

# Diverse, equitable, and inclusive scientific societies: Progress and opportunities in the Society for Freshwater Science

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**Abstract:** Discussions about diversity, equity, and inclusivity are becoming increasingly common in scientific societies. However, more concerted efforts are needed to recognize and challenge systemic discrimination to ensure scientists from marginalized groups can contribute to and benefit from scientific societies. Here, we evaluate efforts and opportunities within the Society for Freshwater Science (SFS) as examples for how scientific societies can make progress toward diversity, equity, and inclusivity. In 2017, SFS collected anonymous demographic information and open-ended feedback from SFS members through an online survey. We combined this information with 2 examples of recent initiatives and challenges that occurred within SFS. We present a guide for SFS and other scientific societies toward creating a more welcoming and equitable space for all scientists. To prioritize diversity, equity, and inclusivity, scientific societies must center the voices of marginalized and underrepresented people in all scientific society activities, including within groups of all sizes and at all society events. These actions will allow scientific societies to better represent and engage with their current and future members and the broader communities those members serve.

**Key words:** scientific societies, marginalized, allyship, discrimination, ableism, race, intersectionality, LGBTQ+, privilege

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DOI: 10.1086/709129. Received 16 May 2019; Accepted 04 January 2020; Published online 9 July 2020.

Freshwater Science. 2020. 39(3):000–000. © 2020 by The Society for Freshwater Science.

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For centuries, science has been a nearly-exclusive domain of upper-class white men, with limited opportunities for marginalized people to either make or be recognized for notable scientific contributions (Bronstein and Bolnick 2018). Marginalized people are discriminated against or oppressed based on characteristics such as race and ethnicity, class, religion, national origin, language, citizenship, marital status, sex, age, differing abilities, sexual orientation, gender identity and expression, transgender status, and parental or pregnancy status. Although science participation has broadened over the last several decades, most American scientific societies remain disproportionately white, male, heterosexual, and cisgender (George et al. 2001, Stevens et al. 2008, Beck et al. 2014, Arismendi and Penaluna 2016, Penaluna et al. 2017). Furthermore, many major scientific awards, positions of leadership within societies, and invited speakers and panels at major scientific conferences lack representation from marginalized groups (Schroeder et al. 2013, Sardelis and Drew 2016, Silver et al. 2017).

Many scientific institutions still fail to adequately address the ways that societal systems of privilege and power operate to marginalize members of our communities (Brown et al. 2017, Potvin et al. 2018), although most institutions now recognize that broadening participation and increasing diversity are important goals. Discrimination can take multiple interacting forms, depending on a person's identities (e.g., race, gender, class, culture, and professional status). We define terms, such as identity, based on their usage in current discourse of diversity, equity, and inclusivity in

STEM. We acknowledge that the meanings of these terms are fluid and are subject to change as the public conversation progresses (see Box 1 for a glossary of relevant terms). We must consider how discrimination acts on these identity dimensions and question how our current practices and the legacy of past practices may reinforce exclusion and discrimination within our scientific societies. Here, we discuss how the Society for Freshwater Science (SFS) and its members have worked to reduce barriers against diversity, equity, and inclusivity, and we highlight areas where additional progress will further advance this goal. In particular, we: 1) review the function of diversity, equity, and inclusivity in scientific societies; 2) outline the current demographics and cultural climate within SFS; 3) describe 2 examples intended to increase diversity, equity, and inclusivity within SFS that differ with regards to their targeted career stages, approaches, and successes; and 4) provide suggestions for how SFS and individual members can continue to expand these efforts. The goal of this article is to initiate a call to action for SFS and its members to actively think about and improve diversity, equity, and inclusivity in our scientific society.

## FUNCTIONS OF DIVERSITY, EQUITY, AND INCLUSIVITY IN SCIENTIFIC SOCIETIES

Increasing diversity, equity, and inclusivity in science and scientific societies has 2 main functions: to promote scientific advancement and to fulfill a moral and ethical obligation to our peers. We define diversity as the variety of

### Box 1

Definitions of terms used in this paper.

**Cisgender** - adjective for a person whose gender identity corresponds with their sex assigned at birth (i.e., someone who does not identify as transgender, gender fluid, gender-nonconforming, gender non-binary, etc.).

**Cognitive diversity** - a measure of how a collaboration between individuals or groups of different backgrounds, experiences, and perspectives represents a variety of unique identities.

**Cultural diversity** - the number of unique identities (e.g., ethnicity, race, language, religion, sexual orientation, gender, age/generation, differing abilities, veteran status, immigration status, career status, and intersections thereof) that are present in a group of people.

**Equity** - providing what individuals need to be successful. Distinguished from equality, which provides exactly the same resources to each individual, regardless of their needs.

**Harassment** - the act of systematic and/or continued unwanted actions by 1 party or a group.

**Identity** - the answer to the question, "Who am I?" Identities arise from self-categorization or identification in terms of membership in particular groups, traits, or roles.

**Implicit or cognitive bias** - attitudes or stereotypes that influence our understanding, actions, and decisions in an unconscious manner.

**Inclusivity** - the act of supporting a collaborative environment that places value on cultural and cognitive diversity.

**Microaggressions** - brief and commonplace verbal, behavioral, or environmental indignities, whether intentional or unintentional, that communicate hostile, derogatory, or negative attitudes or reinforce power.

**Privilege** - unearned advantages derived from identities and attributes of those identities.

**Social justice** - process by which governments, groups, and individuals begin to think about and strive for equity and justice for all individuals.

**Structural bias** - bias against an individual or group that is a consequence of the reward structure and activities carried out by an organization.

identities present, equity as providing people with what they need to be equally successful, and inclusivity as supporting a collaborative environment that values diversity and equity (Box 1). Scientific societies function to bring together people working on related topics, thereby facilitating networking and career development and shaping the direction, culture, and ethics of their fields (Mason et al. 2016). In addition, scientific societies advance scientific knowledge, facilitate public understanding of science, and engage with policy makers. To accomplish this goal of scientific advancement, many scientific societies recognize that greater membership diversity can lead to better science by broadening viewpoints, questions, and problem-solving skills (Nathan and Lee 2013, Page and Vandermeer 2013, Lee 2015, Trax et al. 2015, Gao and Zhang 2016, Nielsen et al. 2017). For example, the SFS Statement on Diversity, approved in June 2016 (Fig. 1, Box 2), contextualizes the value of diversity as a belief that it "fosters a richer understanding of freshwater ecosystems and conservation of global freshwater resources". The benefits of diversity will not be realized, however, unless scientific societies work to increase equity and inclusivity by welcoming and valuing members

of marginalized groups and removing barriers to their participation (Joshi and Roh 2009, Maton et al. 2016, Puritty et al. 2017).

