

Enhancing Diversity in Undergraduate Degree Programs in Forestry and Related Natural Resources: a Brief Review of Critical Issues and Promising Actions

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Abstract

Although forestry and related natural resources (FRNR) undergraduate degree programs in the United States have become increasingly diverse in recent years, women and minorities remain underrepresented in multiple disciplines; this is particularly true in forestry undergraduate programs. We reviewed over one hundred reports and publications to help understand the critical issues that must be addressed to enhance diversity in FRNR undergraduate programs. Based on that review, here we summarize eight critical issues in recruiting and retaining a more diverse FRNR undergraduate student body, and we also present promising actions to address the issues. Our goal is to more widely communicate validated ideas and practices, thereby prompting further discussion and effective actions to make more tangible gains in enhancing the diversity of FRNR undergraduate degree programs in the United States in the future.

Study Implications: To be effective managers and stewards of forestry and related natural resources (FRNR), professionals must be effective in developing, communicating, and implementing plans and actions. From recommendations for a single stand or forest, to community-level natural resource issues, to state, regional, and national policy decisions, FRNR professionals must be trusted by increasingly diverse stakeholders in our society. FRNR professions can become more diverse in terms of gender as well as race and ethnicity by developing and implementing actions that address specific critical issues in undergraduate enrollment. A more diverse and society-ready cadre of leaders in FRNR will help to ensure healthy biotic communities are restored, sustained, and valued while meeting long-run societal needs.

Keywords: diversity, inclusion, equity, undergraduate degree programs, enrollment, recruitment, retention, forestry, natural resources, bachelors

Major advances have been made in recent years in terms of the diversity of students in undergraduate degree programs and in the cadre of practicing professionals in forestry and related natural resource (FRNR) disciplines. However, there is still much work to be done. For example, membership in the SAF in March 2023 was only 8% women (of the members who chose to identify), and 6.60% of members were historically underrepresented minorities; 1.05% of SAF members were Black/African American, and 1.15% were Hispanic/Latino (Darnell Pinson, email message to author, March 20, 2023).

In comparison, Payne and Theoe (1971) estimated there were only five Black SAF members in 1971, and in 1986, SAF membership was less than 2% ethnic minorities and less than a quarter of 1% Black (Washington and Rodney 1986). Although there has been significant improvement over the past 50 years, the percentages of racial and ethnic minorities and women in most FRNR disciplines are still much lower than their representation in US society.

In FRNR undergraduate degree programs, there is promise of a more diverse future for the profession. The undergraduate enrollment percentage of women has increased steadily in FRNR degree programs since 2005 to nearly 47% of total enrollment in 2017 (Table 1, from Sharik et al. 2019, 22) and 52% in 2021 (Bal et al. 2022, 13). Women and historically underrepresented minority enrollment in forestry programs, however, continues to be low. As highlighted in Table 1, forestry has the lowest percentage of women undergraduates of all FRNR disciplines and also the lowest percentage of minorities. Although Bal et al. (2022) reported an increase in enrollment of women in forestry to 29% in 2021, forestry still had the lowest enrollment percentage of women among FRNR disciplines.

In this article, we address two important topics that relate to further enhancing the diversity of FRNR undergraduate degree programs: what are the critical issues that have kept the diversity of FRNR enrollments relatively low and what actions show promise for addressing the issues?

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Table 1. Undergraduate enrollment percentages for women and minorities in FRNR programs, by discipline, 2017 (adapted from Sharik et al. 2019).

Discipline	% Women	% Minority
Environmental Science & Studies	57.5	22.8
Fisheries & Wildlife	50.4	13.4
NR Conservation & Management	51.3	23.1
NR Recreation	39.7	11.6
Range Science & Management	42.5	14.0
Watershed Science & Management	34.6	13.5
Wood Science/Products	25.6	18.1
Forestry	23.0	11.1
Total Enrollment	46.6	17.2

Background

There are many reasons why diversity is critical for university degree programs and their associated professions, in general, as well as in FRNR disciplines. There are moral and ethical reasons to enhance diversity, of course, but there are also “enlightened self-interest” reasons. For example, diversity is critical for creating and developing new ideas as well as for troubleshooting old problems; that is, diverse teams outperform homogeneous teams (Rock 2021; Rock and Grant 2016). Diverse perspectives and the ability to connect ideas are clearly identified as critical elements for genuine breakthroughs in societies and human thinking over time (Johnson 2010) as well as being germane to discovery and problem-solving in science-based disciplines (Bernard and Cooperdock 2018).

In FRNR disciplines, a key argument for diversity is the continued relevance of the professions to society and to decision makers and policy makers at all levels from local to global. As stated by Batavia et al. (2020, 711): “To be socially relevant requires natural resources to demonstrate that it is engaged with and attentive to the values, interests, and concerns of a demographically diverse society.” For FRNR professions to continue to be relevant to society, “people of non-dominant groups must be empowered to shape the actions, policies, and cultures of natural resource communities” (Batavia et al. 2020, 712, rephrasing Riccucci and Van Ryzin 2016).

From the perspective of FRNR employers, diverse candidates can be hard to find, although employment opportunities continue to be outstanding in both public and private sectors. In a 2013 nationwide survey, 97% of forestry employers indicated they had difficulty in recruiting non-White employees for professional forestry positions (Sample et al. 2015). The same survey showed that forestry deans and directors highlighted a lack of diversity in their enrollments, and they recognized a clear need to attract a more diverse student body to more effectively produce a society-ready workforce.

In the next two sections, we discuss critical issues and promising actions related to diversifying FRNR undergraduate enrollments based on a review of articles and reports in the literature and on our experiences in the College of Forest Resources (CFR) at Mississippi State University (MSU). Although not an exhaustive review, by briefly summarizing some of the key thoughts and findings from decades of published work, our goal is to more widely communicate valuable ideas and practices and to prompt further discussion

and effective actions, as recommended by Brown (2020) and Batavia et al. (2020).

Critical Issues

To diversify undergraduate enrollments in FRNR disciplines, we must understand the issues involved; that is, we must understand how college and career choices are made and actualized and then identify and understand the most critical issues, barriers, or other factors that prevent recruitment and retention of more women and historically underrepresented minorities in FRNR undergraduate degree programs.

In reviewing the literature and considering our own experience with this topic, we identified eight critical issues; six of them involve recruitment and two of them involve retention of a more diverse student body. In figure 1, we cite over fifty unique articles and other sources of information, most of which were published in the last 20 years. In developing the issues summarized in figure 1, studies that applied social cognitive career theory (SCCT; Lent et al. 1994) to FRNR and other science, technology, engineering, and mathematics (STEM) career choices were particularly helpful. These studies specifically address how FRNR and other STEM career choices are made and acted upon. As stated by Haynes et al. (2015, 229), SCCT “suggests that personal influences (gender, race or ethnicity, and predispositions) and contextual influences (supports and barriers), self-efficacy (beliefs in the capacity to succeed in specific tasks), and outcome expectations (what individuals expect will happen as a result of a given action) help shape career interests, goals, and actions.”

