COMMUNICATING SCIENCE THROUGH PRESS RELEASES TO NEWS MEDIA

The Case Study of What Is Controlling the Fabled Water Clarity of Lake Tahoe

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Transparent scientific discourse creates public trust of science and thus may support the use of science to develop policies to protect the environment. Scientific discourse commonly proceeds through independent peer review leading to scientific manuscripts that may guide management actions. Prior to peer review, institutions may release information via press releases which may be circulated near verbatim by news organizations and social media; these organizations have demands to produce content in a timely manner (Autzen 2014). If later found to be inaccurate, the resulting dissemination of information can impact public trust and alter science priorities to address environmental challenges.

Here, we address several factual issues we found in a press release (https://www.ucdavis.edu/climate/news/lake-tahoes-clarity-best-its-been-1980s-0, last accessed 15 April 2023) whose message highlighted the role of zooplankton as a dominant control of clarity. The release was picked up by many major media organizations (e.g., Wulfeck 2023) incorrectly presenting information to the public. In this commentary, we utilize openly available data (U.S. Geological Survey 2021; Watanabe and Schladow 2023), peer-reviewed science from Lake Tahoe (Bess et al. 2021 and citations there in) and concepts from the scientific literature to show that zooplankton are unlikely to have caused the recent water clarity improvement as stated in the press release. Instead, other factors override any effect zooplankton grazing might have on the Lake's clarity. We discuss potential best practices for institutions and researchers who have a sense of urgency to share findings via press release prior to submitting their work for independent scientific peer review and the media who shares this information.

KNOWN KNOWNS: CONTROLS ON LAKE TAHOE CLARITY

Scientific evidence from Lake Tahoe indicates the seasonal fluctuations in light attenuation and water clarity are seasonally controlled by non-living inorganic and organic fine particles (< 5 μm in diameter). The press release concludes grazing by herbivorous zooplankton (*Daphnia* and *Bosmina*) is an important control on particles which affect lake clarity. It claims that clarity increased in the summer and early autumn of 2022 due to particle filtration by cladocerans. This proposed mechanism of particle reduction leading to lake clarity increases is not supported by the data (Watanabe and Schladow 2023) and contradicts peer-reviewed scientific publications addressing Lake Tahoe's clarity.

The literature suggests grazing effects of zooplankton communities are strongest in lakes with moderate algal production, whereas nutrient poor Lake Tahoe has very low rates of primary production. These low productivity rates do not produce sufficient resources (food) required by the grazers to reach population sizes large enough to control algae. In addition, fine particle concentrations, known to control the lake's clarity, are not affected by zooplankton grazing and their nutrient excretion may stimulate algal productivity (Bess et al. 2021 and additional citations there in). The press release also discussed the role of the invasive mysid shrimp, suggesting their potential role in grazing their algal food supply. Looking closely at the lake's monitoring data, we see the number of mysids decline at the same time clarity is improving (Fig. 1) and previous research indicates that mysid shrimp are not efficient at clearing algal particles from the water. The May to December 2022 data from Lake Tahoe's long-term monitoring program (Watanabe and Schladow 2023) shows that fine lake particles decreased, and clarity improved prior to the increase in cladocerans in the lake (Fig. 1). Furthermore, during the peak density of cladocerans, no decrease in lake particle concentration or improvement in clarity was observed. Simply stated, the existing data collected by the University of California, Davis and current peer-reviewed science contradict the idea that grazer zooplankton control clarity as suggested in the institution's non peer-reviewed medial press release.

CLIMATE CONNECTIONS AND WATERSHED RUNOFF

While fine particles are implicated in the decline of clarity, clarity measured in the summer is declining faster than winter clarity (Naranjo et al. 2022). The decline of summer clarity is caused by reduced sediment inputs and lake warming which favor smaller phytoplankton taxa in the genus *Cyclotella*. The origin and fate of the particles in Lake Tahoe is determined by (a) watershed mediated-climate dynamics resulting in the delivery of nutrients and particulate matter from streams and urban runoff, (b) within lake processes including water column vertical stability, and (c) settling of particles from the upper water column. Watershed runoff depends on snow accumulation and snowmelt which deliver a large portion of the annual input of particles to the lake and the greatest change in clarity (Naranjo et al. 2022). The long-term (40-year) data from the watershed and lake show significant variability in the deviation of summer clarity and discharge from the lake's largest tributary (Fig. 2a). The variation of discharge and clarity are inversely correlated suggesting dependence of clarity on variations in the snowpack (Fig. 2b). In years with large amounts of snow there is a decrease in clarity, while in drier years clarity improves in the summer (Naranjo et al. 2022). Improvements in clarity during the summer of 2022 were likely caused by a protracted drought, leading to below normal inputs of sediment to the lake.

