

Training the Next Generation of U.S. Coastal Scientists and Engineers: 2018

Science and Technology Committee
October 2018

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Background

In a February 2012 policy statement, the American Shore and Beach Preservation Association (ASBPA 2012) concluded that the U.S. coastal engineering and science profession was unhealthy. ASBPA's findings were that

- Coastal engineering and science programs at U.S. universities are or will be declining due to reduced funding,
- Fewer coastal engineers are entering academia due to the difficulty obtaining funding, so retiring coastal faculty are not being replaced or are being replaced by non-coastal faculty and the number of traditional coastal courses offered is declining, and
- U.S. Army Corps of Engineers (USACE) coastal R&D funding has also declined dramatically since 1983.

The 2012 policy statement stated that ASBPA seeks to support the implementation of an updated version of recommendations from the 1999 National Research Council study, "Meeting the Research and Educational Needs in Coastal Engineering" (NRC 1999):

1. The coastal engineering and science academic community should establish a consortium to improve research and education through cooperative arrangements for leveraging major research facilities and educational capabilities.
2. The National Science Foundation (NSF) should establish a program to fund fundamental research on coastal engineering and science (in its Engineering Division and/or elsewhere).
3. The USACE and other federal agencies should establish a substantial program to fund applied research in academic coastal engineering and science programs and promote partnerships between academia, federal agencies, & private interests.

ASBPA has played a major role in some progress toward these recommendations in the last several years, particularly with the foundation of the new [U.S. Coastal Research Program](#) (USCRP), which begins to address recommendations 1 and 3 from above. The program is made up of federal agency partners, academics, and stakeholders. Through a competitive grant process, over \$900,000 has been awarded to coastal graduate student research over the last two years, ranging from research on dune management challenges along developed coasts to innovations in forecasting storm processes and impacts. In addition, to address the lack of large-scale, multi-agency field experiments in recent years, USCRP is organizing DuNEX (During Nearshore Event eXperiment) which will occur in 2020. In a time of fiscal uncertainty in government funded coastal research, USCRP has also been attempting to organize its partners to better share research infrastructure and assets in order to do more with less. NSF has recently expressed increased interest in coastal science and engineering through its Engineering and

Geoscience Directorates (e.g., <https://coastlinesandpeople.org/>), thereby partially addressing recommendation 2.

In 2018, ASBPA sought to update the findings of the 2012 policy statement through a survey of coastal academic researchers. Appendix A includes the results of a survey of 51 coastal academics from Geology, Engineering, Oceanography, Planning, Marine and Wetland, and Environmental Science programs. The online survey was conducted during the spring of 2018 by reaching out to ASBPA's list of academic professors and researchers via email.

Responding academics were affiliated with, but not limited to, the following institutions: **Coastal Carolina University**, Florida Atlantic University, Florida Institute of Technology, Florida State University, Massachusetts Institute of Technology, North Carolina State University, Northeastern University, Old Dominion University, **Oregon State University**, Portland State University, **Rutgers**, Skidaway Institute of Oceanography, Stevens Institute of Technology, **Stony Brook University**, **Texas A&M University**, University of California Los Angeles and Santa Cruz, **University of Florida**, University of New Hampshire, **University of New Orleans**, **University of North Carolina at Chapel Hill**, University of Puerto Rico, University of South Alabama, **University of South Carolina**, University of South Florida, **University of Virginia**, University of Washington, United States Naval Academy, and Woods Hole Oceanographic Institution. Universities with coastal programs with greater than 11 graduate students are shown in bold.

Results

Most coastal academics (62% of respondents) stated that funding has generally decreased over the last five years (Figure 1). Only 14% of survey participants stated that funding has increased.