Some studies of career choice and development in FRNR and other STEM disciplines also mentioned the negative influence of discrimination, a factor that underpins many of the issues and actions highlighted in the present article (see Schelhas 2002, for example). Sharik et al. (2015) reported racial discrimination as a significant factor in the consistently low enrollment of minorities in natural resource fields. Discriminatory practices of the past were deeply rooted in social structures that led to the denial of access to land and resources to racial/ethnic minorities. Currently, women and minorities express concerns about a general lack of diversity in FRNR professions and the potential of workplace discrimination. In the literature, however, discrimination was mentioned more often in discussions of career development in FRNR professions rather than in discussions of recruiting and retaining a more diverse student body in undergraduate degree programs. Consequently, we do not focus on discrimination in this article. We acknowledge the fundamental role discrimination has on current and future recruiting and retention issues, however, and call for more research attention to this factor in efforts to diversify undergraduate FRNR degree programs.

Promising Actions

To effectively enhance diversity in FRNR undergraduate degree programs, the eight critical issues highlighted in figure 1 must be addressed “head on.” We highlight actions that are promising in that they are initiatives, programs, and in some cases practices that are highly intentional, that is, specifically designed to address critical issues. To help organize and briefly discuss recruitment and retention actions, we use four

Recruitment Issues		Supporting Citations
Specific to FRNR Professions and Degree Programs	1 There is a general <u>lack of awareness</u> of FRNR careers and professions; this is true across society, including high school students, parents, teachers, and counselors, as well as among college advisors and currently enrolled college students.	Abusow et al. (2023); Balcarczyk et al. (2015, 2016)*; Burmann et al. (2022)*; Carter et al. (2021); Hager et al. (2007); Hubbard (2014); Jean-Philippe et al. (2020); Maughan (2001); Moreno et al (2020); O'Herrin et al. (2018); Sharik et al. (2015)
	2 Among those who are aware of FRNR professions, there is a <u>common perception that the jobs are relatively low paying and/or not prestigious or stable</u> .	Adams and Moreno (1998); Bettis and Bettis (2017); Cotton et al. (2009); Griffin et al. (2016); Mejia and Griffis-Kyle (2020)*; Nyland (2008); O'Herrin et al. (2018); Outley (2008); Sharik and Frisk (2011); Talbert et al. (1999)
	3 There are <u>relatively few female and minority role models</u> in some FRNR disciplines and professions; this is particularly true in forestry and forest industry-related disciplines.	Anderson (2020); Bal and Sharik (2019); Burmann et al. (2022)*; Dewsbury et al. (2019)*; Haynes et al. (2015)*; Macinnis-Ng and Zhao (2022); McGown (2015); Morgan (2013)*; Outley (2008); Staples (2020); Sharik (2015)
	4 FRNR professionals and undergraduate students often cite a love or passion for the outdoors as a vocational motivator, but <u>historically marginalized groups have generally had fewer opportunities to be engaged in the outdoor environment and FRNR issues</u> . They may see wildlife-related careers on TV or social media, but this is not true for forestry and forest industry-related professions.	Burmann et al. (2022); Flores et al. (2018); Haynes et al. (2015); Innovative Learning Concepts (2016); Kuhns et al. (2004); McGown (2015); Moreno et al. (2020); Morgan (2013)*; Outley (2008); Rouleau et al. (2017); Sharik et al. (2012, 2015, 2020)
General	5 <u>College affordability</u> is a critical issue, particularly for students from groups that are historically underrepresented in FRNR careers.	Coker and Glynn (2017); Delaney (2014); Foltz et al. (2014); Grout (2022); Keane (2019); Minta (2022); Perna and Li (2006); Peters et al. (2019); Welbeck et al. (2014)
	6 <u>College accessibility</u> is critical, particularly for first-generation students and their families navigating unfamiliar processes for college admission as well as for federal, state, and university financial assistance.	Anzelone (2023); Boyer 2030 Commission (2022); Coker and Glynn (2017); Gault et al. (2014); Keane (2019); Minta (2022); Perna (2006); Woodward Hines Education Foundation (2023a)
Retention Issues		Supporting Citations
General	7 <u>Cultivating a sense of belonging must be highly intentional in the student's academic program; inclusiveness means being present, but it also means being heard and truly engaged</u> .	Bal and Sharik (2019); Balcarczyk et al. (2015)*; Crandall et al. (2020); Hausmann et al. (2009); Hurtado et al. (2009); McGown (2015); Murphy et al. (2020); Newhouse (2023); Rawana et al. (2015); Taylor (2018); Westphal et al. (2022)
	8 <u>Affordability issues continue throughout the undergraduate experience, particularly for students without a 'safety-net' of financial support</u> .	Anderson and Kim (2006); Coker and Glynn (2017); Estrada et al. (2016); Foltz et al. (2014); Jean-Philippe et al. (2020); Maughan et al. (2001); Peters et al. (2019)

Figure 1 Eight critical issues that relate to recruitment and retention of a more diverse student body in forestry and related natural resources (FRNR) undergraduate degree programs, with representative references for each issue. (*Studies that applied social cognitive career theory to FRNR career choices.).

broad periods where actions may be focused: early childhood through middle school, high school, transition to college, and college/university. We summarize potential actions for these four periods in [figures 2–5](#).

Early Childhood Through Middle School

Programs that encourage children to be active in the outdoors and promote an understanding of forests and other natural resources—what they are, how they function, and

how they provide sustainable benefits to society—are much needed in all communities. In a report sponsored by the SAF, the USDA Forest Service, and the National Association of University Forest Resources Programs entitled “Increasing Talent Through Increasing Diversity” ([Innovative Learning Concepts 2016](#)), one of the activity types recommended to be continued or “preserved” was reaching out to and communicating with children prior to high school. Increasing outreach efforts to young age groups was also a primary recommendation for enhancing undergraduate diversity



Figure 2 A brief summary of promising actions for programs and initiatives to address issues 1, 3, and 4 (figure 1) for elementary and junior high students.

in natural resources and conservation disciplines in North America (UBC Faculty of Forestry, Sharik, and Saracina 2021).

Interest in STEM careers must begin before students reach secondary school and begin choosing courses (Christensen and Knezek 2017); before students enter the eighth grade, many conclude that some STEM subjects are too challenging, boring, and/or uninteresting (Mohr-Schroeder et al. 2014). In FRNR disciplines, the larger issue relating to potential career interest may simply be the broad lack of awareness of college and career options in multiple FRNR professional areas, as summarized in issue 1 in figure 1.

There are many excellent examples of programs, campaigns, and initiatives to reach children before high school, directly or through their teachers or other program leaders, with information on FRNR subjects. Some initiatives and outreach efforts are national in scale and very broad in scope, whereas others are very localized and focused in subject matter. They involve many enterprises, including federal and state agencies, universities, nongovernmental organizations, private companies, professional societies, and professional associations. Programs range from highly informal, like national ad campaigns directed to young children, to much more formal initiatives, including structured curricula that involve teacher certification for program delivery. Project Learning Tree (PLT; <https://www.plt.org>) is an excellent example of a nationwide program that includes FRNR career options and opportunities in the curriculum.

