provide yet more insight into how PPSR has taken shape in Northern California, but have not been analyzed thoroughly enough to present here.

Open-ended fields in the inventory

- Project Challenges: “What are 3 key challenges that you face in meeting your goals for citizen science work?”
- Project Evaluation: “What kind of project evaluation or assessment, if any that you’re aware of, does your project do?”
- Other participant activities: “Describe any other notable project features or volunteer activities”
- Project Purpose: What is the scientific research purpose or environmental question your project addresses?

Preliminary Final Thoughts

By focusing on Northern California, we are identifying as the full range of PPSR projects, from large initiatives on the national radar to very small projects, from web-driven to those built through neighborhood connections around local issues, including projects that may not call themselves “PPSR” or citizen science. By creating an in-depth inventory of a particular region we gain an understanding of what the cumulative efforts of PPSR practitioners in Northern California look like. Doing so will allow us, in partnership with project leaders, (a) to learn where best to target future efforts in the field and research, and (b) to relate environmental, educational, social outcomes to program typologies and characteristics of the field overall. In particular, we hypothesize that PPSR work in the region has cumulative impacts on the ecological and social communities in Northern California.

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