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Vessels of Opportunity in Marine Science Outreach and Education: Case Study and Caveats

COMMENTARIES AND LETTERS TO THE EDITOR

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ABSTRACT

Studying unexpected, ephemeral, or transient events in ocean ecosystems, such as gelatinous zooplankton blooms, is important because it provides us with valuable data on how our oceans may be changing in response to climate change and other anthropogenic activities. However, planning for such events is nearly impossible and making use of opportunistically acquired data allows the marine science community to be adaptive and efficient given the logistical and financial constraints of time at sea and in the field. Because such sampling events are often responsive rather than planned, they are typically not accompanied by outreach and education efforts. This commentary considers if opportunistically acquired data sets can be applied to generate opportunistic outreach and education activities. A case study is provided with successes and caveats outlined.

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INTRODUCTION

Across ocean ecosystems, unexpected, ephemeral, and transient (UE&T) events frequently occur, often in response to anthropogenic activities, natural disasters, or atypical environmental conditions. Examples of such events include gelatinous zooplankton blooms, mass die offs of organisms (e.g., whale strandings, or loss of site-specific kelp forests), and large-scale glacial calving. Documenting UE&T events is critical as it provides insight into how the ocean may be changing and how organisms may respond. However, studying the ocean at-large, and UE&T events in particular, is limited by the logistical and financial constraints of field research. With such constraints in mind, the marine science community has developed novel and efficient means of increasing the chances of observing a UE&T event by taking advantage of opportunistic data collection. For example, some research groups rely on community science sightings and reporting to gather data (e.g., Bruce et al. 2014, Mwango'mbe et al. 2021); while others make use of "Vessels Of Opportunity" –such as merchant, tourism, and recreational ships– as platforms for autonomous oceanographic equipment (Rosa et al. 2021). Additionally, federal (e.g., National Science Foundation) and non-governmental entities (e.g., National Geographic Society) often provide money to fund quick response research to UE&T events, though because such events are often hard to predict, this route is not always as effective. Opportunistic data collection has also proven vital to the marine science community when scientific operations are temporarily halted, such as during the COVID-19 pandemic.

While the opportunistic collection of marine science data has been used effectively for some time, there has been little attention to the use of these opportunistic datasets by the marine outreach and education (O&E) community. Can unplanned, opportunistic research successfully include O&E activities as part of their larger project; and can educational opportunities that take advantage of unplanned research be viable options for O&E platforms to employ? This commentary provides a case study of the application of opportunistically gathered data from a UE&T event to numerous O&E activities in diverse mediums. While this case study provides an example of the successful implementation of unplanned data to opportunistic O&E activities, we also acknowledge the caveats of its success, limitations of such a model, and takeaways for educators and researchers.

CASE STUDY: PROJECT SWARM'S ANTARCTIC DATA IN OREGON

In early 2020, the National Science Foundation-funded team, Project SWARM, observed an anomalous bloom of the gelatinous zooplankton, *Salpa thompsoni* (salps), while deploying equipment near Palmer Station, Antarctica. The research team took advantage of the unexpectedly high number of salps during the bloom and used nets, acoustics, and video recordings to collect samples at high resolution.

Prior to the salp bloom, Project SWARM team members developed a multi-year education program plan as part of the broader impacts of their research project in partnership with Polar Interdisciplinary Coordinated Education (Polar-ICE; now the Polar Literacy Project; https://polar-ice.org/) that would work with middle and high school groups from New Jersey, Delaware, and Oregon (https://polar-ice.org/swarm-2019/). Unfortunately, due to budgetary constraints, the proposed outreach in Oregon was canceled. Within the first few months of the COVID-19 pandemic, it quickly became evident that remote education opportunities would be critical. This presented an opportunity for Project SWARM to reimagine the Oregon O&E program in a way that would not involve any additional costs to the grant.