By increasing diversity, equity, and inclusivity, society members fulfill a moral and ethical responsibility to include everyone in scientific spaces and serve populations affected by the issues we study here. To work toward a more equitable scientific enterprise, we must examine whom the society is serving, both directly and indirectly, and the ways that cognitive and structural biases influence our activities. For example, although SFS has a stated mission to increase diversity and inclusivity within its membership (Box 2), the current SFS mission statement does not include social justice issues related to freshwater resources. If diversity, equity, and inclusivity are goals for SFS, we must expand our focus to include the populations affected by the issues we study, including how reduced water quality and quantity, unequal access to clean water, and diminished ecosystem services disproportionately harm poor and otherwise marginalized communities (Balazs et al. 2012, Hanna-Attisha et al. 2016, McIntyre et al. 2016, Brooks et al. 2017, Switzer and Teodoro 2017). Our research, as well as our professional

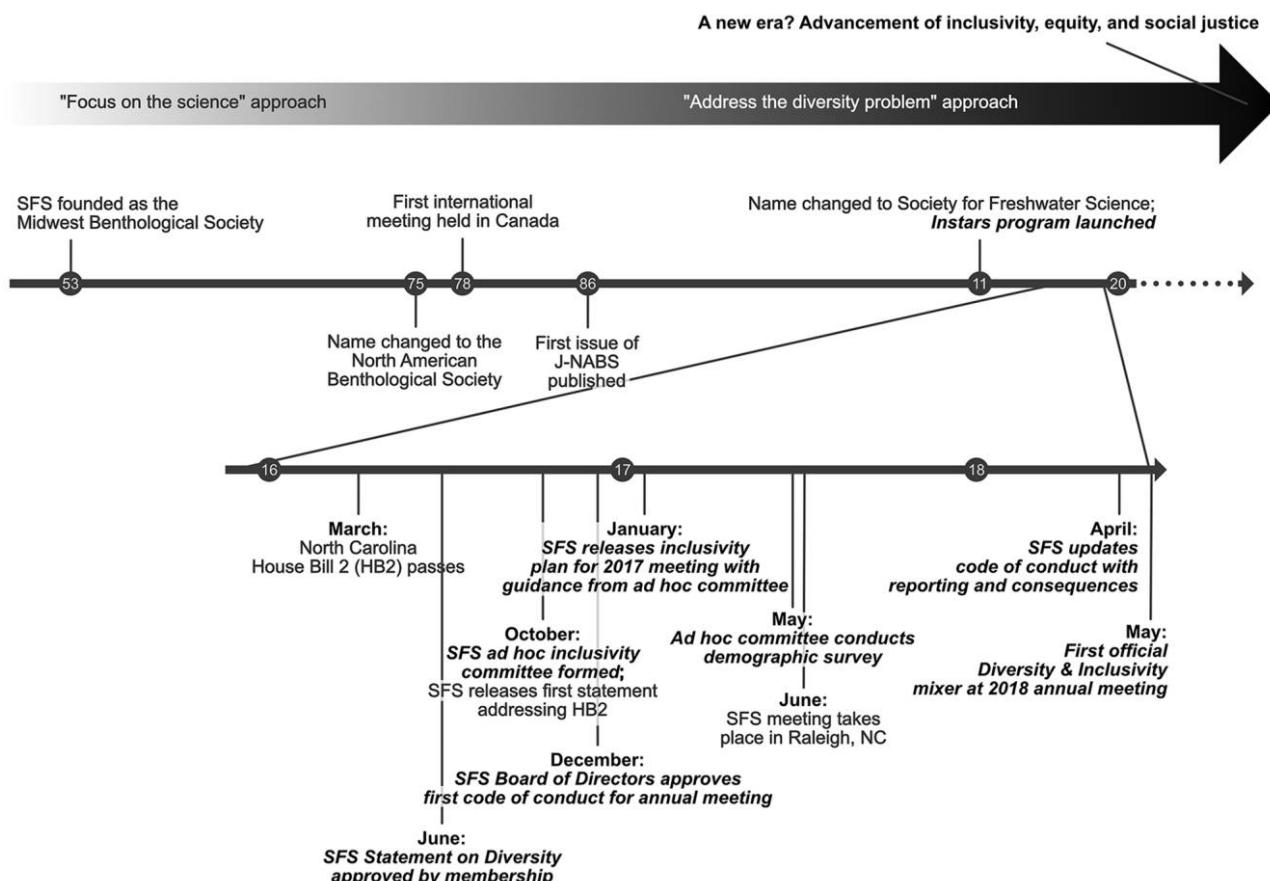


Figure 1. Timeline of diversity, equity, and inclusivity activities and events in the context of Society for Freshwater Science (SFS) history. Events of 2016 to 2018 (see text for details) are expanded and highlighted. Top arrow coarsely indicates 3 eras of approaches to increasing diversity, equity, and inclusivity in science. Bolded, italicized text indicates efforts by SFS members and leadership to increase diversity, equity, and inclusivity. Years are abbreviated to 2 digits.

**Box 2**

SFS Statement on Diversity. Approved by membership, June 2016.

"The Society for Freshwater Science is dedicated to promoting diversity among its members and welcomes and encourages participation from all, regardless of ethnicity, sexual orientation, gender identity, socioeconomic status, physical or mental difference, religion, age, or national origin. The SFS is inclusive and accepting of all people and built on tolerance, respect, and a welcoming spirit at all of our activities. We strive to actively promote diversity across all levels of our society including members, leaders, committees, and staff. We value a diverse community and believe it fosters a richer understanding of freshwater ecosystems and conservation of global freshwater resources. Members with questions, comments or concerns about SFS diversity issues are encouraged to raise them with a member of the SFS Education and Diversity Committee."

societies, must include the voices and participation of marginalized people to fulfill our moral and ethical obligations.

Several scientific societies have begun to assess their demographics and provide frameworks for actively encouraging diversity, equity, and inclusivity (e.g., Penaluna et al. 2017). However, a number of additional activities may be necessary to successfully counter systemic oppression and implement these frameworks. These activities include: amplifying marginalized voices; recognizing and validating different cultures and experiences; ensuring leadership positions, opportunities, and awards are received by members from diverse groups; providing financial and material support for members who have fewer resources; and addressing systemic societal and implicit biases. Continuing to reform institutions and their practices will strengthen our science and help to fulfill our moral and ethical obligations (Ely and Thomas 2001, Nielsen et al. 2017).

### APPROACHES TO DIVERSITY, EQUITY, AND INCLUSIVITY WITHIN SCIENTIFIC SOCIETIES

We identify 3 general approaches that scientific societies can take to increase diversity, equity, and inclusivity. First, the traditional approach has been to assume that science is innately a value-neutral, colorblind process of knowledge creation that cannot discriminate. Thus, scientific organizations need only to focus on the science. However, this view privileges the majority and perpetuates oppression toward other groups by ignoring the different barriers that people with marginalized identities face in doing science (Pless and Maak 2004). In addition, this approach forces marginalized members to assimilate into the dominating culture without recognizing their own unique experiences (Shore et al. 2011).