KNOWN UNKNOWNS: PARTICLE FATE, THE ROLE OF MICROBES, CLIMATE, AND LAKE PHYSICAL DYNAMICS

The roles of particle aggregation and vertical settling is important for determining the fate of particles once they enter the lake. Microbial communities play an important role in transforming particles and nutrients within nutrient-poor lakes. Studies from Tahoe show that microbes attach to non-living material are involved in particle aggregation. Settling velocity calculations based on Stoke's equations indicate that particle aggregation should lead to the enhanced particle export to deeper depths. There are additional within-lake and climatic processes which can modify the

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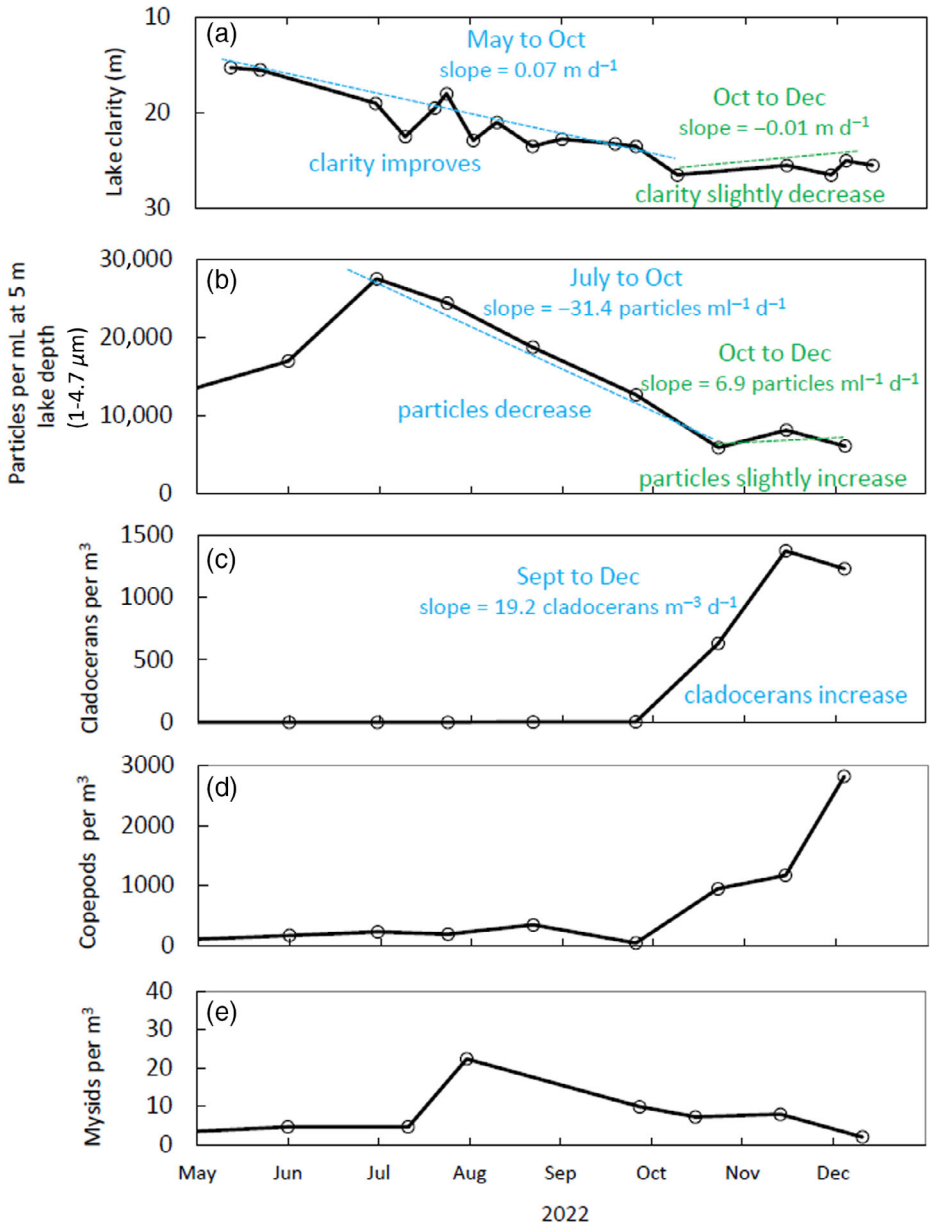

FIG. 1. Measured (**a**) lake clarity, (**b**) lake fine particles, (**c**) cladocerans, (**d**) copepods, and (**e**) mysids collected from lake Tahoe from May to December 2022 (Watanabe and Schladow 2023). Zooplankton were collected from a single site using vertical net tows from the upper water column. Herbivorous grazing zooplankton cladocerans have been implicated in improving the clarity. Note that the clarity began improving in May 2022 and the fine particles in the lake which control clarity are declining in July 2022, well before the increase in cladocerans in September 2022. Both lake particles and lake clarity did not decrease or improve during the period of highest cladocerans density, respectively.

