**SPOTLIGHT**

# Capacity Building with Volunteers: Divers and Boaters Collect Data on Southern California Bight

By Craig Gelpi, David Kushner, Andrew Solomon, and Sean Eckley

## INTRODUCTION

"The science we need for the ocean we want" (IOC, 2020) may be more science than we can afford unless we devise additional cost-effective ways to produce it. Much of the science we need may require local knowledge and skills that are difficult to generate at scale. Global problems, such as ocean acidification, may be lessened by using site-specific solutions that require knowledge of local oceanography. Similarly, implementing solutions to local problems, such as pollution and fisheries sustainability, will require local knowledge and skills that cannot immediately be drawn from global capacity. Supplying the know-how for inexpensive staff and scientific gear to achieve these solutions may be part of capacity building and sharing in the UN Ocean Decade.

The Catalina Marine Society (CMS) provides one model for scaling the required effort. The Society's mission is to emphasize the use of volunteers to increase knowledge of physical oceanography of the Southern California Bight off Los Angeles. Its work includes designing research projects, recruiting field volunteers and analysts, securing funds for instrumentation, executing fieldwork, archiving data, performing data analysis, and publishing results in peer-reviewed venues. The Society is a registered nonprofit that strives to be transparent and accessible, characteristics that are important to volunteers. We describe our processes below.

## PROCESSES

CMS projects must be designed to both appeal to and accommodate volunteers, yet provide useful scientific data. We have found that the most effective use of volunteers is for deploying and retrieving automated, long-duration, data-recording sensors. These sensors collect at-depth time series of temperature, conductivity, pH, chlorophyll *a*, dissolved oxygen, water level, and horizontal current. Long-duration automated sensors mitigate schedule constraints and requirements for uncommon skills.

Recruiting field volunteers is relatively easy. There are many ocean lovers with specialized skills, such as scuba diving and boating, who are eager to take these skills beyond recreation. Lectures on ocean topics presented during meetings that support these sports offer a nice change from the usual lineup of vacation or regatta topics, and they provide opportunities to discuss the need for volunteers to support marine research.

Many of our volunteers are professionals. Many have undergraduate degrees in some aspect of marine science (marine biology is popular) but have never worked in the field, instead pursuing law, finance, construction, or other careers. Their practical knowledge is invaluable, as they provide transportation to islands and other locations of oceanographic interest and deploy instrumentation.

Many organizations that could benefit from divers and boaters are leery of doing so because of perceived liability for dangerous undertakings. For that reason, CMS is not a diving or boating organization. We are not responsible for a diver's behavior, equipment, training, schedule, or other factors that may affect safety. The volunteers alone determine how and when they will dive. We only furnish the sensors and suggest where they should be sited. The volunteers' efforts are compensated with satisfaction and possible tax deductions.

We also partner with organizations that use volunteer divers, including the National Park Service (NPS), which has included volunteers among its Kelp Monitoring Program staff; the California Science Center (CSC); and the Aquarium of the Pacific (AoP). NPS recruits volunteers using word of mouth, meetings, and university connections, while CSC and AoP present at local dive clubs, enthrall visitors with exhibits where divers are working, and have website visibility. The ages of volunteers range from twenty-somethings to over 70. Depending on the project, divers can be trained while working in the field or by dive safety staff. Although they often work explicitly on CMS projects, many of their programs collect more data than can be analyzed by the resources funding them. We step in with our analytical capabilities to extract more results from their data in a process that increases collaborative ties.

Recruiting volunteer data analysts and researchers is more difficult. Besides maintaining a website, we present at citizen science and technical symposia. Here, we meet people who wish to contribute in some productive way, whether it is helping with the website or organizing and uploading data, as all quality-assured data we collect can be retrieved by the public from our data portal (https://www.catalinamarinesociety.org/data-portal.html). Occasionally, we will get a student who wants to do a research project, and we suggest ideas and provide data and guidance. The most difficult volunteers to find are those with PhD-level domain knowledge. We do engage such volunteers by presenting at venues such as the biannual Ocean Sciences Meeting.

There is a large and growing pool of non-ocean scientists who may find satisfaction in understanding our ocean, including retired and defense scientists. Such retirees are increasing in number, vigor, and wealth as the US population ages. The defense scientists represent a pool of talent who cannot bring their day jobs home with them. They have expertise in digital signal processing, engineering, research, and perhaps ocean sciences. Importantly, many have skills in program definition and management, so they understand the components required for successful projects. If even a small fraction of the 300,000 civilian STEM employees in the defense industry (https://www.dodstem.us/impact/) were to volunteer, they would significantly expand the several thousand people working in US marine science. Although individuals can be enticed through lectures and conferences, this is impractical for many volunteers unless they are retired, because they have weekday commitments, and using vacation time at professional pay grades to attend meetings may be impractically expensive.

The ocean community can help by holding lectures and presentations describing ocean issues during weeknights and weekends, as Scripps Institution of Oceanography has done. If the lectures are recorded, they can be viewed at the convenience of potential

volunteers. Specific topics such as ocean acidification and marine heatwaves can be introduced to a general, but interested, audience, and volunteer organizations that work in the area could be mentioned to facilitate recruitment.