Project SWARM researchers from Oregon State University reached out to Oregon Sea Grant (OSG) with the broad goal of working with educators throughout Oregon (at a larger geographic scale than originally proposed) and supporting them in adapting to a virtual environment, with a researcher-educator partnership established between the two groups in April 2020. While the partnership initially planned to use Project SWARM science and experiences in one virtual OSG program, participant interest and partnership needs resulted in the augmentation of the partnership. Revised partnership goals included: (1) development of formal classroom products that made use of Project SWARM science and experiences and that fit into pre-existing education frameworks (Next Generation Science Standards, Common Core Standards, Oregon Department of Education Standards), and (2) development of broad O&E activities rooted in

Antarctic data and stories that could be used opportunistically with varied programs identified through the established researcher-educator partnership. While the partnership resulted in the generation of a four-lesson curriculum for K-5 classrooms (Hann, 2021), the real success of the partnership came from the application of broadly designed activities using Project SWARM data and experiences from the field to numerous O&E programs. These included six Oregon Sea Grant programs, and more than five other group and one-on-one engagements (Table 1).

Table 1 Summary of programs generated opportunistically from Project SWARM data and field experiences. Types of programs, number of programs per type, number of participants per program, program format, target audience, and geographic extent of program impact are noted.

PROGRAM TYPE	NUMBER OF PROGRAMS	NUMBER OF PARTICIPANTS	FORMAT	TARGET AUDIENCE	GEOGRAPHIC EXTENT
Webinars/ online speeches	2	35, 80	Virtual	Variable	Across the U.S. with a heavy presence from Oregon
Summer camp	3	15, 18, 19	Virtual and in-person	Campers grades 4–12	Across the U.S. with a heavy presence from Oregon
Homeschool program	1	23	Virtual	PreK-3 homeschool unit	Oregon
Research experiences	4	n/a	Variable	Undergraduate and graduate students	Oregon, Utah, Philippines
Formal curriculum	1	n/a	Open source, online	K-5 grade educators	n/a

EXAMPLE PROGRAMS

During an installation of the OSG Careers in Science Webinar series, participants were taken on a virtual journey to Antarctica via immersive photos and videos, and explored the role of a marine biologist as a vital member of the Project SWARM field team (https://www.youtube.com/watch?v=L3e_CueXKxw&list=PLNch-nxPOrl4Gv6J4hD-mFSKGQU-caMq8&index=22). Thirty-five unique participant groups (one to three individuals) joined in from across the country. During virtual summer camp sessions in 2020, that same journey was used to expose a group of 15 campers (ages 15-18) from across the U.S. to thermohaline circulation and global ocean currents (Supplementary File 1). Campers used at-home materials, such as food coloring and water of varied temperatures, to simulate currents. This demonstration served as a hook for campers to then learn about the techniques Project SWARM used to study ocean currents and how currents drive zooplankton movement.

To increase polar literacy among younger virtual campers (ages 8-10), who may not be as familiar with polar habitats, the 18 campers first explored marine food webs of the more familiar habitat of their local Oregon rocky intertidal zone (tide pools). Investigating the food web of a more accessible habitat served as a tool to increase general understanding of predator-prey interactions in a food web before exploring similar interactions in polar food webs. After learning about polar food webs, camper knowledge was evaluated using a "Scientist Says" (similar to "Simon Says") virtual game, in addition to interactive at-home activities. Students would perform pre-established actions that mimicked the feeding or locomotion strategies of different organisms in the polar food web when "Simon" named the organism. At-home activities further reinforced awareness of predator-prey interactions and polar food web organisms (Supplementary File 2). These activities were modified to expose pre-kindergarten to third grade homeschool students to exciting Antarctic science.

By 2021, in-person summer day camps resumed, and activities were adapted accordingly. To capitalize on recent observations of gelatinous organism blooms washed ashore on Oregon beaches (National Geographic 2017, Oregon Public Broadcasting 2017), campers (ages 8-10) in the "nature discovery" camp identified the characteristics unique to jellyfish and other gelatinous organisms using mainstream information gained from movies and aquaria/zoos. Then, using video footage from observed gelatinous blooms off Oregon and Antarctica, campers learned how to identify and count gelatinous organisms (Supplementary File 3). This offered participants a career-connected learning opportunity, as the activity simulated how a Project SWARM researcher may quantify the presence of salps.