A 2<sup>nd</sup> approach recognizes that science has a diversity problem and works to celebrate diversity and enact anti-discriminatory policies (e.g., societal codes of conduct) (Adamo 2013, Massey 2015, Kaplan et al. 2018). These activities are becoming mainstream among scientific societies (e.g., Penaluna et al. 2017), yet significant social, cultural, and institutional barriers remain and continue to marginalize people (Haynes and Jacobson 2015, McGlynn 2017, Potvin et al. 2018). Even when scientific society members and leadership recognize the value and moral imperative of increasing diversity in our fields, scientific societies still lack mechanisms to ensure equitable and inclusive environments. Societies can actually cause greater harm by recruiting marginalized scientists into discriminatory and exclusionary environments (Puritty et al. 2017). Diversity, equity, and inclusivity are a 3-legged stool. Focusing solely on diversity and ignoring inclusivity and equity can backfire by bringing marginalized groups into environments where they are then excluded and do not receive adequate support to succeed.

A 3<sup>rd</sup> approach is to actively advance diversity, equity, and inclusivity through the lens of social justice with continuous work to combat systematic bias. Scientific societies can enact policies and programs that explicitly and proactively include and amplify the viewpoints of people with marginalized identities and provide them financial and material support. This approach, for which we advocate, requires a concerted effort by scientific society leadership and fellow members to counteract the unconscious biases and intentional social forces (e.g., racism, sexism, xenophobia, homophobia, ableism, colonialism) that cause systemic discrimination (Roberson 2006, Prescod-Weinstein 2017). Unlike the first 2 approaches, this approach ensures that the environment into which marginalized scientists are being recruited is one that recognizes and supports their experiences while simultaneously creating a culture of belonging (Shore et al. 2011). The discourse and role of scientific societies can evolve over time toward this 3<sup>rd</sup> approach through the concerted efforts of advocates and the official adoption of progressive policies and practices (Fig. 1). In the following sections, we detail SFS demographics and culture and describe approaches that SFS has used to advance diversity, equity, and inclusivity.

### STATUS OF DIVERSITY, EQUITY, AND INCLUSIVITY IN SFS: MEMBERSHIP SURVEY

In May 2017, SFS e-mailed out its 1<sup>st</sup> demographic survey, which included questions concerning members' attitudes toward diversity, equity, and inclusivity. This survey was created by an SFS ad-hoc committee on inclusivity and e-mailed to all members enrolled in SFS at any time from 2014 to 2017. The creation of this committee and the survey were prompted by concerns over the 2017 SFS annual meeting held in Raleigh, North Carolina following the passage of the state's House Bill 2. This House Bill, passed

Table 1. Summary of the professional affiliation of respondents to the Society for Freshwater Science survey. Percentages for the academia subcategories are based on responses by academics who identified their type of institution. A total of 279 respondents completed the survey.

Position type	% of respondents
Academia	70
Doctorate-granting university	75
Masters-granting university	8
Primarily-undergraduate institution	15
Other	2
Government agency (any level)	17
Private industry	7
Non-profit organization	4
Other	2

in 2016, eliminated city- and county-level anti-discrimination protections for lesbian, gay, bisexual, transgender, and queer (LGBTQ+) individuals, including removing protections for transgender and gender non-conforming individuals to use public restrooms based on their gender identity (Fig. 1). We acknowledge that some of the responses to the survey may have been influenced by this context.

Once e-mailed, the anonymous online survey remained open for 10 d prior to the SFS annual meeting in June 2017. We received 279 responses, which represented ~20% of the 1426 registered SFS members at that time. Two-thirds (66%) of respondents were under age 50, and ½ of respondents had been members of SFS for >10 y. Most respondents were United States (US) residents (84%) and worked in academia (70%), particularly at doctorate-granting univer-

sities (Table 1). Eleven respondents were from Hispanic-Serving Institutions, none were from Historically Black Colleges and Universities or Tribal Colleges and Universities, and 5 were from institutions that have over 25% African American undergraduate enrollment. Respondents overwhelmingly identified as white (87%). Like other ecology-centered scientific societies, SFS has a higher proportion of white members than the US population as a whole, US college students, or full-time faculty at US colleges (Table 2). Women, respondents with disabilities, and individuals from marginalized racial backgrounds were underrepresented in SFS relative to the US population (Fig. 2). Only 0.7% of SFS survey respondents identified as Black, although African Americans represented 6% of the US professoriate in 2015. Similar underrepresentation of people identifying as Black exists in other professional societies representing the aquatic or ecological sciences, including the Ecological Society of America (1%; Beck et al. 2014) and the American Fisheries Society (1%; Penaluna et al. 2017). We chose to compare SFS demographics to the US population, US college students, and US faculty (Table 2) as most SFS survey respondents were US residents and worked in academia. We present these comparisons, in addition to data on other professional societies, to highlight the opportunity that SFS has to recruit people with marginalized identities and how other scientific societies compare.

People who identified as transgender and people who identified as LGBTQ+ constituted a higher percentage of survey respondents than those identifying as such among US adults (Fig. 2; Flores et al. 2016, Newport 2018). This result has 2 possible explanations. First, LGBTQ+ members may have responded to the survey at higher rates than members who do not identify as LGBTQ+, possibly motivated

Table 2. Percentages of different demographic groups present in the United States (US) population, US college students, US college faculty, members of the Ecological Society of America (ESA) and American Fisheries Society (AFS), and respondents to the Society of Freshwater Science (SFS) survey (reported as all SFS respondents and SFS-student respondents).

Demographic	US population (2010) <sup>a</sup>	US college students (2017) <sup>b</sup>	US college full-time faculty (2015) <sup>c</sup>	ESA (2015) <sup>a</sup> (n = 6803)	AFS (2015) <sup>a</sup> (n = 3546)	SFS (2017) (n = 279)	SFS students (2017) (n = 62)
Women	51	56	46	42	25	43	66
Men	49	44	54	58	75	55	34
White	64	58	75	85.5	91.2	87	87
Black	12	15	6	1.3	1	0.7	3
Asian	5	8	10	6.6	3.3	3	3
Latinx/Hispanic	16	17	5	5.3	3.6	5	7
Native American	0.8	unknown	0.5	unknown	0.9	0.4	0
Other <sup>d</sup>	2	2	4	1.3	unknown	3	2

<sup>a</sup> Penaluna et al. 2017.

<sup>b</sup> USCB 2017.

<sup>c</sup> US Department of Education Digest of Education Statistics. (Available from: [https://nces.ed.gov/programs/digest/d17/tables/dt17\\_315.20.asp](https://nces.ed.gov/programs/digest/d17/tables/dt17_315.20.asp))

<sup>d</sup> Other includes 2 or more races, prefer not to say, and unknown.