Retaining volunteers is most important, and they appreciate our efforts to inform them about what science we are trying to accomplish, often by sending them resulting publications. They can point to a published scatter plot and know what dots they have contributed. We have received many comments from divers and boaters showing appreciation when they see the results of their work.

CMS funds its scientific sensors and their calibration and maintenance mostly from grants. Many private foundations grant resources to recognized nonprofits engaged in volunteer ocean research. Applying for and obtaining these annual grants, along with securing other private donations, also funds licenses, permits, and other legal-requirement costs related to placing instruments in the ocean. For a fee, there are firms that will supply an evolving list of foundations that support relevant work. However, supporting multiyear programs using yearly grants is awkward, as evidence of success, for example, peer-reviewed research, may take years to produce. Therefore, we document intervening activity through articles for local newspapers describing program field expeditions.

**FIGURE 1.** Diver Thomas Arklie is shown locating the David Tsao Continental Thermograph Array shallow sensor at Point Dume in Malibu, CA, USA. *Photo Credit: Andrew Solomon*

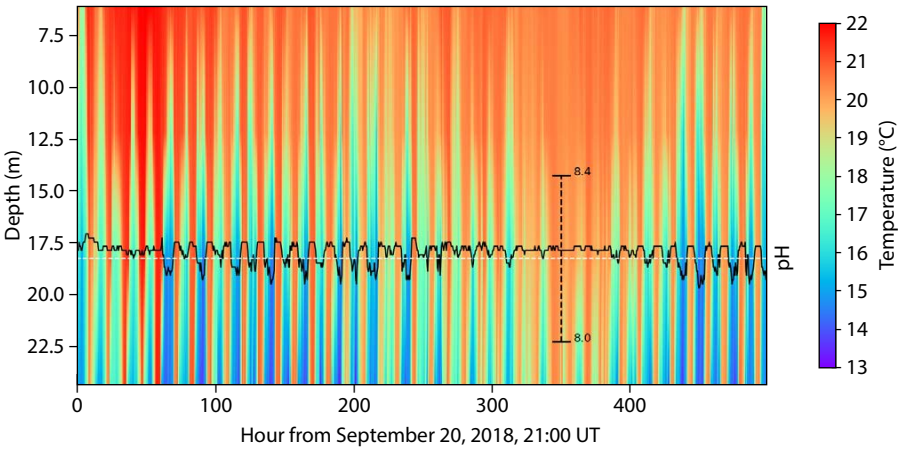


**FIGURE 2.** Data obtained from the Catalina Marine Society's Dirk Burcham Scientific Mooring show the influence of internal waves on pH.

## RESULTS

What capability and success does this activity bring? Experienced boater/diver/analyst teams are established that can collect unique data cost effectively. For instance, we have analyzed a decade of hourly ocean temperature measurements collected by volunteers at multiple sites and depths around Santa Catalina Island to compute vertical eddy diffusion (Gelpi and Norris, 2008). We maintain 12 years of publicly accessible, diver-collected temperature data measured off the nearby mainland (**Figure 1**). Much can be learned by combining these measurements with data available through government infrastructure, such as satellites and buoys. Our mainland data give us a view of coastal upwelling that nearby buoys cannot (Gelpi 2023a). Similarly, repeated expeditions to Santa Catalina Island to gather chemistry data (**Figure 2**) have enlightened us regarding how internal waves bias pH, and a recent open-access publication (Gelpi, 2023b) analyzes these CMS data, which are available for download with the paper.

Hundreds of divers and boaters have volunteered for CMS and its predecessor over the last 30 years. An audit of one project indicated that 77% of the resources used were donated by volunteers. Replicating the CMS model worldwide could make a significant contribution to capacity building in the UN Decade of Ocean Science for Sustainable Development (2021–2030).

## LESSONS LEARNED

In advancing oceanographic knowledge of the Southern California Bight using volunteers, we have learned to design projects that use their boating, diving, and geographic knowledge skills while accommodating their schedules; to be transparent as to goals, methods, and results in order to excite and keep volunteers; and to publicize research activity that is ongoing between scientific publications.

## REFERENCES


Gelpi, C.G., and K.E. Norris. 2008. Seasonal temperature dynamics of the upper ocean in the Southern California Bight. *Journal of Geophysical Research: Oceans* 113(C4), https://doi.org/10.1029/2006JC003820.

Gelpi, C.G. 2023a. Wind-event-induced ocean upwelling, relaxation and chlorophyll response in the Southern California Bight. *Bulletin of the Southern California Academy of Sciences* 122(2):80–100, https://meridian.allenpress.com/scasbulletin/article/122/2/80/494521.

Gelpi, C.G. 2023b. Dynamics of pH at Santa Catalina Island. *PLoS ONE* 18(12): e0290039, https://doi.org/10.1371/journal.pone.0290039.

IOC (Intergovernmental Oceanographic Commission). 2020. *The Science We Need for the Ocean We Want: The United Nations Decade of Ocean Science for Sustainable Development (2021–2030)*. 19 pp., https://unesdoc.unesco.org/ark:/48223/pf0000265198.


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