

# BRIDGING THE GAP FROM STUDENT TO SENIOR SCIENTIST: RECOMMENDATIONS FOR ENGAGING EARLY-CAREER SCIENTISTS IN PROFESSIONAL BIOLOGICAL SOCIETIES

GRANT R.W. HUMPHRIES<sup>1</sup>, SCOTT A. FLEMMING<sup>2</sup>, AMANDA J. GLADICS<sup>3</sup>, SJURDUR HAMMER<sup>4</sup>, KIRK A. HART<sup>5</sup>, KAZUHIKO HIRATA<sup>6</sup>, MICHELLE ANTOLOS<sup>7</sup>, PETER J. KAPPES<sup>8</sup>, ELLEN MAGNUSDOTTIR<sup>9</sup>, HEATHER L. MAJOR<sup>10</sup>, FIONA McDUIE<sup>11</sup>, KRISTINA McOMBER<sup>12</sup>, RACHAEL A. ORBEN<sup>3</sup>, MORITZ S. SCHMID<sup>13</sup> & MICHELLE WILLE<sup>14</sup>

<sup>1</sup>Department of Ecology and Evolution, Stony Brook University, Stony Brook, NY 11795, USA (grwhumphries@humphriesresearch.com)

<sup>2</sup>Department of Environmental & Life Sciences, Trent University, Peterborough, ON K9J 7B8, Canada

<sup>3</sup>Hatfield Marine Science Center, Department of Fisheries and Wildlife, Oregon State University, Newport, OR 97365, USA

<sup>4</sup>Institute of Biodiversity, Animal Health & Comparative Medicine, University of Glasgow, Glasgow G12 8QQ, UK

<sup>5</sup>Korea Institute of Ornithology, Department of Biology, Kyung Hee University, Seoul, Korea

<sup>6</sup>School of Fisheries, University of Hokkaido, Hakodate 060-0808, Japan

<sup>7</sup>Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331, USA

<sup>8</sup>Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331, USA

<sup>9</sup>University of Iceland, Askja, Reykjavik, Iceland

<sup>10</sup>Department of Biological Sciences, University of New Brunswick, Saint John, NB E2L 4L5, Canada

<sup>11</sup>Centre for Tropical Environmental and Sustainability Studies, James Cook University, Cairns 4811, Australia

<sup>12</sup>Department of Biology, Pomona College, Claremont, CA 91711, USA

<sup>13</sup>Takuvik Joint International Laboratory, Département de biologie et Québec-Océan, Laval University, Québec City, QC G1V 0A6, Canada

<sup>14</sup>Zoonos Science Center, Department of Medical Biochemistry and Microbiology, Uppsala University, Uppsala, 751 23, Sweden

Received 18 November 2015, accepted 22 April 2016

## Summary

HUMPHRIES, G.R.W., FLEMMING, S.A., GLADICS, A.J., HAMMER, S., HART, K.A., HIRATA, K., ANTOLOS, M., KAPPES, P.J., MAGNUSDOTTIR, E., MAJOR, H.L., McDUIE, F., McOMBER, K., ORBEN, R.A., SCHMID, M.S. & WILLE, M. 2016. Bridging the gap from student to senior scientist: recommendations for engaging early-career scientists in professional biological societies. *Marine Ornithology* 44(2): 157–166.

Despite their long-standing and central role in the dissemination, promotion and defense of science, scientific societies currently face a unique combination of economic, social and technological changes. As a result, one of the most pressing challenges facing many societies is declining membership due to reduced recruitment and a failure to retain members, particularly early-career scientists (ECSs). To ensure that professional biological societies retain long-term viability and relevance, the recruitment and retention of ECSs needs to be a main priority. Here we propose a series of recommendations that we, a group of ECSs, believe will help professional societies better integrate and retain ECSs. We discuss each recommendation and detail its implementation using examples from our personal experiences in the global seabird research and management communities and from our collective experience as members of several professional societies. We believe these recommendations will not only help recruit and retain ECSs as society members, but will also directly benefit the organizations themselves.

**Key words:** professional societies, early-career scientists, recruitment, engagement, senior scientists, guidelines

## INTRODUCTION

The “cornerstone activities” (journal publication and organization of scientific meetings) of scientific societies have long played an important role in the defense and promotion of science by disseminating advances in scientific theory, research and knowledge within their various disciplines (Musante & Potter 2012). In addition, societies have traditionally served to facilitate and promote networking opportunities, mentorship, professional recognition and collaboration among members (Schwartz *et al.* 2008) and other scientists within the discipline. While these goals are still central to the role scientific societies play (Musante & Potter 2012), economic, social and technological changes associated with the digital age are fundamentally changing how societies operate and how they interact with potential members and