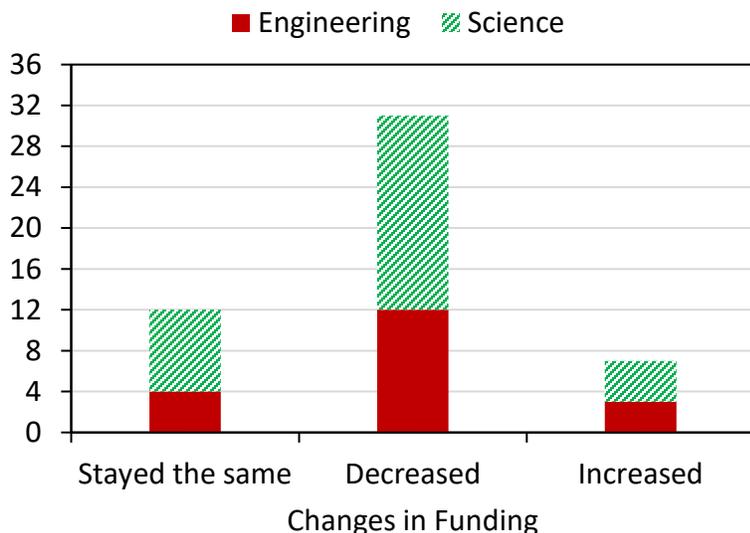


Figure 1. Online survey of coastal academics' responses to "Has overall coastal science/engineering funding increased or decreased over the past 5 years?"

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Despite the reduction in funding, the number of coastal science/engineering university courses has either increased or stayed the same in 84% of the programs; only 16% of programs saw a decrease in the number of coastal courses (Figure A-4). Courses that teach fundamentals are offered annually or every semester by 80% of the programs (Figure A-5).

Survey results showed that the number of tenured professors in 46% of programs is between 2 and 5 and about 34% of programs have either none or only one tenured professor (Figure A-6). On the other hand, only 20% of programs have more than 5 tenured professors. Additionally, nearly half of the respondents (48%) programs have either none or only one non-tenured professor and research staff (Figure A-7).

Sixty-one percent (61%) of programs had one or no postdoctoral researchers (postdocs) while 34% had 2 to 5 postdocs, leaving only about 5% of respondents indicating that more than 5 postdocs are in their programs (Figure A-8). The number of graduate students was reported as 1-5 or 6-10 in 30% and 27% of programs, respectively. A surprising 36% of programs reported having 11-25 or >25 graduate students as depicted in Figure A-9 and identified in bold text in last paragraph of the Background section.

Survey respondents indicated that the federal agencies that fund coastal academic research are (in order of most often cited to least): NOAA, NSF, USACE, BOEM, USGS, ONR, EPA, and the National Park Service (Figure A-10). The typical grant size ranges from \$100,000 to \$500,000 (Figure A-11). Funding was categorized as difficult to obtain by 47 out of 50 respondents (Figure A-12). Overall, the coastal academics surveyed are conducting an even mix of applied vs. fundamental research (Figure A-13).

USACE Staffing Needs Survey

As an example of a federal agency that employs coastal graduates, numbers of existing and retiring USACE coastal science and engineering staff was also included in the analysis. This provides an example of the need or demand for coastal graduates. Future white papers will aim to include statistics from additional federal agencies.

The USACE provided ASBPA with results of a staffing survey of 19 of the 21 coastal districts in Spring 2017 to gauge the following:

1. Number of existing coastal staff including engineers and other coastal staff = 201
2. The existing coastal staffing need/deficit (difference in #1 from ideal), here 243
3. Number of staff that will leave USACE in the next five years (43), and
4. The differential (total deficit) over the next five years $[2+3] = 85$

Today, the USACE has 201 coastal staff that are unevenly distributed amongst the 19 coastal districts that responded to the survey (Figure 2). By 2022, these coastal districts expect to lose 43 staff and thus experience a net loss of approximately 85 coastal professionals. This national need or deficit for the USACE alone is depicted in Figure 3. The greatest need is in the south (e.g., Galveston, Mobile, and Jacksonville Districts). Of today's 201 coastal staff, 57% have formal coastal training and 53% have professional licenses.