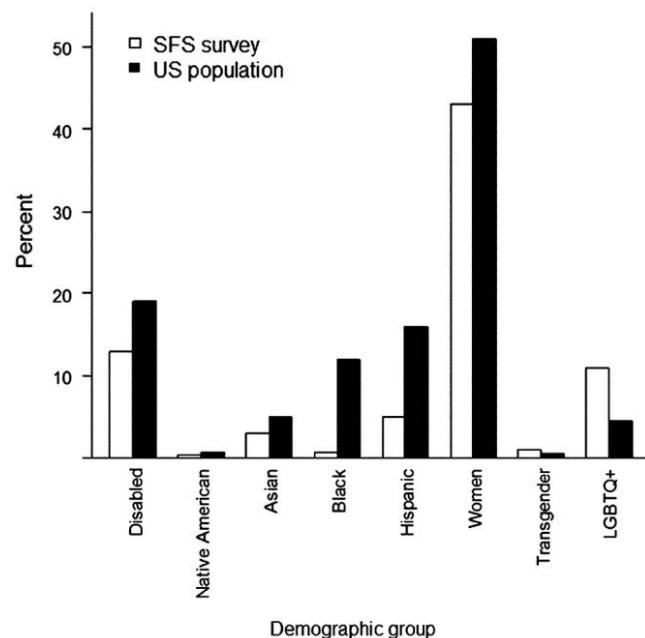


Figure 2. Percentage of survey respondents identifying with marginalized groups relative to the United States (US) population. The membership of Society for Freshwater Science (SFS) is international, but we use the US population for comparisons because of the availability of comparable data and because nearly all previous SFS meetings have been held in the US.

by events leading up to the 2017 SFS meeting (Fig. 1). Second, SFS may have a relatively-large LGBTQ+ population. In either case, SFS would benefit from recognizing and celebrating this diversity as well as fostering inclusivity by actively working to serve and retain these members. Undergraduates who are LGBTQ+ have a 7% lower retention rate in science, technology, engineering, and math (STEM) fields relative to heterosexual, cisgender undergraduates (Hughes 2018), which highlights the opportunity SFS has to contribute to improving STEM retention.

The survey also asked respondents about barriers to attending the SFS annual meeting. Responses suggest that decisions about meeting locations may contribute to lower

attendance rates for LGBTQ+ individuals. In fact, of the 50% of respondents who did not plan to attend the 2017 meeting because of travel and registration costs, 20% also identified the North Carolina House Bill 2 as a barrier to attendance. Additionally, the survey demonstrated that those who identify as LGBTQ+ were affected more by barriers to attending the 2017 meeting than were non-LGBTQ+ identifying members ( $n = 79$ ;  $p = 0.003$ ,  $\chi^2 = 11.45$ ,  $df = 2$ ). Furthermore, several states withheld funding for travel to North Carolina because of House Bill 2, and these funding restrictions affected many state-funded SFS members. This situation is not unique to North Carolina. At the time of this writing, there are 11 states to which California has banned state-funded and state-sponsored travel because these states have enacted laws that require or allow discrimination on the basis of sexual orientation, gender identity, or gender expression.

Responses from the survey highlighted a possible gap between the intention to be an ally to LGBTQ+ members in SFS and meaningful action to demonstrate allyship (i.e., the process of building relationships based on trust and accountability with marginalized people). Only 11% of respondents had taken formal inclusivity training, such as ally or safe zone training, although 73% of respondents considered themselves LGBTQ+ allies. Although formal training is not required to be an ally, nor does it ensure allyship, it does show that a person is taking meaningful action. Demonstrating true allyship is necessary for the retention of scientific society members with marginalized identities. Retention of LGBTQ+ individuals is higher than retention of individuals from some other marginalized groups in STEM, such as African American and Latinx students (Hill et al. 2016), but it remains lower than that of privileged groups, such as white, cisgender, heterosexual males (Hughes 2018).

The survey concluded with 3 open-ended questions, allowing respondents to suggest ways to increase inclusivity and accessibility and share their thoughts on the status of diversity, equity, and inclusivity within SFS (see Table 3 for specific questions). To quantify these results, we coded SFS

Table 3. Number (#) of responses to the open-ended questions on the Society for Freshwater Science (SFS) survey and the percentage of responses coded as positive (i.e., in support of additional actions and attentions by SFS to improve diversity, equity, and inclusivity); neutral (i.e., no preference or unsure); or negative (i.e., not in support of further actions to improve diversity, equity, and inclusivity in SFS).

Question	Total # of responses	% of responses		
		Positive	Neutral	Negative
What can SFS do to make the organization and annual meeting more inclusive to people who are transgender, specifically, and who identify as LGBTQ+, more broadly?	110	74	11	15
What can SFS do to make the organization and annual meeting more accessible to people with disabilities?	67	78	21	1
Please share any thoughts, specific suggestions, or critical feedback on the SFS society and the annual meeting in relation to diversity and inclusivity.	70	86	0	14

member responses to these questions as positive (in support of additional actions and attentions by SFS to improve diversity, equity, and inclusivity); neutral (no preference or unsure); or negative (not in support of further action to increase diversity, equity, and inclusivity in SFS). The answers were independently reviewed by 3 people to ensure consistent coding. To avoid bias, the reviewers were not given the demographic information associated with written answers. Corresponding demographic information was attached to the written answers post-coding for further analysis. Most responses to all 3 questions were positive, but we did receive some negative responses as well. The greatest percentage of negative comments were in response to the question about LGBTQ+ inclusion (15%) followed by the question about general diversity, equity, and inclusivity efforts (14%). Negative responses to the question about inclusion of people with disabilities constituted only 1% of total responses (Table 3). The negative responses to diversity questions were largely from people who identified as white men, although some white women also responded negatively. None of the respondents who submitted negative responses identified as LGBTQ+, and only 1 identified as having a physical disability. Other respondents who responded negatively chose not to provide demographic information. The negative responses received in this survey underscore the need for the demographic majority members of SFS and other scientific societies to engage in opportunities to interact with and learn from those with marginalized identities. Creating a conference environment where diversity, equity, and inclusivity efforts are treated as seriously as scientific research can help to increase participation of marginalized groups in science (Leung 2018).

Finally, this survey is the 1<sup>st</sup> broad demographic survey of SFS membership that can be used to follow and challenge our progress into the future. We encourage future surveys of SFS membership to continue to track both demographics and attitudes toward inclusivity and equity of our scientific society. Our survey focused more on LGBTQ+ demographics, given the issues surrounding the location of the 2017 SFS annual meeting, but more survey efforts are needed to identify demographic make-up and potential barriers to inclusion across other marginalized groups. Importantly, marginalized racial groups, women, and respondents with a disability were not well represented in this survey effort and are not well represented in SFS.