Many of the initiatives and programs aimed at middle school and younger children address issue 4 (figure 1)—they help create an appreciation of and passion for the outdoors and for outdoor experiences in FRNR settings. However, programs like PLT that create awareness of FRNR careers and their importance (issues 1 and 2) are the exception rather

than the rule. Also, many efforts to reach children do not intentionally involve women and minority role models in program delivery (issue 3).

An outstanding example of a local initiative designed to target the first four critical issues summarized in figure 1 was created and led by graduate students in the College of Natural Resources and Environment at Virginia Tech. The Wildlife Viewing Club was created because graduate students wanted to promote the importance of conservation careers and introduce wildlife and the outdoors to underrepresented students (Robertson 2022). Funded by a \$10,000 grant from the Virginia Department of Wildlife Resources, the project allowed FRNR graduate students to develop and deliver their curriculum weekly after school to local 5th graders for about 12 weeks. The club specifically featured scientists from underrepresented backgrounds to highlight career options. The graduate student developers also used research-based, “hands on,” active learning throughout the curriculum.

In figure 2 we summarize some of the practical actions reported to be effective in reaching children, particularly during middle school. The promising, practical actions for STEM-related programs include incorporating hands-on experiences, providing career information, and challenging common stereotypes. FRNR program developers must also be intentional to ensure younger children are reached in all communities, including those from historically marginalized groups, urban and suburban areas, and rural areas.

The impressions made through these initiatives can last a lifetime, with the possibility that some students will choose FRNR careers in the future, but perhaps more importantly, with a much higher percentage of participants having a greater long-term appreciation for FRNR issues, challenges, and solutions.

Potential Actions	Promising Practices	Critical Issues Addressed (Numbers from Figure 1)
<ol style="list-style-type: none"> 1. Offer summer camps and other field-based programs 2. Create opportunities for early FRNR exposure 3. Create and deploy dual enrollment courses 4. Build strong relationships with high school counselors and teachers 5. Sponsor campus visits for high school students and families 6. Partner with community-based organizations (CBOs) and networks 	<ul style="list-style-type: none"> ▶ Seek guidance from diverse alumni and other FRNR professionals. Involve them in events and programs, including relatively recent alumni. In forestry-related events, include female as well as minority role models. ▶ Parents and other family members should be fully informed and involved when possible. ▶ In campus events, include FRNR student ambassadors as well as faculty and staff. ▶ Maintain connections with students as they progress through high school. ▶ Involve community organizations and other partners in designing and delivering outreach messages and events. ▶ In events, courses, programs, and messages, include the full array of career opportunities in FRNR disciplines, including those relating to urban areas; include examples of how FRNR professionals are engaged with social and community issues. ▶ Activities should incorporate hands-on, experiential learning with positive experiences in nature. They should include team-based or collaborative work, and they should be both fun and challenging. ▶ Where appropriate, include basic programming to increase comfort levels with field-based activities. ▶ Cultivate external “champions” to support specific programs; examples include summer camp sponsorships, student travel support, or support for creating and sustaining high school-level FRNR clubs or other organizations. 	<ol style="list-style-type: none"> 1 Widespread, general lack of awareness of FRNR careers 2 Misperceptions regarding FRNR careers and opportunities 3 Relatively few diverse FRNR role models 4 Relatively few opportunities for outdoor, nature-based experiences
<ol style="list-style-type: none"> 7. Offer competitive scholarships and other financial assistance 	<ul style="list-style-type: none"> ▶ Ensure that scholarships are available and that ‘net’ tuition is competitive and communicated effectively. ▶ Inform students, parents, and counselors about opportunities to earn income while in college, including the potential for paid internships and part-time jobs, as well as paid research activities with faculty. 	<ol style="list-style-type: none"> 5 College affordability
<ol style="list-style-type: none"> 8. Assist with applications and onboarding, including financial aid issues 	<ul style="list-style-type: none"> ▶ Involve on- and off-campus partners with a similar mission. ▶ Actively help with applications and processes of all types. Have a ‘go to,’ program-level contact person for students and parents. 	<ol style="list-style-type: none"> 6 College accessibility

Figure 3 Eight potential actions and associated practices that show promise for addressing critical issues 1 through 6 (figure 1) with high school students.

High School Students

The programs and initiatives we summarize in figure 3 for high school students address issues 1 through 6 in figure 1. These actions for reaching high school students with messages about FRNR degree programs and career opportunities show promise based on published research as well as in our experiences in FRNR disciplines at MSU. The subheadings below follow the eight actions in figure 3.

Action 1. Offer Summer Camps and Other Field-Based Programs for High School Students

Research shows summer camps and other field-based programs can be highly effective in creating awareness of and interest in FRNR degree programs and careers among historically underrepresented student groups. Cerv and Zink-Sharp (2022) noted summer camps are widely considered to be effective at increasing interest and engagement among

underrepresented minority students in STEM fields, citing Yilmaz et al. (2010); Martinez et al (2012); National Research Council (2015); Carrick et al (2016), and Whitaker et al (2017). Students who participated in a summer camp are more likely to attend the university that hosted the camp and pursue the camp's field of study (Sibthorp et al. 2020 and Trivedi et al. 2021). For example, 10% of high school participants in MSU CFR-sponsored Conservation Camps have matriculated to FRNR degree programs (Leslie Burger, unpublished data).

One key point deserves special emphasis—the importance of maintaining a connection with individual students as they progress through high school. We have seen the importance of this continuing connection in field-based high school programs at MSU, and this has also been noted by others. Spangler (2019) and Stalla et al. (2019), for example, referred to “longitudinal engagement” as a common element of success among actions to enhance diversity in the fisheries profession.

For maximum effectiveness in diversifying FRNR enrollments, field-based programs are a means of beginning and developing a relationship that can lead to college enrollment and an FRNR career. Sharik et al. (2020) predicted that one of the major trends in FRNR education will continue to be an increased emphasis on field-based youth programs, including greater focus on gender, racial, and ethnic diversity.

Action 2. Create Opportunities for Early FRNR Exposure for High School Students

Programs and opportunities for high school students to gain exposure to FRNR experiences can take many forms and they can be organized and supported in many ways. High school summer jobs and internships are examples of opportunities for early exposure to FRNR issues, leading to career awareness and potentially to career interest. The Forest Service provides an excellent example of creating and effectively communicating agency-related opportunities of this type. The Forest Service website (www.fs.usda.gov) has “Opportunities for Young People” as one of the menu options. Bold print states “Join the Next Generation of Conservation Stewards ... find out how you can become part of the next generation ...” The opportunities presented by the Forest Service include: Summer Apprenticeship Program in Forestry, Fire, Ecology, and Wildlife at Alabama A&M University; Resource Assistants Programs; Pathways program (including an internship program for high school students); Job Corps; Youth Conservation Corps (paid summer work experiences); and 21st Century Conservation Service Corps.