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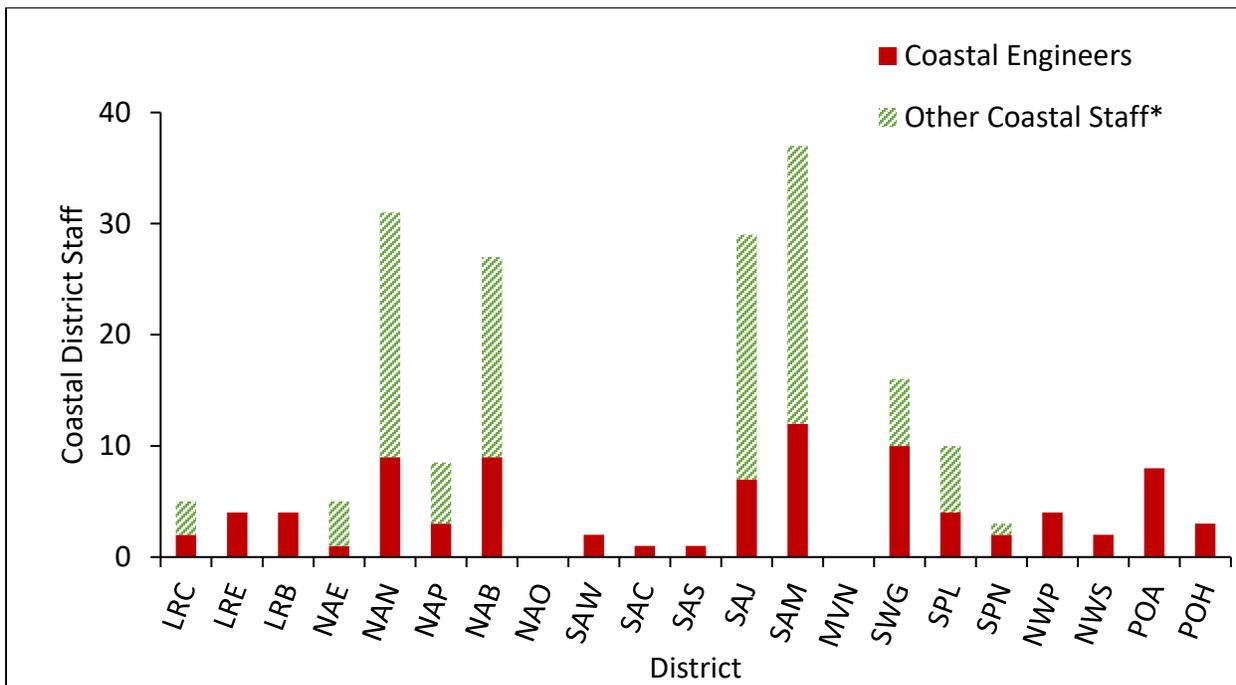


Figure 2. Coastal Districts' coastal staff statistics. Districts with no data did not respond to the survey. *May include engineers not classified as such (e.g. research engineers).