### SFS EFFORTS TO INCREASE DIVERSITY, EQUITY, AND INCLUSIVITY

The 2017 survey was meant to formally gauge the state of the society in terms of current thoughts and perspectives on diversity, equity, and inclusivity. The survey highlighted the need for increased diversity, equity, and inclusivity within SFS, and here we discuss 2 examples of SFS and its

members doing this work. The 1<sup>st</sup> example is the Instars mentoring program, a long-term initiative by SFS that has increased recruitment and retention of students from marginalized groups. The 2<sup>nd</sup> example is the North Carolina House Bill 2 coupled with the 2017 SFS meeting in Raleigh, which demonstrates the work that remains to be done for SFS to be inclusive along multiple identity dimensions.

#### Instars mentoring program

SFS has actively invested in efforts to broaden diversity within its membership by sponsoring undergraduate students from underrepresented groups (i.e., those who identify as either being from a marginalized racial group, being a 1<sup>st</sup>-generation student, or having a disability) to attend the SFS annual meeting as Instars Fellows through the Instars mentoring program. Before the start of the meeting, Instars Fellows take part in a half-day orientation workshop to learn the layout of a typical scientific meeting, and a group of graduate student mentors help the Instars Fellows navigate the meeting. During the meeting, Instars Fellows attend plenary sessions and a variety of special, technical, and poster sessions. They are guided through multiple networking activities, participate in a professional development workshop, and have opportunities to present their own research.

A large part of the program's success is attributable to the financial buy-in and recruitment support from SFS leadership and membership at large. Specifically, the program currently operates as a line item in the society's annual budget. Three other main factors also contribute to the program's success. First, there is involvement from many junior and senior SFS members, as a rotating advisory group who review student applications and provide feedback on funding allocations. Second, the Instars program offers targeted undergraduate sessions involving well-established scientists who engage with Instars Fellows at meet-and-greet activities associated with the meeting's special presentation session on education. Third, Instars enlarged the graduate mentoring program by enlisting the assistance of the Student Resources Committee. This committee is composed of graduate and undergraduate students who participate in fundraising and organizing activities to enhance the sense of community within SFS. As a result of Instars activities, some past graduate mentors are now active members in the SFS Education and Diversity Committee, which oversees the program. Another important measure of the program's success is the number of past fellows who have maintained SFS membership and have returned to the annual meeting and participated in the program as graduate mentors (Fig. 3B).

The SFS Instars mentoring program has funded an average of 14 fellows annually by providing a stipend (~\$635/ student, though this amount varies by year and meeting location) and also covering meeting registration costs, as

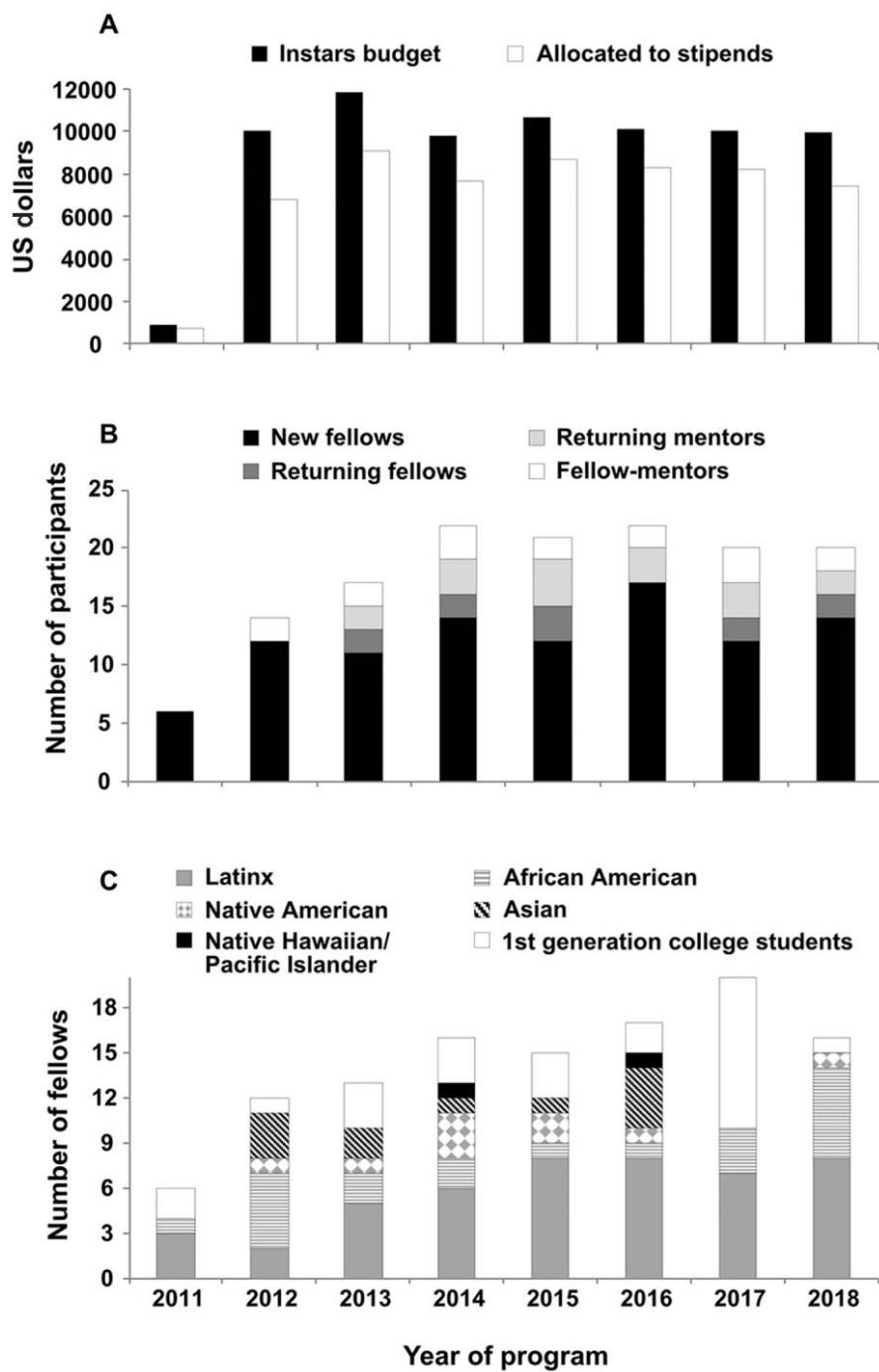


Figure 3. Development and current status of the Instars mentoring program. A.—Annual Instars expenditures and amounts allocated to participating student stipends, unadjusted for inflation. On average the program has allocated 78% of the yearly budget to student support to partially cover the cost of attendance to the conference (e.g., registration, travel, lodging, etc.). B.—Instars participation by year (2011–2018), including new undergraduate fellows and students who returned to the program for a 2<sup>nd</sup> year as undergraduate fellows (returning fellows), graduate mentors (returning mentors), or as undergraduate fellows returning to the program as graduate mentors (fellow-mentors). C.—Number and demographics of students participating in the SFS annual meeting as Instars Fellows from 2011 to 2018. Data provided by Dr Colón-Gaud.

well as some meals and activities, to supplement the cost of attending the annual meeting (Fig. 3C). In 2011, the inaugural year of Instars, SFS allocated \$900 to the program, which partially funded the meeting expenses of 6 fel-

lows. Since 2011, SFS has allocated more than \$80,000 (~\$10,000/y; Fig. 3A) for program activities to continue the Instars mission of “recruiting students from underrepresented groups to freshwater science, particularly as

pursued by the academic diversity of SFS scientists". As of the 2019 SFS meeting, SFS Instars has been approved for funding for the next 3 y with an annual budget of \$15,000. SFS's investment is extended by funds available through some of the students' home institutions and grants to the students' advisors. Note that the Instars advisory group and graduate mentors volunteer their time at no cost to SFS.