Another excellent example of early exposure to FRNR experiences specifically intended to reach women and minorities is the Hutton Junior Fisheries Biology Program of the American Fisheries Society (AFS; <https://hutton.fisheries.org>). The Hutton program's mission is to “engage, inspire and support diversity in the next generation of fisheries and aquatic specialists.” In the 8-week summer internship program, selected high school students (known as Hutton Scholars) are mentored by a fisheries science professional in marine or freshwater activities in their local area. Hutton Scholars receive a stipend and work experience via partners and financial supporters from a wide array of state and federal agencies and AFS state and local chapters.

Universities should engage faculty as mentors and help communicate opportunities for high school students. They

can also help through applied research to evaluate early exposure programs for effectiveness and by widely sharing the most effective designs and practices.

Action 3. Create and Deploy Dual Enrollment Courses for High School Students

Dual enrollment courses, in which high school students earn both high school and university credit, can create awareness of and potential interest in FRNR and other STEM subjects and careers. An excellent example of dual enrollment as a means of enhancing student diversity is the Acceleration Academy and Acceleration High Schools program, a key component of the Alaska Native Science and Engineering Program (ANSEP). ANSEP is a “longitudinal pathway program” that leads Alaska Native students through a series of program components, from middle school through high school, and then a University/Graduate Success program (Spangler 2019). University faculty are the course instructors in ANSEP, with support from graduate and undergraduate students, high school teachers, and practicing STEM professionals from partner organizations (Spangler 2019). This model could be replicated by universities across the United States to broaden participation by traditionally underrepresented students in locally relevant FRNR disciplines.

Action 4. Build Strong Relationships with High School Counselors and Teachers

Whether formal or informal, guidance counselors and teachers are active college advisors for students in the traditional high school setting. It is common for counselors and educators to work diligently to engage students in college and career fairs, college planning workshops, completion of the Free Application for Federal Student Aid (FAFSA), and standardized test prep workshops. High school students value these relationships and often credit their college decisions to their counselors and teachers (Walker 2021).

In the CFR at MSU, we are developing an outreach event for high school guidance counselors, teachers, and career coaches, as well as community college success coaches and community college faculty in FRNR academic programs. The one-day event will be held on campus and will feature FRNR immersion activities and the opportunity for participants to earn continuing education units. It will emphasize the full range of academic offerings in FRNR, including employment and career options. We intend to measure and evaluate the effectiveness of this event and future practices to develop an evidence-based model that can be modified and adopted by other FRNR undergraduate programs.

Action 5. Sponsor Campus Visits for High School Students and Families

At most universities, campus-wide recruitment days are scheduled to host high school and community college students. When such visits involve FRNR programs, it is very important to use the relevant promising practices outlined in figure 3. It is also important to embrace visits from individual students and their family members, and where possible, to involve FRNR student ambassadors. It is essential that a welcoming atmosphere is authentic, and the first impression of FRNR programs is one that truly embraces a strong sense of belonging for potential new students and their families.

Engaging actively with high school students' family members is particularly important with traditionally underrepresented minority students. These students often follow the college-related advice of family members, whether the advice is based on accurate or inaccurate information (Walker 2021). Sharing accurate information on FRNR careers and undergraduate programs with family members is essential for overcoming a general lack of awareness and widely held misperceptions of FRNR disciplines, jobs, and opportunities (issues 1 and 2, figure 1).

Action 6. Partner with Community-Based Organizations and Networks

Creating and cultivating a network of community partners is essential to effectively enhance FRNR undergraduate program diversity. Community groups, churches, and other trusted organizations are especially vital to recruiting underrepresented youth (Haynes et al. 2015). The partner network should include secondary and postsecondary education leaders, clergy, and FRNR businesses and industries. The network can help communicate FRNR career options as well as opportunities for high school students to participate in summer programs, dual enrollment courses, campus visits, and other activities.

In an effective community-based organization network, some members will have personal bonds with target high school audiences and their family and social networks. Referring to the fisheries profession, Parker (2019) emphasized the importance of connecting with parents, family members, and other "influencers," convincing them to support students who show an interest in careers the influencers may not have considered. To effectively cultivate a network of community partners, continuing communication is essential, including sharing up-to-date information on FRNR jobs, salaries, and opportunities, as well as personal stories of program impact on students who have recently engaged in FRNR programs and activities.

Action 7. Offer Competitive Scholarships and Other Financial Assistance to High School Students

College affordability (issue 5, figure 1) is a critical issue for many high school students and their families, including students who are historically underrepresented in FRNR programs. For students from low-income families, "the door to higher education is only partially open, because financial and other constraints limit not only where but also how they attend college" (Engstrom and Tinto 2008, 5). In addition to providing information on current costs, detailed information on available scholarships, grants, and other means of reducing the cost of attendance is essential. Financial concerns can also be addressed by sharing income opportunities undergraduate FRNR students may have during the academic year.

Development offices in FRNR programs can also intensify efforts to prioritize scholarships. In the CFR at MSU, for example, FRNR scholarship distributions from within the college increased by 73% from the 2017-18 to the 2022-23 academic year, a significant increase made possible by internally prioritizing direct financial support for students. Coker and Glynn (2017) recommended universities clarify financial aid letters and policies and explicitly show the nontuition costs of college attendance. They also recommended that universities prioritize need-based grants and not reduce institutional aid when students receive private scholarships.

Action 8. Assist Underrepresented High School Students with Applications and Onboarding

The college application process, including financial aid application forms, can be intimidating to some students and their families (Hefling 2013). To assist underrepresented high school students, many of whom are from first-generation families, we highly recommend FRNR program leaders engage actively with on-campus admissions and financial aid offices. We also recommend FRNR leaders seek out and work with off-campus partners, including nonprofit organizations or other groups with a mission to make college more accessible to all students. In Mississippi, for example, the Woodward Hines Education Foundation's Get2College program (<https://get2college.org>) helps Mississippi students in planning, preparing, and paying for college by providing personalized hands-on support. Engaging their staff and their expertise in accessibility issues is a "force multiplier" for enhancing the diversity of FRNR undergraduate programs in the MSU CFR.

FRNR programs should have a "go to" person at the program level to help with navigating processes and procedures relating to admissions, and with questions and issues after students are enrolled. In the MSU CFR, the Student Diversity Coordinator position is a professional staff position dedicated to helping incoming and ongoing underrepresented students as they encounter and navigate college and campus systems, processes, offices, and resources.

Transition to College

The transition from high school to college can be a very anxious time for incoming first-year students, particularly for those who may not have a strong sense that they belong in college, on a particular campus, or in a specific degree program (issue 7, figure 1). Speaking of forestry degree programs, McGown (2015, 586) stated that students' desire for connection "may be especially strong for undergraduates as they transition into their adult lives."