SUCCESSES AND CAVEATS

Following the observation of an unexpected salp bloom in Antarctica and onset of COVID-19 in the beginning of 2020, Project SWARM set out to establish a researcher-educator partnership that would broaden the geographic application of Project SWARM's science to O&E activities, while lessening the burden placed on educators to adapt their lessons to a virtual environment. After successfully solidifying a researcher-education partnership between Project SWARM and OSG, the partnership applied UE&T event data to more than 10 opportunistic O&E activities for over 160 learners from pre-kindergarten to adults, and the development of a four-lesson elementary school curriculum (Table 1).

Participants demonstrated comprehension of the material and increased understanding of and interest in the Antarctic and research process through their responses to the programs. This included verbal participation, completion of activities, and questions/comments on the materials posed by participants. Participant responses to online post-program surveys also helped gauge participant gains. With regards to the summer camp programs, positive sentiments were expressed toward the program materials, speaker engagement, and functionality of the virtual platform; however, online survey response was low. The majority of campers responded "strongly agreed" or "agreed" to the question "would you refer a friend/would you attend again?" Interestingly, multiple campers in the (ages 15-18) year-old session noted their favorite part of camp was speaking to marine science professionals or wished there was more time for that. Campers provided separate feedback on take-home activities with none expressing negative sentiments. Responses ranged from "it was ok" to "it was cool" with regards to the Project SWARM take home activities; however, multiple campers noted they did not have time to complete all take-home activities. Responses to the online survey for the homeschool program were also positive. Respondents noted they "loved it." One respondent noted they most enjoyed "the grad[uate] student's presentation [on Project SWARM work]." For the Careers in Science webinar, most noted they were more interested in marine careers in post-program survey responses. All verbal feedback received across programs was very positive. Given many of these programs were the first iteration of a virtual program or had never occurred before, sheer participant presence and involvement also served as a gauge of program impact. Through these metrics, the programs were deemed successful.

Nonetheless, there are many caveats to this success. Similar to the constraints that the marine science community faces in conducting field research, marine science O&E efforts are logistically and financially limited. Capitalizing on research from UE&T events (e.g., a gelatinous bloom), which may provide more timely and relatable materials for O&E activities, is increasingly difficult to do as such research is often not planned ahead of time. Additional barriers to the sustained success of O&E include the recognition of O&E efforts by the scientific community as essential to research projects (Leshner 2007, Provencher et al. 2011, Johnson et al. 2014), the long-term viability of successful O&E projects (Salmon and Priestley 2019), limited availability of quality data on O&E (from a geosciences perspective; Laursen et al. 2007, Provencher et al. 2011, Johnson et al. 2014, Salmon and Priestley 2019), and recognition of and appropriate training for experts in science and O&E (Leshner 2007, Provencher et al. 2011). For future successes in the application of opportunistically gathered marine science data to O&E activities to occur, such barriers must be surpassed.

TAKEAWAYS FOR EDUCATORS

UE&T data should be viewed as a viable educational resource for O&E programs. Other programs have developed tools and networks for UE&T data to be recorded (and potentially used) by any observer. Example tools include Jellywatch (jellywatch.org), which encourages anyone who observes jellyfish and other marine organisms to document their sightings online; and iNaturalist (inaturalist.org), which can identify organisms from uploaded photos and collect and collate sightings for research. Research groups have also developed more nuanced tools to allow community scientists (such as educators and their students) to collect and collate data sets for specified research projects. Example programs include Plankton Portal (https://www.zooniverse.org/projects/kelseyswieca/plankton-portal), where online volunteers help classify plankton from images collected via a macro-camera system towed behind research vessels; and FISHstory (https://safmc.net/citizen-science/fishstory/), where volunteers identify

and enumerate fish in historic photos from anglers. Such tools require minimal training of participants, benefit research, and can be incorporated into formal and informal O&E.