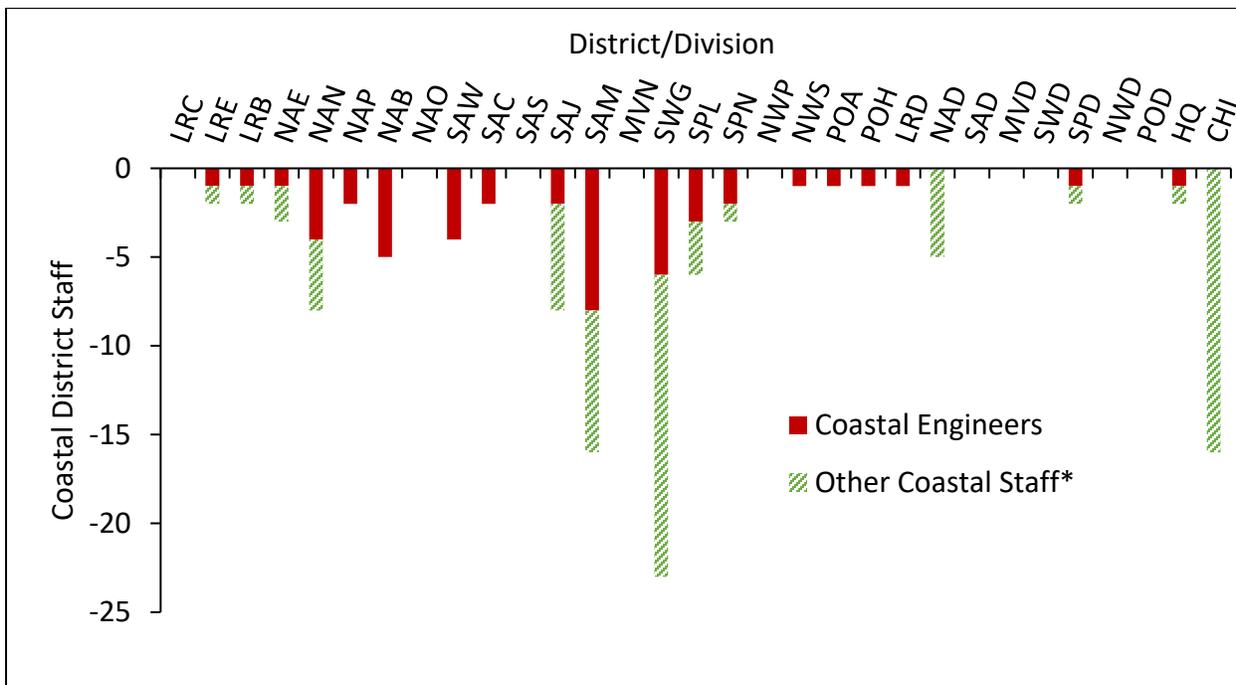


Figure 3. Defining the need: Of the existing 201 coastal staff at USACE districts, the net loss of coastal professionals at USACE coastal Districts over the next five years is 85. *May include engineers not classified as such (e.g. research engineers).

Additional feedback from the USACE Coastal Working Group, a community of practice of coastal scientists and engineers within USACE, recommends that students receive academic training rooted in fundamental science and engineering (the underlying physics, the traditional curriculum of waves, hydraulics, structural design, ocean/nearshore labs, etc). This broader based set of fundamentals is considered key for future USACE staff.

There was a concern that students are graduating with more knowledge in ecosystem/wetland restoration than with traditional coastal structural engineering training. Diverse engineering training is quite useful, specifically as the USACE transitions to embracing natural and nature-based features; however, building and maintaining gray infrastructure is a large part of the mission of the USACE. Given this mission, USACE needs more graduates that understand the physics of open ocean/near shore high energy areas and impacts on aging coastal infrastructure. We suspect that other similar disciplines (naval, civil engineering) have similar challenges.

Finally, the private sector has also anecdotally cited an increasing demand for coastal professionals due to pressures of sea level rise, coastal development, and potential increased storminess. This growth is out of phase with the declining funding for basic and applied coastal research. Future updates to this white paper will include staffing surveys of other federal agencies, NGOs, and the private sector.

Summary and Recommendations

Despite some advancements since the 2012 ASBPA position statement, including formation of the USCRP and increased coastal research investment by NSF, funding for coastal academics remains difficult to obtain and has declined over the last five years. There also seems to be a discrepancy in the academics' opinion that they are frequently (annually or every semester) offering courses in fundamental coastal science and engineering; while the USACE specifically, feels that students are graduating with less traditional coastal engineering training (the underlying physics, the traditional curriculum of waves, hydraulics, structural design, ocean/nearshore labs, etc). This inconsistency may be connected to fewer new USACE construction projects that require coastal structures, like breakwaters. Thus, little research investment in this area has occurred in recent years. As such, students may not have the opportunity to conduct graduate research or receive field training in these areas. However, the USACE mission is transitioning to maintaining their investments, which requires new knowledge about aging coastal infrastructure. Our students likely understand the physics of open ocean/nearshore high-energy areas, but may not understand its effect on aging coastal infrastructure.

In an era of increasing coastal challenges due to growing populations and rising seas, these shortcomings in coastal research support will likely only become more glaring in the near future if the nation does not further invest in addressing them. ASBPA endorses the implementation of an updated version of recommendations from NRC (1999) and ASBPA (2012), and additional

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sub-recommendations (3a and 3b) informed by the community outreach conducted during this white paper effort:

1. The coastal engineering & science academic community should continue to work toward a robust consortium to improve research and education through cooperative arrangements for interdisciplinary approaches by leveraging major research resources, facilities, and educational capabilities.
2. NSF should continue to fund fundamental research on coastal engineering and science (in its Engineering and Geoscience Directorates and/or elsewhere).
3. Federal agencies, academics, and stakeholders should continue to support the U.S. Coastal Research Program, which is making significant progress toward the previously stated goal that “the USACE and other federal agencies should establish a substantial program to fund applied research in academic coastal engineering and science programs and promote partnerships between academia, federal agencies, & private interests.” A portion of the USCRP’s academic funding should be specifically dedicated to:
 - a. Traditional coastal engineering topics (e.g., design/maintenance of gray infrastructure, beach nourishment), and
 - b. New, interdisciplinary research projects to support Recommendation #1.

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References

ASBPA 2012. “The state of U.S. coastal engineering & science.” Science and Technology Committee of the American Shore and Beach Preservation Association, www.asbpa.org.