Summer bridge programs—held during the summer "bridge" period between high school and college—are educational interventions widely used to help ease the transition to college, particularly in STEM degree programs. Although they vary greatly, they typically provide students with both academic skills and social resources needed to succeed in a university environment (Institute of Education Sciences 2016). STEM bridge programs generally provide academic instruction in one or more subjects, exposing students to "realistic expectations for STEM course work," while also engaging them in other resources available at universities, including tutoring, access to research opportunities, mentorship programs, and intensive advising (Bradford et al. 2021, 2).

In a review of forty-six published reports on thirty unique STEM bridge programs, Ashley et al. (2017) found 50% of the programs were designed for underrepresented minority students and 20% for women students. Bradford et al. (2021) conducted a meta-analysis of the effectiveness of sixteen bridge interventions, and reported program participation had a "medium-sized effect" on first-year overall grade point average and first-year student retention. After reviewing the effectiveness of various initiatives and practices to improve underrepresented minority student persistence in undergraduate STEM programs, Estrada et al. (2016) recommended summer bridge programs, particularly for highly talented but underprepared minority students.

In figure 4, we highlight the most common elements of STEM summer bridge programs (adapted from Bradford et al. 2021), including support for underrepresented students. Figure 4 includes an overview of recommendations made by Ashley et al. (2017) for STEM summer bridge program developers. The points highlighted in figure 4 for STEM summer bridge programs can help in designing and developing FRNR summer bridge programs for maximum impact and program effectiveness.

Initiatives to assist with students' transition to college can also be of shorter duration, sometimes held the week before fall semester classes begin. In the literature on persistence to college graduation, several studies showed that "growth mindset" interventions before college matriculation resulted in improved year-over-year retention as well as higher overall grade point averages, particularly for students from socially and economically disadvantaged backgrounds (Yeager et al. 2016). A recent study involving twenty-two universities

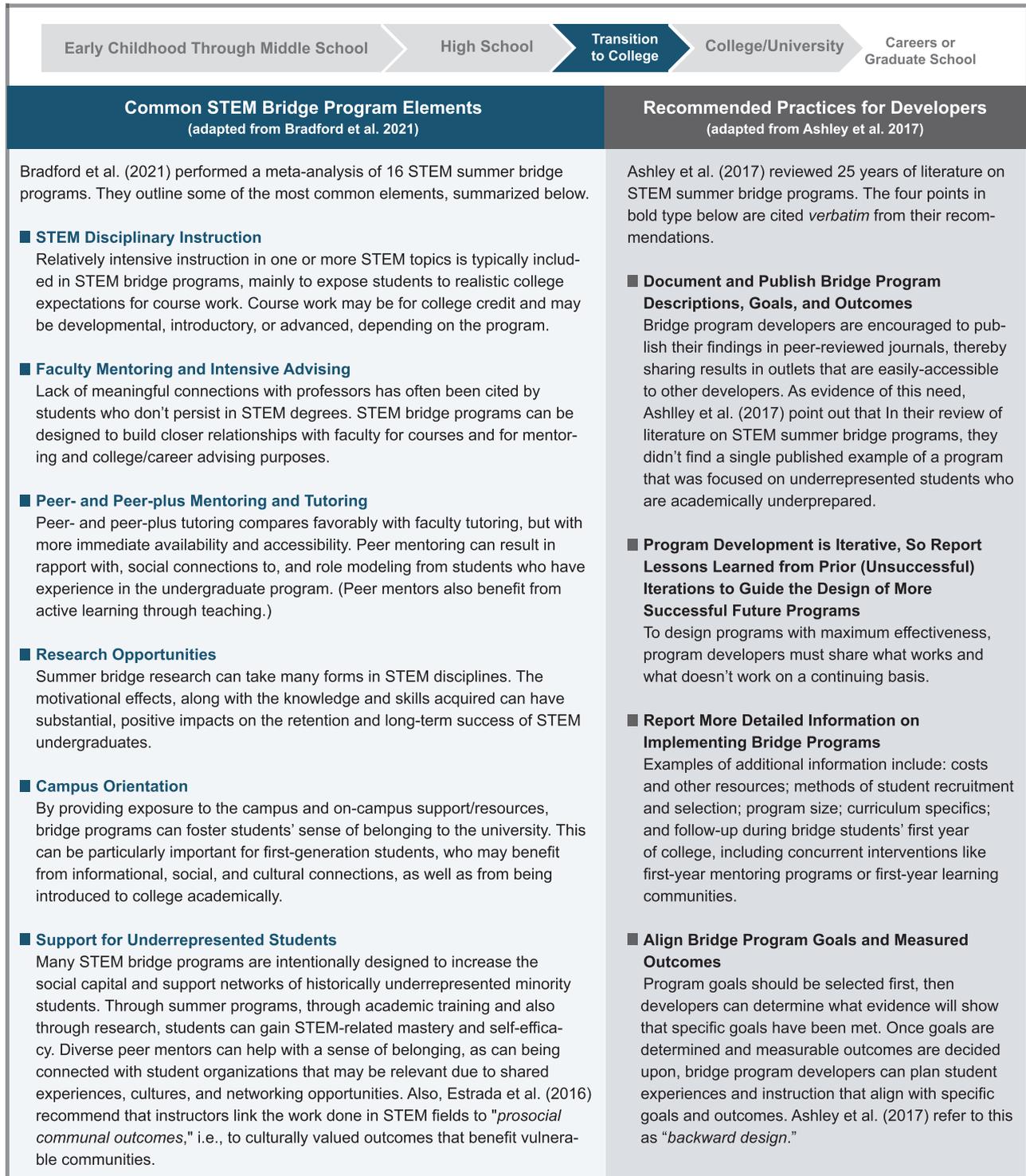


Figure 4 Elements of and recommendations for developing effective STEM summer bridge programs.

and nearly twenty-seven thousand incoming students showed that a brief (10–30 minute) social-belonging intervention positively affected first-year completion; the intervention was described as a “promising way to mitigate inequality” (Walton et al. 2023, 1).

Sense of belonging interventions typically involve upper-year students and/or recent alumni sharing their personal stories of facing and successfully dealing with on-campus adversity. The adversity can range from residence hall interactions to in-class discussions to selections of laboratory partners. As stated by Suh and Owens (2021, 2), “students of color can benefit from other diverse students’ stories of transitory belonging uncertainty because many students encounter internalized racial stereotypes related to academic achievement and historically based underrepresentation of students of color on college campuses.”

An excellent example of a transition to college initiative among FRNR programs is the Tanglewood Fall Field Camp held by the School of Forest Resources at the University of Maine (<https://forest.umaine.edu/undergraduate-programs/field-experience/>). The one week field-based course is taken by students in all majors in the school, allowing newly arriving students to interact with other new students while also interacting with professors. Activities may include navigating with a compass, visiting a timber harvesting operation, performing trail maintenance, and touring a lumber mill. The Fall Field Camp helps students develop connections that help cultivate a sense of belonging.