A recent survey of past participants in Instars ( $n = 40$  respondents; 40% of total past participants at time of survey) showed that 35% of Instars Fellows are current SFS members. More than 37% have attended a scientific society meeting after participating as fellows, with 15% having attended 3 to 5 additional meetings. More than 95% of survey respondents indicated they had become more aware of educational or career opportunities in freshwater science and ecology, as well as having become more aware of environmental issues, because of their participation in the program. Furthermore, 95% of survey respondents indicated that their confidence in their ability to excel in a STEM field increased after participating in Instars. A similar percentage credited their participation in the program as having a positive influence on their decision to pursue graduate studies and a career in a related field. Additionally, more than 80% of survey respondents indicated that their perceptions of the types of people who pursue careers in freshwater science, ecology, or environmental science had changed in a positive manner after participating in Instars. Survey respondents also reported that their impression of the openness and inclusiveness of freshwater science, ecology, or environmental science had positively changed after their involvement in the program. All survey respondents indicated that their interactions with other program participants and meeting attendees were overwhelmingly positive and beneficial. Nearly ½ of survey respondents (48%) remain active in freshwater science, 80% remain involved in ecology or environmental science, and all respondents reported active involvement in a STEM field. The vast majority of survey respondents (>90%) indicated they continued conducting scientific research following their participation in Instars. More than 15 previous fellows have completed or are presently in graduate programs in freshwater science or a related field.

The Instars mentoring program is an excellent example of a grassroots membership organizing effort that received financial support from SFS leadership and created a successful program to increase diversity, equity, and inclusivity within SFS at the undergraduate level. Other scientific societies have adopted comparable diversity initiatives with active programming, with varying levels of financial support and subsequent reporting on participant retention and success. For example, since 1996, the Ecological Society of America (ESA) has maintained a student mentoring program known as the Strategies for Ecology Education, Diversity, and Sustainability (SEEDS; Mourad et al. 2018). The SEEDS initiative is substantially larger than SFS In-

stars, with an annual budget of >\$300,000 and several full-time staff running the program. However, SEEDS has resulted in retention metrics similar to SFS Instars, with 47% of program participants subsequently pursuing graduate programs in ecology and 23% of survey respondents remaining members of ESA. Survey responses from SEEDS and SFS Instars indicate that ongoing, maintained efforts to increase scientific society diversity result in overall positive outcomes. Our demographic survey from 2017 also suggests that Instars has succeeded in increasing diversity, equity, and inclusivity at the undergraduate level. However, more work is needed to propagate these successes into later career stages and across other marginalized identity dimensions.

### SFS annual meeting inclusivity plan

The Instars mentoring program is an example of successful efforts to advance diversity, equity, and inclusivity; however, the 2017 SFS meeting in Raleigh, highlights the work we still must do as a scientific society. In 2016, the SFS Elections and Place Committee recognized the issue of North Carolina House Bill 2 but decided against moving the annual meeting because financial commitments for the meeting had been made prior to the bill's passage. Having made the decision, SFS released several statements avowing support for LGBTQ+ members and promising that actions would be taken to ensure an inclusive meeting. However, members questioned the decision not to change the location once it became clear that some SFS members would be unable to attend, would feel unsafe attending, would not receive funding to attend, or wished to support the international economic boycott targeting North Carolina over House Bill 2. Concurrent with the 2017 SFS survey described above, an ad-hoc committee, composed of affected members and allies, formed through grassroots organizing and made recommendations to the Annual Meeting Committee regarding opportunities to make the meeting more inclusive. Some, but not all, of these recommendations were accepted in a statement posted as the 2017 SFS Inclusivity Plan on the meeting webpage (<https://sfsannualmeeting.org/archive/2017/InclusivityPlan.cfm>). In this plan, SFS pledged to provide a safe and inclusive environment to all attendees; raise awareness across the broad membership; provide remote access to plenary talks and promote social media discussions for those unable to attend the meeting; and increase formal institutional support of inclusivity within SFS. Nevertheless, survey results showed that LGBTQ+ members disproportionately considered House Bill 2 a barrier to attending the annual meeting.

As the ad-hoc committee on inclusivity worked with the SFS Executive Committee and the 2017 Annual Meeting Committee, it was clear that the intention of the committees was not to produce feelings of exclusion. Instead, issues arose because members directly harmed by the House Bill 2

were not included in meeting planning and subsequent related decisions. We emphasize that—as both the Annual Meeting Committee and the ad-hoc committee on inclusivity had hoped—many positive steps were taken at the 2017 meeting to increase inclusivity. For instance, the meeting featured a place for people to indicate their pronouns on name badges, gender-neutral bathrooms at the conference center and hotel, and a map of LGBTQ+-friendly businesses with gender-neutral bathrooms in the surrounding area. Presentations by ad-hoc committee members about inclusivity and diversity during the meeting's opening plenaries raised awareness among members who did not understand the issue of House Bill 2 in North Carolina. For example, a video of testimonials on the benefits of diversity, equity, and inclusivity in STEM was posted to YouTube and shown during the opening plenary (<https://www.youtube.com/watch?v=GKXrhSvhso>).

The meeting's commitment to diversity and inclusivity continued beyond the opening sessions. A 4-h workshop, “LGBTQ+ identity and contemporary cultural climate”, and a lunchtime workshop, “Understanding gender and sexuality”, were organized by Dr Kate Boersma, a member of the SFS ad-hoc committee on inclusivity, in collaboration with the North Carolina State University Gay, Lesbian, Bisexual, and Transgender Center. A number of SFS members who had no prior involvement in the ad-hoc committee attended the meeting's LGBTQ+ inclusivity workshops and learned how to make their lab groups and classrooms more inclusive. Several students who were unaware of the complex history leading up to these workshops have since remarked to members of the committee how impressed they were by the commitment of SFS to openly discuss these issues. Together, all of these initiatives helped make the 2017 meeting more inclusive for transgender and gender-nonconforming members. Furthermore, to our knowledge, no discriminatory incidents were reported at the meeting.