National Research Council 1999. *Meeting Research and Education Needs in Coastal Engineering*. Washington, DC: The National Academies Press.
<http://www.nap.edu/catalog/9613.html>

Appendix A

Coastal Academics Survey Results
 Online Survey Date: Spring 2018

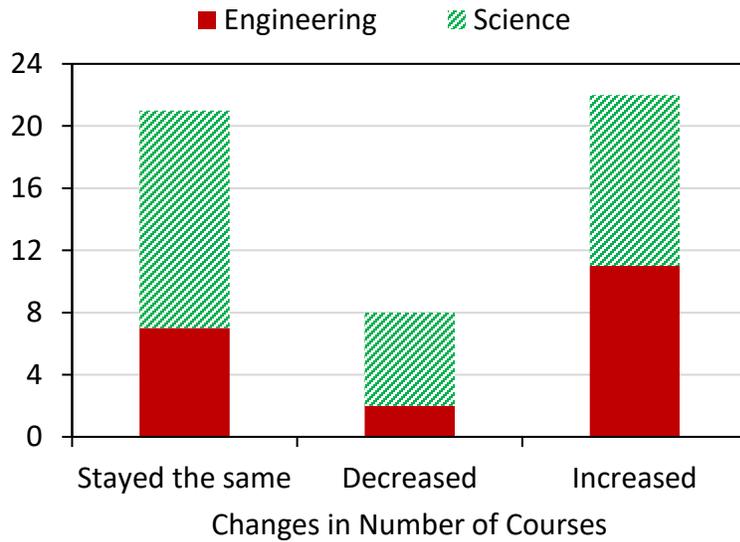
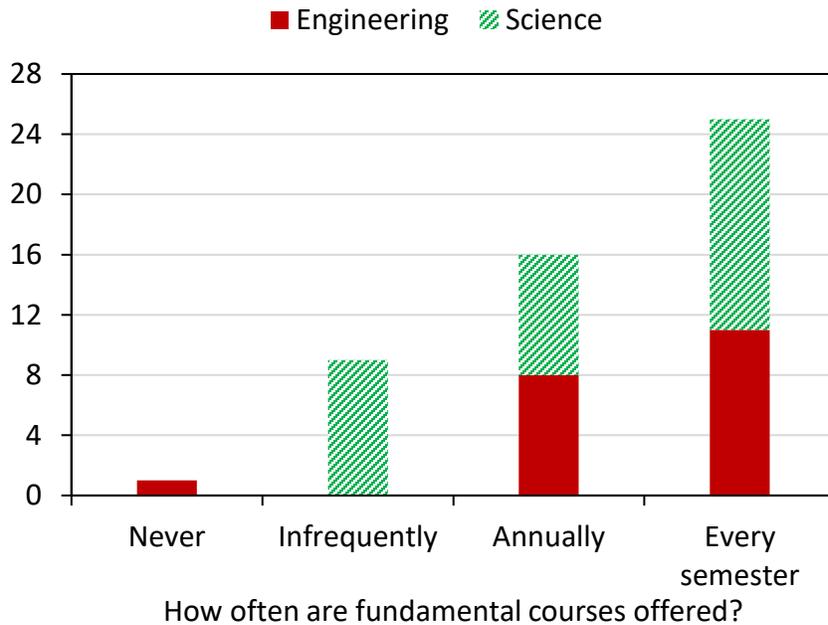


Figure A-4. Responses to "Has the number of coastal science/engineering courses increased or decreased over the past 5 years?"



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Figure A-5. Responses to "How often does your university offer courses that teach fundamentals (the underlying physics, traditional nearshore oceanography, coastal geology or engineering curricula of waves, sediment transport, geomorphology, hydraulics, structural design, structures' effects on shorelines, ocean/nearshore labs, etc.)?"

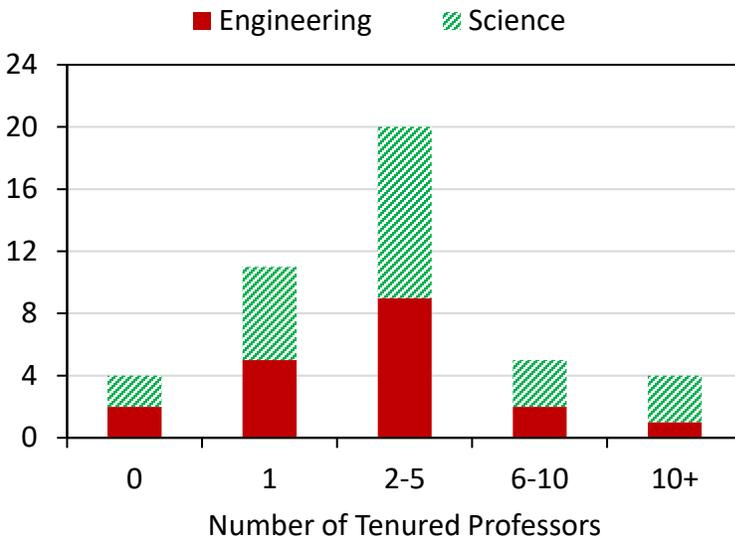


Figure A-6. Responses to "How many tenured coastal engineering/science professors are employed in your program?"