Efforts to help with the transition from high school to FRNR college programs may also involve introductory courses after the fall semester begins. At Stephen F. Austin State University (SFASU), first-semester students (first-year students and transfer students) in forestry enroll in an introductory

course that includes a weekend program called Root Camp intended to help students establish roots in a forestry community of practice (John Kidd, email message to author, April 12, 2023). Root Camp is held after the fall semester begins, typically the weekend between weeks 3 and 4. Primary objectives are to provide hands-on learning activities relating to the forestry curriculum and create opportunities for new students to participate in team-building activities, to get to know each other, to network with more experienced students and with FRNR student organizations, and to become acquainted with the wide variety of FRNR career pathways.

The Tanglewood Fall Field Camp at the University of Maine, the Root Camp program at SFASU, and similar initiatives in FRNR undergraduate programs can help establish a sense of belonging among students early in the undergraduate experience. With intentional design, such efforts also have excellent potential for welcoming women students and underrepresented minority students to the university, the undergraduate program, and to FRNR professions. (We continue the discussion of cultivating a sense of belonging in the Retaining FRNR Majors section.)

College/University Students

Figure 5 includes two sections, based on whether current college students are FRNR majors.

Recruit College Students Who Currently Are Not FRNR Majors

Connect with and Market to Undeclared Majors, Plus Certain STEM Majors

FRNR program leaders have widely realized that there is a general lack of awareness of FRNR careers and degree programs

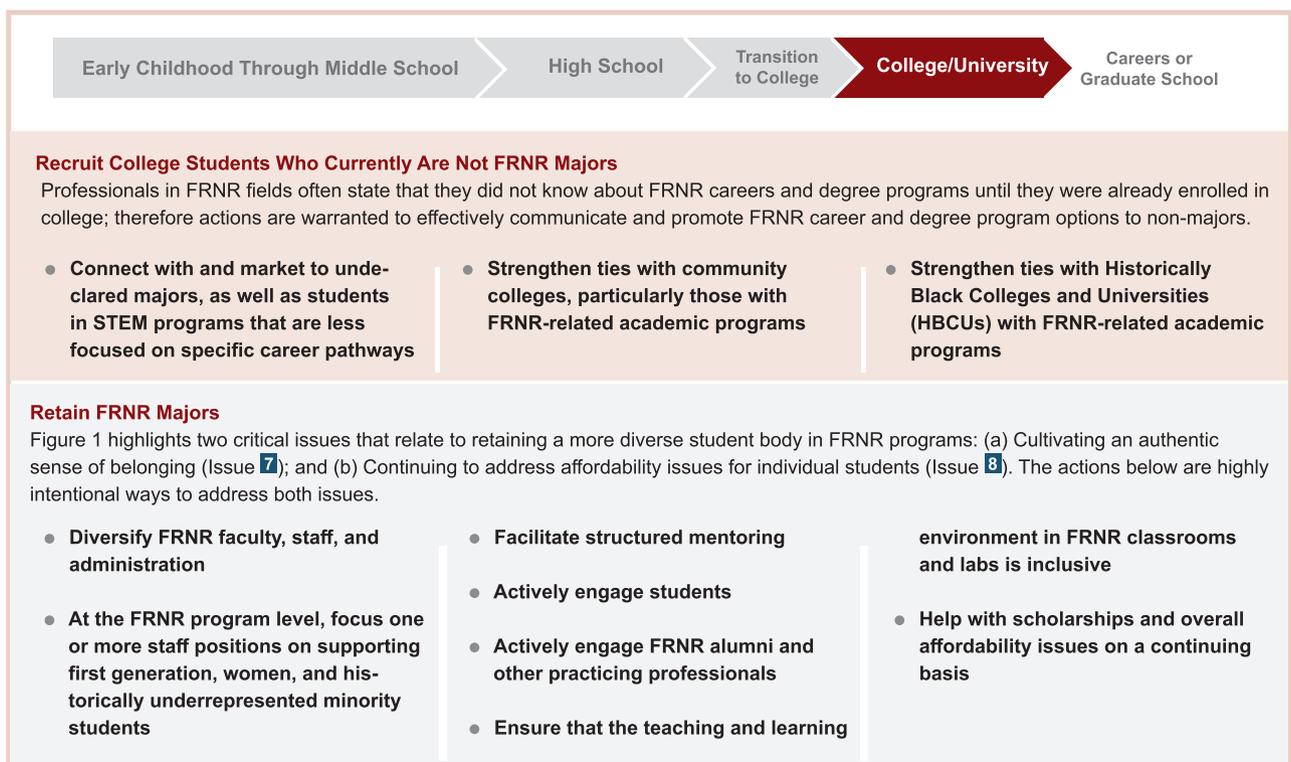


Figure 5 Actions for recruiting current college students to FRNR undergraduate degree programs, and for retaining FRNR students.

(issue 1, [figure 1](#)). Many current FRNR professionals report they were not aware of natural resources degree programs and careers until they were already enrolled in college. In a study of natural resource professionals, nearly 75% of minority group respondents agreed that one way to promote ethnic diversity in the natural resources workforce was to “find interested students in other academic disciplines” ([Adams and Moreno 1998](#), 979). [Outley \(2008\)](#) also noted that minority students often transfer to agriculture and natural resources programs after their first year of college. One method to create awareness and connections is to provide and market speaker panels and other campus events that highlight the successes of diverse FRNR professionals, including recent alumni.

Strengthen Ties with Community Colleges

In the United States today, 36% of Black college undergraduates are enrolled at community colleges ([Camardelle et al. 2022](#)). Across the nation, some community colleges have 2 year degree programs that align directly with 4 year FRNR degree programs, and continuing relationships are needed to articulate and communicate seamless pathways to FRNR bachelor's degrees. Many community college students are not enrolled in programs aligned with FRNR degrees, however, and strong ties are needed to ensure that FRNR careers and opportunities are effectively communicated, particularly given the general lack of awareness of FRNR careers and employment opportunities.

[Cerv and Zink-Sharp \(2022, 196\)](#) indicated recruiting efforts at community colleges should be increased because their enrollments are diverse and they educate almost half of the nation's undergraduates. As a promising action, they suggested providing an FRNR-based summer program for community college students as a “unique opportunity to reach a larger, more diverse audience who are already inserted in higher education.”

[Jean-Philippe et al. \(2020\)](#) recommended four actions to accomplish this: (1) establish more “intrusive” advising; that is, build strong interpersonal relationships with students before they enter the university; (2) implement a “chief knowledge officer” model of advising, where the intrusive advisor helps with both mentoring and academic advising; (3) remove financial barriers; and (4) engage students in meaningful professional development. These recommendations align well with actions needed to address the issues of recruiting and retaining underrepresented students in [figure 1](#).