microbial community and thus determine productivity and assist in the transformation and settling of particles to deeper waters. Global warming has altered oceanic temperature and salinity, resulting in increased stratification of the upper ocean. By inhibiting vertical mixing of the water column, vertical stratification slows the exchange of nutrients and gases, which can decrease biological productivity. These effects are also evident in large deep lakes (e.g., Lake Superior) when they are thermally stratified, with warmer temperatures strengthening vertical stratification of the water column, thus reducing nutrient inputs to the euphotic zone. Studies of the interactions of climate, lake mixing processes, and microbial dynamics and their influence on the fate of particles may improve understanding of temporal changes in the lake's clarity, but no studies have been completed at Tahoe.

HOW CAN WE IMPROVE OUR COMMUNICATION TO THE PUBLIC VIA PRESS RELEASES?

Institutional press releases present an opportunity to convey information to the public about timely findings that can help shape discourse on subjects and affect public policy and management outcomes. These releases may be published near-verbatim to convey information that has not undergone traditional peer review. The publishing of information near-verbatim suggests that media outlets use information without review or conducting fact-based investigation prior to dissemination. We offer suggestions on how to ensure that factual information is presented to the public, recognizing that information released from institutions may have significant weight in guiding outcomes or generating resources on topics of the day.

At the levels of the institution and principal investigator, efforts to have a "friendly yet constructive" peer review should be encouraged and adopted by the offices related to community relations, marketing, and media relations. Institutions and their faculty should consider using peer-reviewed pre-print services (e.g., Peer Community in) to share information while papers are in review but before scientific peer review is completed. Agencies within the U.S. government (e.g., U.S. Geological Survey, Environmental Protection Agency, Department of Energy) have extensive pre-print review processes which can include some sort of peer review. There are open communities where preprints may be publicly available without having to pay which can be cited in an informational release. If information is not in the stage of developing a pre-print of a report or paper, then institutions and their faculty should (1) seek independent peer review *of the press release* to ensure factual and data supported information is presented in the release and the quotes released support the factual information. We recognize that open data sharing can require resources but given the move in the ecological sciences to have open data sharing policies, it is important to release data that supports key statements in press releases to offer open discourse on the topics at hand. (2) Ensure that materials and data referenced in the press release are publicly accessible at the time of the press release so others may evaluate the facts presented in the release. (3) Differentiate in the release between hypotheses and statements supported by available data and distinguish between what is