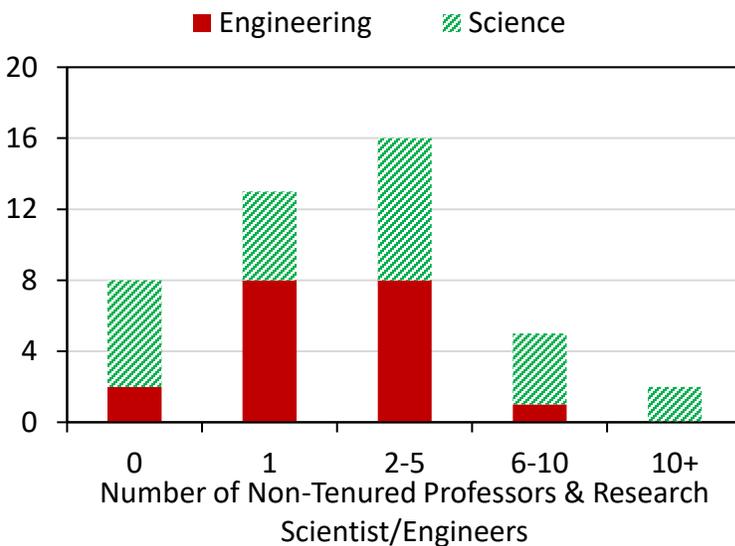


Figure A-7. Responses to "How many non-tenured coastal engineering/science professors and research scientist/engineers are employed in your program?"

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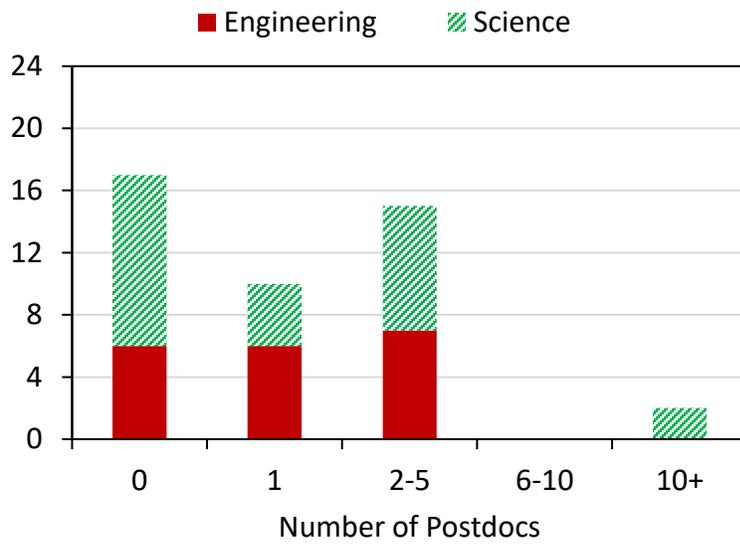


Figure A-8. Responses to "How many post-docs are in your program?"

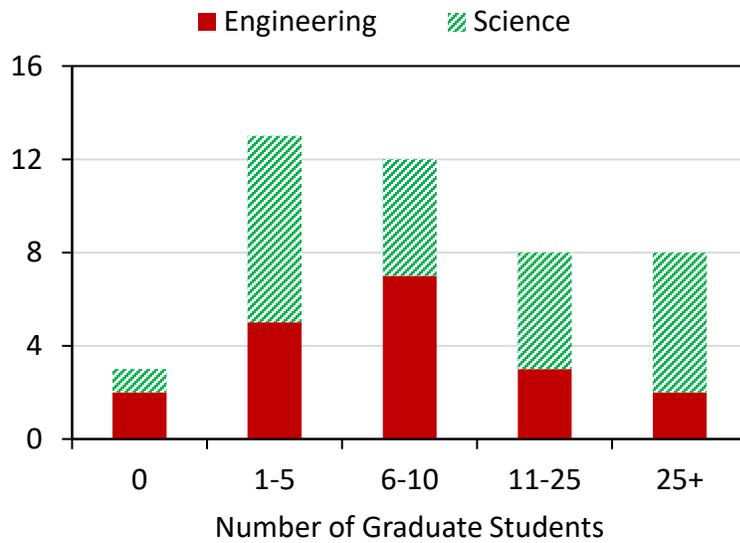


Figure A-9. Responses to "How many graduate students are in your program?"