Strengthen Ties with Historically Black Colleges and Universities

There are multiple examples of successful “2 + 2” programs, where students begin their academic study in a FRNR program at a historically black college or university (HBCU) or other minority-serving institution and then complete their undergraduate degree at a partnering university. Referring to the partnership between Florida A&M University (FAMU) and the University of Florida (UF), [Onokpise et al. \(2008\)](#) recommended recruiting among first-year students and sophomores who were undeclared majors. They described the following as crucial to success for both schools: scholarships and internships; provision of laptop computers; an Academic Success Workshop to help with the transition from FAMU to UF; and awarding of an Associate of Arts degree when students complete the FAMU program. They also recommended students participate in professional groups such as MANRRS

(Minorities in Agriculture, Natural Resources and Related Sciences) and the student chapters of SAF and The Wildlife Society, along with FAMU and UF advising and mentoring services.

Three alumni of the FAMU/UF 2 + 2 program highlighted positive factors like financial assistance, dedicated advisors, work experience, and travel support from the Forest Service, including the opportunity for future employment ([Warwell et al. 2008](#)). They also recommended more effective communication with students and coordination between universities, including orientation sessions and preparation for specific courses at UF. [Markle et al. \(2022\)](#) also recommended support structures to help students overcome barriers to successful transitions between collaborating institutions.

Retain FRNR Majors

Cultivating a sense of belonging must be highly intentional (issue 7, [figure 1](#)). [Lu \(2022, 31\)](#) stated that “Belonging, or a sense of connectedness and the feeling that you matter to those around you, translates into stronger academic performance, persistence, and engagement.” To effectively cultivate this feeling, inclusion and engagement efforts must be well focused and not just based on diverse representation. Inclusiveness means being present, but it also means being heard and truly engaged.

As discussed in the Transition to College section (above), summer bridge programs and programs like Tanglewood Fall Field Camp and Root Camp are promising interventions that FRNR programs can offer to help incoming students with the transition from high school to college—intentionally building a sense of belonging and of being well connected to other students, staff members, and resources while adjusting to a new environment.

In the second section of [figure 5](#), we highlight several actions that, in addition to transition-to-college initiatives, also show promise for cultivating a strong sense of belonging among new and continuing FRNR students.

Diversify FRNR Faculty, Staff, and Administration

Many colleges and universities in the United States today have initiatives to guide actions to diversify their faculty, staff, and administrative employees. FRNR programs benefit from university-level initiatives, of course, including both recruitment and retention actions.

Also, many university-based FRNR programs have college-, school-, or department-level diversity strategic plans that emphasize actions to diversify undergraduate and graduate programs, as well as faculty, staff, and administrative employees. Some of the staff-related actions are near-term, like striving for diverse candidate pools to interview for open positions at all levels; other actions are longer term, like diversifying FRNR graduate programs to grow future faculty and professional staff members. See [Breckenridge et al. \(2021\)](#) for an employee-focused Diversity Recruitment and Retention Toolkit prepared by the Department of Forestry at Michigan State University, the Society of American Foresters, and American Green Consulting Group.

At the FRNR Program Level, Focus One or More Staff Positions on Diversity Concerns

Creating, nurturing, and sustaining an inclusive, welcoming environment in FRNR programs for incoming and continuing

students from all backgrounds must be an intentional priority, as stated by 2023 SAF president Sam Cook (Cook 2023). Having dedicated staff positions in university FRNR programs whose job is entirely focused on supporting first generation, women, and historically underrepresented minority students can demonstrate a high degree of intentionality to create and nurture a welcoming, inclusive culture in FRNR programs, departments, and schools/colleges.

In the MSU CFR, two new staff positions were created in 2022 with financial support from two foundations—a Student Diversity Coordinator position and a Director of Diversity Programs and Student Development position. The positions were created after reviewing the most critical issues we face in diversifying FRNR degree programs and also based on recommendations for action in recent research for diversifying FRNR programs. These staff members are the go-to contact point for students, providing advice, mentoring, assistance with employment and all issues relating to success and progress to graduation.

Facilitate Structured Mentoring

Mentoring can take many forms in undergraduate degree programs, including student-to-student approaches (e.g., near-peer, peer-peer, and/or peer-plus) and between faculty members or practicing professionals and students. In the report “Black Faces in Green Spaces: The Journeys of Black Professionals in Green Careers” (Sustainable Forestry Initiative 2023), each of the twenty-two Black professionals highlighted shared the impact of mentoring on their choices and their career path, demonstrating a wide variety of ways that effective mentoring can occur.

In many cases, college mentoring programs use a dyadic model, in which one person (whether a student, faculty member, or practicing professional) serves as a mentor for a mentee. Other approaches include using “structured mentoring networks,” an approach recommended by Markle et al. (2022) specifically for supporting historically underrepresented students in STEM higher education. They listed specific recommendations for academic units to create opportunities for nondyadic mentoring, with the specific intent of building social capital for student mentees using organized networks of multilevel mentoring.

Another aspect of mentoring programs is the potential for a positive impact on minority students who serve as mentors for other students. Good et al. (2000) reported positive outcomes on minority students’ grades and retention resulting from peer mentoring in an engineering program. Both mentees and the minority students serving as mentors benefited from the mentoring experience.

Undergraduate research programs have become widely adopted in the United States as a specific type of mentoring, whereby faculty members guide undergraduate mentees in research projects. In many cases, the student is paid to work with the faculty member(s) as a junior colleague. These programs have been shown to positively affect students’ self-efficacy for STEM-related careers, including among women and historically underrepresented minority students (Carpi et al., 2016; Hurtado et al., 2009; Moss, 2011).

Although not formal or structured in any way, it is important to note that many college staff members—office and administrative assistants, student affairs assistants, research assistants—are de facto mentors to students. They can have a

very significant impact on students’ sense of belonging, retention, and success (Chambliss 2022).

Actively Engage Students

In the CFR at MSU, we strongly encourage all students to engage in professional organizations. Our Student Diversity Coordinator serves as the staff advisor for the Dean’s Council of Student Leaders, which helps ensure we are proactive in reaching out and engaging all our students. CFR students were selected to participate in SAF’s Student Diversity Scholar (SDS) program in 2022, a program designed to help students from underrepresented groups thrive in the forestry profession by providing a year of tailored mentoring, leadership, and networking training, a year of complimentary membership, and a full scholarship to the SAF National Convention. For the fifteen to twenty students selected nationally each year for the SDS program, this is an excellent opportunity to connect with professionals and other students.

In many US FRNR undergraduate programs, funds are allocated to assist with students’ travel to state, regional, and national conferences. During those meetings, students are encouraged to participate in sessions of interest to them professionally and personally. At the SAF and The Wildlife Society national conventions, for example, there are multiple opportunities to connect with practicing professionals through events such as the Women in Forestry breakout session, which has been held at the SAF convention each year since 2015 (Tamblyn 2022).

Women’s Forest Congress was established in 2022 with an aim of building a shared sense of belonging among women in forestry (Newhouse 2023). Another excellent example of professional networking among women in forestry is SWIFT—Supporting Women in Forestry Today (Crandall et al. 2020), a program with demonstrated effectiveness in retaining women in the forestry undergraduate degree program at the University of Maine. Establishing support networks and engaging positive role models are actions that are recommended for FRNR educators by Macinnis-Ng and Zhao (2022).