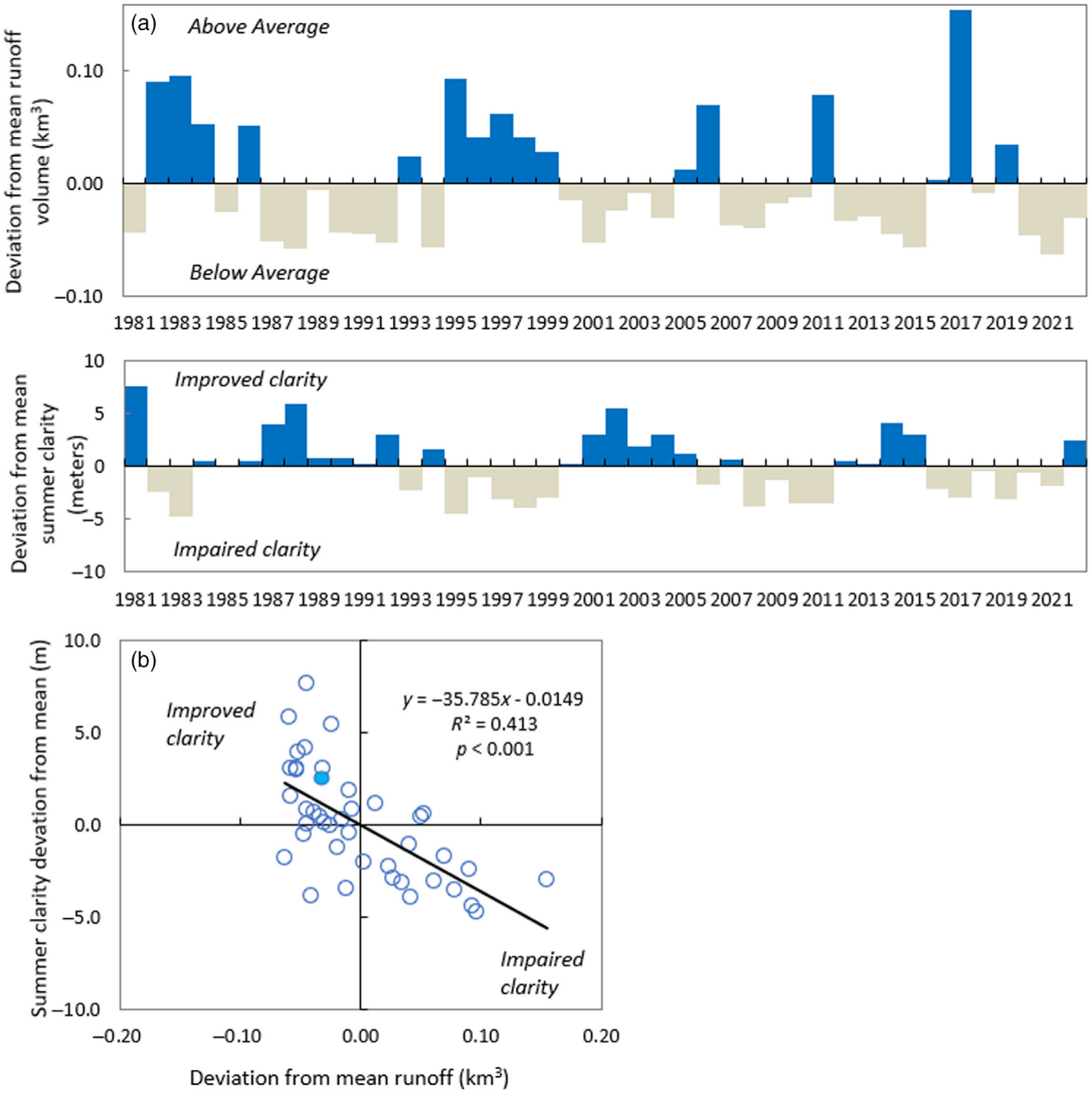

FIG. 2. Annual streamflow volume deviation from (**a**) the mean runoff volume (0.0846 km^3; 1981–2022) measured at the U.S. Geological Survey's Upper Truckee River gauge at South Lake, CA (10336610; U.S. Geological Survey 2021) and mean values of clarity (Watanabe and Schladow 2023) calculated over three periods 1980–1999, 2000–2019, 2022–2022 as 22.2, 19.3, and 18.6 m, respectively, and (**b**) linear fit to data highlighting 2022 summer lake clarity (solid fill). Long-term data suggest that summer variations in clarity are correlated with the amount and deviation of runoff from the watershed as measured by the gauge. Summer months are June through September.

supported by data and important next steps that should examined to test hypotheses. (4) Ensure the headlines represent the facts in the study, do not mislead the public and use caution when reporting sensationalized interpretations. If it sounds "too good to be true," ensure a review process has been completed.

For the media, we understand that scientific issues can be a complex subject to convey to the public, but we rely on news stories to frame and convey scientific information that has the potential to shape our society. The media are critical to sharing information to the public, so we recommend: (1) not publishing externally supplied media releases verbatim. (2) Obtaining perspectives from multiple scientists and institutions for context and to evaluate ideas presented in the release. For example, news stories in widely read journals like *Nature*, *Science*, and *PNAS* usually include commentary by researchers from other institutions who were

not involved with the study. (3) Embrace complexity even when working toward a deadline. Share the complexity with the public, but also the novelty of the research. With the best practices conducted by institutions, researchers, and the media, we can help guide proper discourse on subjects of relevance to our society and ensure resources are used properly to address important environmental challenges.

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References

Autzen, C. 2014. Press releases—The new trend in science communication. J. Sci. Commun. **13**: C02. doi:10.22323/2.13030302.

Bess, Z., S. Chandra, E. Suenaga, S. Kelson, and A. Heyvaert. 2021. Zooplankton influences on phytoplankton, water clarity, and nutrients in Lake Tahoe. Aquat. Sci. **83**: 26. doi:10.1007/s00027-020-00772-6.

Naranjo, R. C., P. Work, A. Heyvaert, G. Schladow, A. Cortes, S. Watanabe, L. Tanaka, and S. Elci. 2022. Seasonal and long-term clarity trend assessment of Lake Tahoe, California–Nevada. USGS Numbered Series 2022–5070. 2022–5070 U.S. Geological Survey.

U.S. Geological Survey. 2021. USGS water data for the nation.

Watanabe, S., and G. Schladow. 2023. Lake Tahoe historic Secchi depth. doi:10.6073/PASTA/651F53D1340FC0131E05274672762F63.

Wulfeck, A. 2023. Lake Tahoe's clarity is the best it's been in 40 years. Available from. Foxweather.com, https://www.foxweather.com/weather-news/nevada-california-quality-water-sensor.

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