

LOOKING TO THE FUTURE

Perspectives from the Next Generation of Coral Scientists

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If we look to the future of coral reef science and see an inclusive and diverse field where researchers from a variety of disciplines are widely engaged with the community at large, it will herald the success of the issues discussed thus far in this series of essays (Czieleski et al. 2021; Love et al. 2021; Nowakowski et al. 2021; Wilkins et al. 2021). Interpersonal communication and collaboration are necessary to garner excitement for the future of coral reefs. It is also necessary to implement these within an open and inclusive atmosphere, to welcome and ensure diversity in future generations of scientists who will bring with them important and unique perspectives. This is not only a moral obligation; recent research demonstrates that diversity in research teams leads to more impactful publications (Freeman and Huang 2014, 2015). The dire future of the planet's coral reefs is an urgent problem that will require the best working scientific collaborations to resolve. To address this urgent problem, we have identified three aspects of coral reef science that should be focused on for future generations: connecting people to coral reefs, inclusion and diversity, and holistic training programs that prepare future generations for an evolving science.

Connecting the general public and stakeholders to coral reefs means implementing communicative and collaborative tools that were discussed in previous sections, such as personalizing narratives (Nowakowski et al. 2021) and local outreach (Love et al. 2021). Beyond incentivizing interpersonal outreach, coral scientists now and in the future should be more proactive about sharing their discoveries and results through the variety of platforms that exist on the internet. Laced within that communication piece (geared toward a nonscientific audience) needs to be a message of hope, with tangible goals that can be achieved through actionable plans. That same plan of action should be refined through collaborations with local stakeholders who help to manage the reef where scientific studies are

being conducted. With ample attention drawn toward interpersonal communication and collaboration, scientists can use their emotional attachment to coral reefs as a conduit to incite both excitement and action in the general public.

However, perhaps the most relevant and timely way to connect more people to coral reefs is to broaden the diversity of individuals who represent coral reef science. Toward this end, coral scientists have a particular part to play as role models. Institutions need to be mindful of this when hiring new faculty and researchers, because senior professionals that students (both current and prospective) can personally identify with are crucial for recruitment and retention (González 2006). Despite the fact that this is well-understood at the institutional level, a recent study documenting faculty recruitment of under-represented minorities (URMs) at four major institutions reported that only 4–9% of tenure-track faculty between 2011 and 2015 were from URM populations (Gumpertz et al. 2017). Worse perhaps is that the coral sciences are no exception, where URM groups are typically those most impacted by the social and economic repercussions of degrading coral reefs. Inclusion of a broader set of experiences leads to asking more important questions and therefore discovering more sustainable solutions. By missing this representation, we are missing essential opportunities that the planet's coral reefs cannot afford.

While current representation is far from ideal, steps are being taken toward addressing the lack of diversity, inclusion, and equity in STEM fields. STEM-support programs typically help URM students from various universities by arranging campus visitations, assisting with summer research opportunities, and promoting informal mentoring relationships. While many programs like this exist for general STEM fields, there are none that we are aware of specifically targeting coral research. Given the important links between coral reefs, the URM populations that typically inhabit them, and diverse research groups, this should be a priority moving forward for the future of coral science.

Expectations for professional scientists are changing. Dwindling funding opportunities coupled with increasingly available technologies are putting greater demands on the skill sets that scientists must have in order to succeed as working professionals. Graduate programs must therefore adapt to these growing demands and properly equip their graduate students with a more holistic set of tools to ensure their success beyond graduation. Coral scientists are finding

that their collaboration teams need to include more than just other researchers in the physical sciences. Economists, policy-makers, and various stakeholders are taking an interest in research being conducted on coral reefs, yet scientists are often not trained to operate in such eclectic working groups. Training for this evolving scientific environment should come in the form of collaboration through internships and opportunities within nongovernmental organizations, industry, and even on the scientific advisory staff of political candidates. Important personnel from these organizations should be regularly invited to give talks to graduate students at their local seminars, creating avenues for job opportunities outside of academia.

Much of the training of graduate students is laid at the feet of their respective mentors, who are expected to teach the budding scientists everything they need to know about life as a successful researcher. Even some of the best mentors will admit that taking on a graduate student is a “labor of love.” This monumental task of training a graduate student must be shouldered with the high demands placed on career scientists in this modern “publish or perish” professional climate. This is an unrealistic expectation that creates inefficiencies in a scientific discipline that demands efficiency to thrive in the current political and environmental climate. While workshops are offered to both graduate students and faculty members alike to improve skills in grant proposal writing, laboratory management, and classroom teaching, further attention needs to be paid toward proper training in mentoring. Many corporate structures in the business world have already instituted management classes to maximize efficiency at a variety of management levels. Coral science working groups, academic institutions, and funding bodies must recognize the merits of investing into the professional development of their science staff and graduates moving into the future.

The next generation of coral reef scientists stands on the precipice of the unknown. Coral reefs are in an unprecedented state of decline, and if the current generation of coral scientists wishes to pass the proverbial torch of knowledge that will illuminate such an uncertain state, then they must prepare future generations for inevitable change. Encouraging coral scientists to embrace their place as role models will help garner excitement and action from the general public. Improving the state of diversity, inclusion, and equity in coral reef science will heighten both the quality and reach of coral research.

Finally, providing the next generation of coral scientists with a holistic set of tools will prepare them for the rapidly changing field of professional science. If coral scientists in the coming century prove to be as adaptable as coral reefs to the coming challenges, then hope for their future is indeed well warranted.

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