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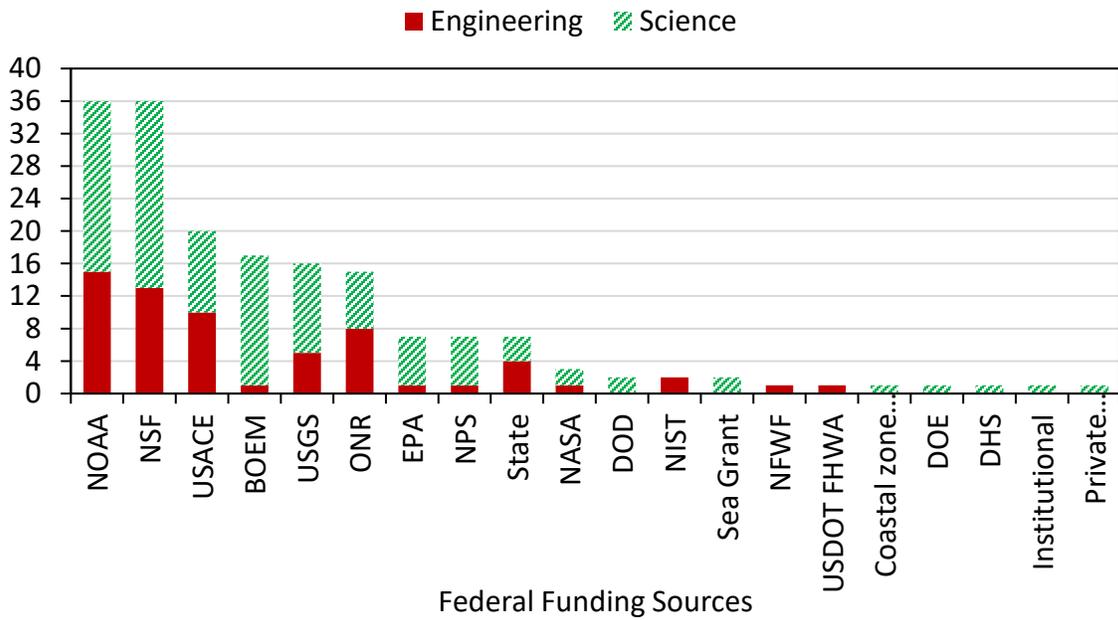


Figure A-10. Responses to "Where do you receive Federal funding from:"

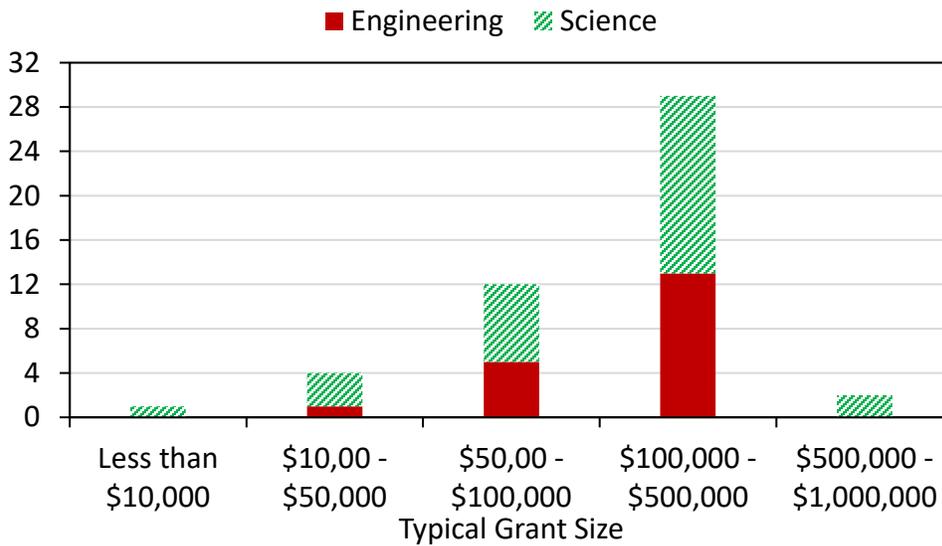


Figure A-11. Responses to "What is your typical coastal science/engineering grant size?"