Researcher-educator partnerships can take many forms. Early career scientists (e.g., graduate students) can be effective facilitators of K-12 grade O&E activities in such partnerships as they are often closer in age to the learners and thus can be viewed as more near-peer role models. Early career scientists also have different professional commitments than seasoned researchers, which can make them more accessible for developing and maintaining researcher-educator partnerships and O&E activities. Despite their status as "early career," such scientists still have diverse and robust experiences (in science and beyond) and should be viewed as viable candidates to form a researcher-educator partnership. The Project SWARM-OSG partnership also demonstrated that well thought-out, yet broad education plans can be successful when rooted in strong researcher-educator partnerships.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Supplementary Files.** Supplementary file 1 to 3. DOI: https://doi.org/10.5334/cjme.76.s1

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COMPETING INTERESTS

The authors have no competing interests to declare.

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REFERENCES

Bruce, E., Albright, L., Sheehan, S., & **Blewitt, M.** (2014). Distribution patterns of migrating humpback whales (Megaptera novaeangliae) in Jervis Bay, Australia: A spatial analysis using geographical citizen science data. *Applied Geography,* 54, 83–95. DOI: https://doi.org/10.1016/j.apgeog.2014.06.014

Hann, A. M. (2021). Southern Ocean science and society: case studies at the nexus of research, education, and policy (Master's thesis, Oregon State University, Oregon).

Johnson, D. R., Ecklund, E. H., & **Lincoln, A. E.** (2014). Narratives of science outreach in elite contexts of academic science. *Science Communication, 36*(1), 81–105. DOI: https://doi.org/10.1177/1075547013499142

Laursen, S., Liston, C., Thiry, H., & **Graf, J.** (2007). What good is a scientist in the classroom? Participant outcomes and program design features for a short-duration science outreach intervention in K–12 classrooms. *CBE—Life Sciences Education, 6*(1), 49–64. DOI: https://doi.org/10.1187/cbe.06-05-0165

Leshner, A. I. (2007). Outreach training needed. *Science, 315*(5809), 161–161. DOI: https://doi.org/10.1126/science.1138712

Mwango'mbe, M. G., Spilsbury, J., Trott, S., Nyunja, J., Wambiji, N., Collins, T., Gomes, I., & **Pérez-Jorge, S.** (2021). Cetacean research and citizen science in Kenya. *Frontiers in Marine Science, 8*, 642399. DOI: https://doi.org/10.3389/fmars.2021.642399

Profita, C. (2017). Massive bloom of pickle-shaped sea creatures fills the Pacific. *Oregon Public Broadcasting*. https://www.opb.org/news/article/massive-bloom-of-pickle-shaped-sea-creatures-fills-the-pacific/

Provencher, J., Baeseman, J., Carlson, D., Badhe, R., Bellman, J., Hik, D., Huffman, L., Legg, J., Pauls, M., Pit, M., & **Shan, S.** (2011). Polar research education, outreach and communication during the fourth IPY: How the 2007–2008 International Polar Year has contributed to the future of education, outreach and communication. Paris: International Council for Science.

Rosa, T. L., Piecho-Santos, A. M., Vettor, R., & **Guedes Soares, C.** (2021). Review and Prospects for Autonomous Observing Systems in Vessels of Opportunity. *Journal of Marine Science and Engineering, 9*(4), 366. DOI: https://doi.org/10.3390/jmse9040366

Salmon, R. A., & **Priestley, R. K.** (2019). Celebrating IPY Education, Outreach and Engagement – 10 years on. *Polar Record, 55*, 199–202. DOI: https://doi.org/10.1017/S0032247419000494

Welch, C. (2017). Bizarre, glowing sea creatures bloom in the Pacific. *National Geographic*. https://www.nationalgeographic.com/science/article/pyrosome-fire-body-bloom-eastern-pacificwarmwater#:~:text=Pyrosomes%2C%20meaning%20%22fire%20bodies%2C,down%20in%20the%20water%20column

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