Diverse students are not monolithic in their perspectives and in the actions that are effective in cultivating a sense of belonging. For Hispanic college students, for example, Hurtado and Carter (1997) found that discussions with other students outside of class and membership in religious and social-community organizations were strongly associated with students’ sense of belonging.

Actively Engage FRNR Alumni and Other Practicing Professionals

It is also important to involve diverse role models in FRNR classes and other activities. In the MSU CFR, we are being intentional about this through a newly formed college-level Diversity Engagement Council (DEC)—a group of women professionals and minority professionals, some of whom are alumni of our academic programs, to help us address the relative dearth of role models in FRNR professions (issue 3, figure 1). Members of the DEC agreed to help guide our efforts to enhance diversity and to be “on deck,” that is, we may call on them occasionally to speak to FRNR classes, meetings, or other events involving current students. They may also be asked to interact with community college students or other events involving high school students and their families, teachers, and counselors.

Ensure that the Teaching and Learning Environment in FRNR Classes and Laboratories is Inclusive

A welcoming and inclusive atmosphere in FRNR classes and laboratories requires focused action by program faculty, staff, and administrators. [Copenheaver et al. \(2020\)](#) organized a focus group of ten experienced faculty members who teach university-level outdoor field laboratories in agriculture and natural resources, and they identified best instructional practices for retaining women students. The practices they deemed essential to having inclusive learning spaces were

- (1) Enforce Title IX policies.
- (2) Set clear expectations for faculty and student behavior and enforce consequences for faculty and students who violate these expectations.
- (3) Establish a laboratory code of conduct that includes information about sexual harassment.
- (4) Create a lab climate with both open communication and zero tolerance for sexual harassment.

These are excellent recommendations that can be communicated and implemented within FRNR academic units. In a similar way, the teaching and learning climate must be inclusive for all students, regardless of their gender, race, ethnicity, or background. A growing body of evidence indicates that a relatively simple in-class intervention using videos called Scientist Spotlights can be very effective at cultivating inclusive classroom environments. [Metzger, Dingel, and Brown \(2023, 16\)](#), for example, stated: “In short, any instructor who has recognized the need to cultivate a more inclusive STEM environment should be persuaded and empowered to implement Scientist Spotlights as part of their course.” For a broader guide to pedagogical choices that can influence students’ sense of belonging, see [Dewsbury and Brame \(2019\)](#); [Hogan and Sathy \(2022\)](#), and [Sathy and Hogan \(2023\)](#).

FRNR program leaders should create opportunities for students to share their sense of belonging experiences—in class and out-of-class—via one-on-one or small focus-group exercises. A study of persistent norms and the lack of gender equality in forestry education in Sweden specifically recommended small-group discussions to help cultivate awareness of biases and as a way to develop prosocial behaviors ([Grubbström and Powell 2020](#)). FRNR program leaders should be intentional in sharing the positive and negative experiences and perceptions of students with faculty, staff, and administrators, as well as with other students, helping to create, nurture, and sustain an inclusive, welcoming culture throughout the program.

Help with Scholarships and Overall Affordability Issues on a Continuing Basis

Affordability issues throughout the undergraduate experience must continue to be addressed (issue 8, [figure 1](#)). Citing the US Department of Education, [Swaak \(2022\)](#) stated that 42% of college dropouts leave because they face financial stress, not because they are failing. Unexpected financial emergencies for students are being met in some universities through emergency aid programs and by integrating financial aid and social services ([Coker and Glynn 2017](#)).

In FRNR programs, staff members must continue to be very involved with individual students regarding scholarship

applications and other aspects of being able to afford college, including FRNR summer jobs, paid internships, and other income opportunities that also build students’ FRNR work experience ([Balcarczyk et al. 2015](#); [McMullin 2019](#)). To attract diverse undergraduate students to “field internships and field technician positions,” [Jensen et al. \(2021\)](#) recommended competitive pay/salary, flexibility in scheduling, and opportunities for students to work near school or family.

Universities across the United States are also implementing and assessing retention grants and completion grants, which are designed to “increase retention and completion rates among first-generation students, low income students, and students of color” ([University Innovation Alliance 2021, 1](#)). Similar initiatives are also being implemented and evaluated in individual states. In Mississippi, for example, the [Woodward Hines Education Foundation \(2023b\)](#) implemented a grant program called IMPACT (Improving Mississippi’s Persistence and Completion Together) with multiple universities to reduce achievement gaps and improve degree completion among underserved populations. The program also created a community for university practitioners in the state to learn from each other.

Conclusions

The pipeline to US FRNR professions has great potential to grow in gender, racial, and ethnic diversity, particularly in undergraduate forestry degree programs. To effectively enhance the diversity of FRNR undergraduate degree programs, leaders and practitioners must understand the critical issues summarized in [figure 1](#) and share practices and programs that show promise, so we can learn and become more effective on a continuing basis. Systemic solutions, widely shared, are needed to address systemic issues ([Estrada et al. 2016](#); [Markle et al. 2022](#)).

[Batavia et al. \(2020, 715\)](#) recommended “more concerted attention to developing and sharing best practices that cultivate diverse and inclusive and equitable communities.” [Sharik et al. \(2015, 550\)](#) suggested further research on the perceptions of women and minority students of FRNR professions to guide recruiting and retention practices, and they advocated “examining academic programs that have been successful at recruiting and retaining minorities and applying their strategies elsewhere.” [Sharik \(2015\)](#) also recommended we collectively implement diversity strategies and measure and share their outcomes.

The recommendations outlined by [Ashley et al. \(2017\)](#) for STEM summer bridge programs (summarized in [figure 5](#)) can be broadened to include many types of diversity-focused FRNR efforts and programs. When possible as developers, we should document and publish descriptions, goals, and outcomes of activities, events, interventions, programs and other efforts. We should report lessons learned from both successful and unsuccessful efforts and share detailed information on costs, resources, curricula, and other program specifics, including follow-up efforts.

Another important recommendation is to carefully align diversity program goals and measured outcomes. [Ashley et al. \(2017\)](#) recommended program goals should be selected first, followed by determining what evidence will show that specific goals have been met. Developers can then plan student experiences and activities that align with specific goals and

outcomes, referred to as “backward design” (O’Connell et al. 2018, 2022).

After reviewing one hundred years of literature on demographic diversity in forestry, fisheries, wildlife, rangelands, and natural resources management, Brown (2020) noted the *Journal of Forestry* was the top peer-reviewed journal in terms of the number of articles published; of 137 total articles, 48 were in the *Journal of Forestry*. In concluding the review, however, Brown (2020, 65) suggested “the need to further explore the gap between saying and doing; between publishing articles about diversity and making widespread, tangible gains.” Our primary goal in the present review of critical issues and promising actions is to help guide the *doing*—by better understanding the issues we confront, we can more effectively implement programs and practices with greater promise for making widespread, tangible gains.

Supplementary Materials

Supplementary data are available at *Journal of Forestry* online.

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