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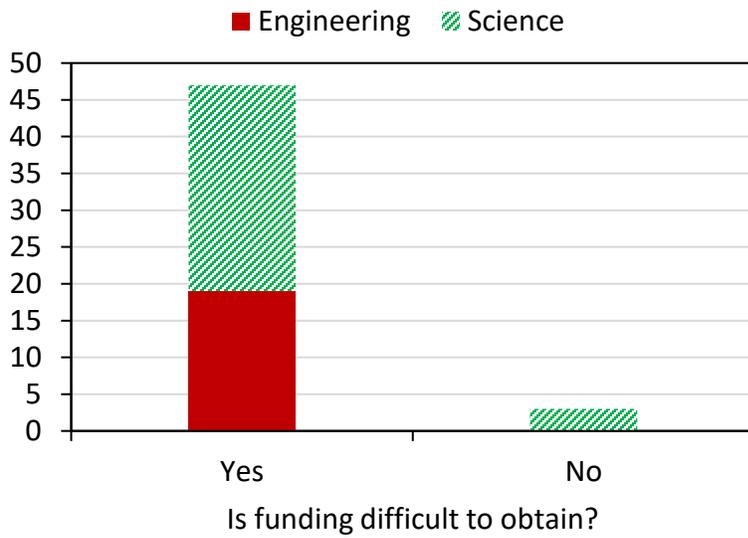


Figure A-12. Responses to "Is funding difficult to obtain?"

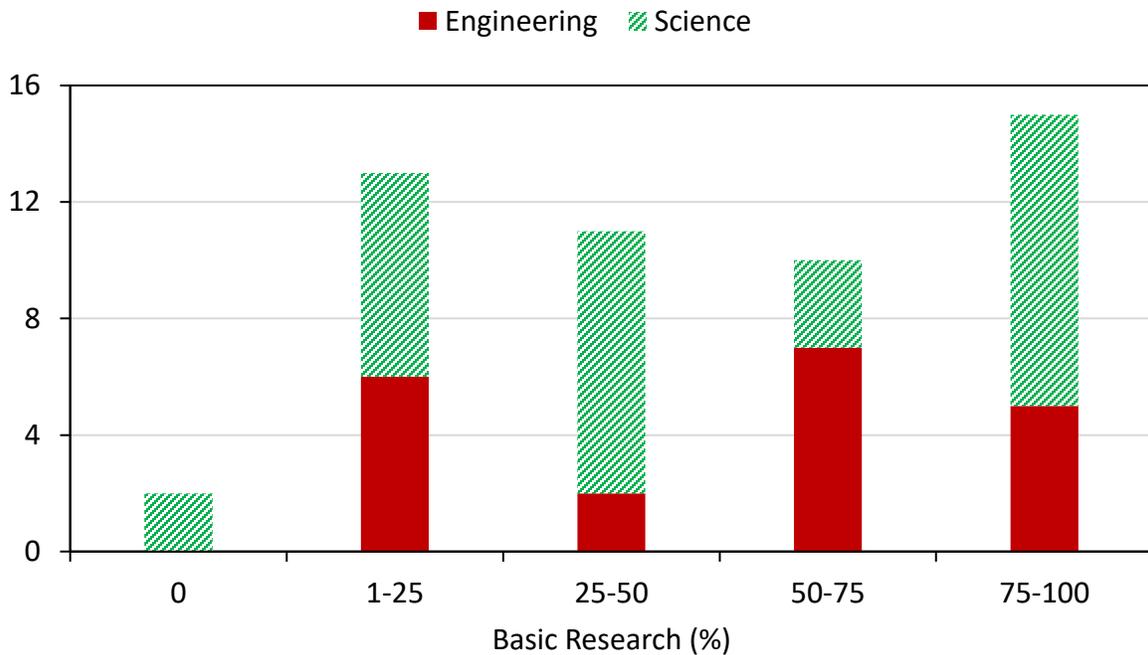


Figure A-13. Responses to "What percent of your research is basic (i.e., fundamental) research (rather than applied)"