The efforts made at the 2017 meeting were positive steps toward improving our scientific society as a whole, but work toward a more diverse, equitable, and inclusive scientific society must be ongoing and institutionalized within the culture of SFS. As SFS membership becomes more diverse at lower levels of our organizational hierarchy, we face a new challenge to ensure that these voices are both heard and supported to foster an inclusive organization (Beck et al. 2014, Pezzoni et al. 2016, Smith-Doerr et al. 2017). The decision not to move the 2017 SFS meeting from North Carolina serves as an example of how SFS leadership (i.e., the Board of Directors) could have sought the perspectives of marginalized (in this case, LGBTQ+) members in the decision-making process from the start. In addition, the 2017 meeting is an example of scientific society leadership and members responding to enact change after inclusivity issues arose. This example focuses on LGBTQ+ identities, but other marginalized identities (e.g., parental status, ability

status, socioeconomic status, citizenship status) face financial and logistical barriers to meeting attendance and participation. A plan for increasing inclusivity and equity in meeting attendance and participation should consider these and other identities.

### What has happened since the 2017 SFS meeting?

After the Raleigh meeting catalyzed greater attention to diversity, equity, and inclusivity, SFS has continued to become more inclusive by supporting changes implemented in 2017 and through additional equity and inclusivity measures at meetings and within SFS institutional structure (Fig. 1). In 2018, the SFS Board of Directors approved an updated meeting Code of Conduct with repercussions for individuals who violate its terms and a clear mechanism for reporting violations (<https://freshwater-science.org/about/society-governance/code-of-conduct>). Several members of the 2017 ad-hoc committee led the organization of and fundraising for the 1<sup>st</sup> official Diversity and Inclusivity Mixer at the 2018 meeting, which was inspired by an unofficial and impromptu LGBTQ+ mixer at the 2017 meeting. The Diversity and Inclusivity Mixer was intended to expand upon the LGBTQ+ mixer to also include meeting attendees who are marginalized on other identity dimensions. Private fundraising efforts generated over \$1000, which was matched by SFS presidential discretionary funds. The 2018 mixer was attended by 75 to 100 SFS meeting attendees, many of whom were students and early career members. With financial support from the Board of Directors, this mixer is slated to become a regular part of annual meetings.

Members of the Elections and Place Committee have indicated that they are more actively thinking about which locations could pose barriers to attendance as well as creative solutions in the event that laws like House Bill 2 affect future meetings. Additionally, at the 2019 meeting, a local tribal chairman gave a territorial acknowledgement. This statement provided awareness of local Indigenous presence and land rights and highlighted the importance of recognizing our history of colonialism and a need for change in settler-colonial societies. Furthermore, the Education and Diversity Committee has been given a voting seat on the Board of Directors, which will allow more diverse voices to have a say in future SFS policies and decisions. These steps all represent progress toward increasing and retaining diversity in our membership.

To conclude, we offer our suggestions for continued improvement in diversity, equity, and inclusivity within SFS. These suggestions are intended to be a starting point for further conversations about strategies for advancing diversity, equity, and inclusivity within SFS and other scientific societies, who may also find many of these suggestions helpful. Additionally, we encourage SFS to solicit suggestions from the entire community on how to make SFS more diverse, equitable, and inclusive.

## SUGGESTIONS FOR SFS FUTURE WORK ON DIVERSITY, EQUITY, AND INCLUSIVITY

Increasing diversity and creating inclusive spaces requires change at all levels of organizational hierarchy. We offer our suggestions for how to move forward as individuals, research groups, institutions, and scientific societies but note that action at all levels still requires action by individual members. We provide an additional list of resources in Appendix S1 as a potential starting point, and we encourage readers to seek out additional material as they continue working toward understanding privilege, equity, and inclusivity.

### Individual level

**Educate yourself** Learn about and trust the lived experiences of people with different identities who experience discrimination and exclusion. Avoid only asking others to educate you. Instead, seek out available resources to educate yourself (e.g., follow people on social media and other platforms who discuss these issues).

**Take time for self-exploration** Set aside time to reflect upon your own social identity (e.g., gender, race and ethnicity, class, ability, professional title) and consider how the various aspects of your identity may benefit you in scientific, professional, and public spaces. Those in the demographic majority often feel that their identity is normal. However, this feeling of normality usually comes from being in a dominant position in society, a position reinforced by media representation and societal norms. Recognize that the privilege that your identity provides you is not necessarily a choice, but what you do with it is your choice. Consider how you can use your privilege to uplift and support others.

### Research-group and institution level

**Encourage open conversations** Enable dialogue about diversity, equity, and inclusivity in your groups and institutions. Be aware of and actively work against power dynamics and internal biases that may limit these conversations. Always promote and trust the voices of marginalized people and their experiences.

**Actively recruit and mentor marginalized individuals** First, seek out training for yourself and your colleagues on how to be an effective mentor and advocate for people with marginalized identities. Actively recruit potential graduate students, postdocs, and technicians from organizations that support individuals with these identities. The ESA's SEEDS program specifically recruited students from Historically Black Colleges and Universities and found that research experience and positive outcomes in the field of ecology were positively correlated with the decision to pursue a career in ecology (Armstrong et al. 2007).

### Scientific society level

**Increase representation of marginalized members** Ensure that members of underrepresented groups are nominated for scientific society awards, are invited to give plenary talks, and are appointed to or invited to serve on SFS committees and related media. Increase the representation of membership diversity in SFS-affiliated media, such as the *Making Waves* podcast, *In the Drift* newsletter, and other digital outlets.

Track trends in the demographics of membership and the cultural climate of the scientific society to gauge how the society is doing at recruiting and retaining a diverse membership. To ensure that efforts continue, reporting requirements should be added to SFS by-laws. Data collection could take the form of an annual survey of membership. For example, upon membership renewal or meeting registration, encourage people to voice concerns about issues in the scientific society and provide feedback on what has worked well, in addition to collecting demographic data. An annual report summarizing these results, diversity and inclusivity efforts, and progress made could be prepared by the Public Information and Publicity Committee and made available to the membership.

Encourage members and leadership to revisit the scientific society's Mission Statement and Strategic Plan to ensure they reflect a holistic understanding of who the society is meant to serve as well as the diversity, equity, and inclusivity goals presented in the Diversity Statement. For example, the research, education, and service work of scientists that influences the management of freshwater resources directly affects everyone in our communities.

**Encourage open dialogue between scientific society leadership and membership** Develop an easier way for membership concerns to reach leaders and for leaders to communicate effectively and transparently with members. Leaders can increase communication with members by posting times and locations of Executive Committee and Board of Directors meetings and providing live streaming and recording. Leaders can also provide more frequent e-mail updates on SFS news (e.g., through the *Monthly Splash* newsletter) and open up major decisions for member comments before voting occurs.

Explicitly state in SFS by-laws that member concerns can be brought to the Board of Directors and Executive Committee by the Education and Diversity Committee representative on the Board of Directors or the Executive Director. Create a digital platform by which members can raise inclusivity concerns with these liaisons anonymously or, if desired, directly submit concerns to SFS leaders. Annual funding should also be allocated for the training of these liaisons.

Members may not be aware of the diversity, equity, and inclusivity initiatives that SFS already implements. We encourage the relevant SFS committees to consolidate information about diversity, equity, and inclusivity work and

explore alternative forms of communication, such as providing an annual report on efforts and demographics on the SFS website so that members can get involved and provide feedback.

***Continue to expand diversity, equity, and inclusivity efforts at the SFS annual meeting*** Encourage members to read and commit to following the annual meeting Code of Conduct and report violations (revised and approved by the Board of Directors in April 2018). Require the Education and Diversity Committee to regularly evaluate the Code to ensure that it supports an inclusive and equitable climate. Continue to require acknowledgement of the Code of Conduct as a mandatory step in registering for the annual meeting.

Continue partnering with other freshwater science groups throughout the globe to pursue efforts to be more inclusive to international members of SFS and to make SFS more representative of the global diversity of viewpoints on freshwater science. The 2018 AQUATROP (an international congress focusing on tropical aquatic systems) meeting in Quito, Ecuador, and the upcoming 2021 SFS meeting in Brisbane, Australia, are great examples of such efforts. Partner with other global societies (e.g., our membership in the Consortium of Aquatic Science Societies and their Diversity Joint Venture, which is a partnership between government agencies, universities, non-profit organizations, and scientific societies to increase diversity in the conservation field).

Provide the membership with a transparent understanding of how and when meeting location decisions are made by dedicating a page on the SFS website to this purpose. Formally place equity and inclusivity concerns in the decision-making framework. For example, meetings should not be planned in locations with laws that discriminate against groups of SFS members or have travel bans in effect or proposed, and a plan should be in place for what to do if laws change after a meeting location has been decided. Incorporate the Education and Diversity Committee into annual meeting planning and solicit membership feedback on the decision-making framework to enhance accessibility and inclusivity.

Design and offer workshops on creating an inclusive classroom and scientific society (e.g., “Inclusive and accurate approaches for teaching sex and gender in biology” workshop by Dr Ash Zemenick, Dr Alex Webster, and Sarah Jones at the 2018 annual meeting).

Expand outreach to local non-profit environmental groups, K–12 educators, and colleges and universities that serve marginalized populations, and invite them to participate in the meeting at a discounted or complimentary rate. Invite local freshwater-related groups, with an emphasis on participation of people from marginalized groups.

Invite local Indigenous leaders to commence meetings with a territorial acknowledgement, an overview of the ar-

ea’s local tribes, and Indigenous connections to and knowledge of local freshwater resources. Offer speaker fees, free meeting attendance, SFS resources, and other forms of compensation for this work.

***Promote Instars and other diversity programming*** Continue to expand the Instars mentoring program. Work with the Development Committee to seek long-term, sustainable funding for Instars to continue supporting and growing the program. Create text for scientific society members to use in the Broader Impacts sections of National Science Foundation grant proposals to increase research funding for Instars mentees.

Encourage SFS members to develop training workshops for Instars mentees (e.g., “The effective use of improv techniques to advance communication and confidence in the scientific community” workshop by Drs Juliana D’Andrilli and Kaleb Heinrich at the 2018 annual meeting).

Invite more diversity-related programming at the annual meetings. For example, invite program officers from the National Science Foundation to talk about the Louis Stokes Alliances for Minority Participation funding program and other initiatives aimed at broadening participation in the sciences. Offer workshops on mentoring and how to find sponsors.

Continue supporting and developing mixers for different groups to create inclusive social spaces at the meetings, such as the Primarily Undergraduate Institution Mixer and the Diversity and Inclusivity Mixer at the 2018 meeting.

## Conclusions

Those who have privileges or are in leadership roles have a responsibility to work actively toward inclusivity, equity, and diversity while prioritizing the needs and voices of those who have been marginalized. Following challenges associated with the 2017 SFS meeting in Raleigh, North Carolina, and efforts made during the 2018 SFS meeting in Detroit, Michigan, to improve inclusion, we have compiled recommendations on how to create a more inclusive scientific society by listening to the needs of marginalized SFS members. However, the 2 examples of challenges and successes in addressing diversity within SFS described in this paper largely focus on only 2 identity dimensions (race and LGBTQ+ status). Moving forward, it is important for scientific societies and their members to recognize that work on inclusivity must be done across multiple visible and invisible identity dimensions (e.g., parental status, ability status, socioeconomic status, veteran status). From the individual to the scientific society level, we invite every SFS member to participate in actively increasing diversity, equity, and inclusivity within the field of freshwater science. In particular, we challenge individuals from the demographic majority or with privileged identities to commit

to breaking down the barriers faced by marginalized scientists. We advocate that this work must continue for the advancement of science and scientists and that the collective effort of all SFS members is needed to make these actions possible.

## ACKNOWLEDGEMENTS

Author contributions: All authors conceived the study. AGB, MRC, MWS, and IA analyzed the SFS survey data. EFA, IA, AGB, CCG, MRC, EIL, EKM, AJS, and AJW drafted individual sections of the manuscript. CCG collected and analyzed Instars survey data. CCG, AJW, and EKM made the figures. EFA, AGB, EIL, and MRC combined individual sections into a cohesive manuscript. All authors edited the manuscript. EFA and AJS addressed reviewer comments.

We thank the members, organizers, and committee members of the Society for Freshwater Science for creating a space where we can celebrate innovative research and the diversity of scientists. Pam Silver, Ben Cuker, David Strayer, Judy Li, and an anonymous reviewer provided constructive feedback on drafts of this manuscript. We are grateful to all participants in the 2017 survey for providing valuable insights and information. We appreciate the members of the ad-hoc committee who are not coauthors but were instrumental in providing feedback on the SFS survey and creating an inclusive 2017 SFS annual meeting: Michael Bogan, Kate Boersma, Dustin Kincaid, Gary Bucciarelli, John Kominoski, Raphael Mazor, Brian Gill, Timothy Hoellein, and Kevin Nevorski. This publication is not endorsed or sponsored by the Society for Freshwater Science or any of its committees. The authors would like to acknowledge that during the development of this manuscript they lived and worked on the traditional homelands of the Kalapuya, Dena'ina, Cayuga, Onondaga, Mvskoke (Muscogee/Creek), Yamassee, Anishinaabe, Peoria, Odawa, Miami, Potawatomi, Anishinabewaki, Sauk/Sac, Tanana Athabaskan, Mohican, Wabanaki, Abenaki, Ohlone, and Yokut peoples.

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