the scientific community at large (Schwartz *et al.* 2008, Musante & Potter 2012). Despite the challenges, changes in membership and activities of these societies in the digital age (Carroll 2014, Potter *et al.* 2013), societies remain relevant for disseminating research, encouraging collaboration and building public awareness of global issues. However, the “cornerstone activities” are losing some of their traditional motivating power for membership retention. The advent of the Internet and the proliferation of scientific journal databases have led to a decoupling of the traditional benefits of paying dues for society membership (Hurd 2000, Carroll 2014). Potential society members can now access their respective society journal articles through institutional library websites or web searches (Leslie 2007). This increase in access also applies to the many new journals that have appeared and have no connection to societies, but rather are commercial

ventures from publishers and compete with the society journals, thus lessening the impact of societies on the furthering of science. Also, investigators with shared professional interests and new collaborators can be found through simple web searches and social media. As a result, membership of many scientific societies has declined (Schwartz *et al.* 2008). Decreased recruitment and retention of early-career scientists (ECSs) are major contributors to this problem. In a recent study, nearly half of the 110 presidents and executive directors of scientific organizations surveyed identified recruitment and retention of young and ECSs as the most important challenge facing their organizations (Musante & Potter 2012).

Clearly, there is cause for concern, given that the future of any scientific organization depends on the recruitment and retention of ECSs. Their continued participation and involvement in a society provides long-term continuity of professional opinions, advances in research and promotion and endorsement of society positions on important topics. Furthermore, the continued promotion and defense of science depends on the existence of groups (e.g. societies) that agree on concepts and theories, and the perpetuation of these groups depends on ECS participation. We believe that focusing attention on ECSs is one of the best ways to address declining membership. However, the recruitment and retention of ECSs in professional societies depends on a variety of factors (e.g. job availability, personal and professional goals and discipline of study), and certain barriers exist. Also, membership costs, while generally low for a single society, may inhibit ECSs from joining multiple organizations. Consequently, this puts pressure on smaller or taxon-specific societies, such as The Waterbird Society or Pacific Seabird Group, which are competing with large societies such as the Ecological Society of America or the Society for Conservation Biology. Furthermore, society membership continues to be perceived as beneficial only for academic career paths, and ECSs interested in management, conservation or industry may not recognize how continued membership will be a benefit. Despite these factors, we, as ECSs, believe there are a number of actions that scientific organizations can implement to increase the involvement of ECSs. These activities would help encourage ECSs with regard to future career outlooks, give them a sense of belonging and help build a network of peers for future collaborations.

As ECSs in the process of exploring and comparing different societies, we are in a unique position to comment on the practices of various organizations and the resources they offer that we believe to be important when making decisions about membership. Obviously, it is difficult for us to foresee whether these incentives will translate into lifelong participation. However, we feel our perspective can help inform societies about what ECSs feel is most important when deciding which societies to join. Collectively, we are actively involved with the Pacific Seabird Group (PSG), the World Seabird Union (WSU) and the Association for Polar Early Career Scientists (APECS), all of which have been extremely responsive to suggestions from the ECS community. The actions of these organizations have attracted our attention and led to subsequent engagement with these groups. As a result, we felt that it might be helpful to compile our ideas into the following recommendations:

1. ECS representation on executive boards;
2. inception and active perpetuation of an ECS communication channel;

3. ECS mentor/mentee program;
4. facilitation of professional development sessions;
5. hosting social media events;
6. invitations for ECSs to participate in professional working groups; and
7. establishment of an excellence award for ECSs.

To investigate how professional societies engage ECSs outside of meetings, we examined the websites of 42 organizations. We performed a web search using the key words: “biology,” “chemistry,” “physics,” “society,” “group,” “organization,” and “union,” then visited the websites for the first 40 scientific organizations on the list. We added two more societies (The Wildlife Society, and the American Fisheries Society) *post hoc*, as they are two organizations known to us that have grown rapidly in recent years. We queried each website to determine whether each society had either a student or ECS representative, or whether there were student- or ECS-focused committees. We also listed whether the websites advertised ECS-related activities that were not directly associated with activities from the organization’s meetings.

Because of the web search strategy used, we drew from a broad range of professional societies, with varying goals and sizes. For example, APECS is not a taxon-based professional society, but promotes the advancement of ECSs within Arctic research. We have excluded this society from Table 1, although many of our recommendations are inspired to some degree by these examples. Other societies (e.g. Ecological Society of America, Society for Conservation Biology) are very large and have local chapters, that may (or may not) engage in ECS activities, and we have pointed these out in our examination of particular groups.

We broadly define ECSs as graduate students (MSc or PhD), field or lab technicians, postdoctoral researchers, and early-career tenure-track faculty less than five years into a position. This inclusive definition is key, as it encompasses individuals across career “pinch points,” at which society memberships are often discontinued. It is also important to note that the seabird research community, from which we draw our analytical data (and many of our examples), is both small and global (e.g. the largest global meetings consist of ~1000 people from 50 countries).

Based on our own experiences, we believe our recommendations address issues that are most important to ECSs. We encourage professional biological societies and organizations to implement some or all of the following to increase recruitment and retention of ECSs.

## RECOMMENDATIONS

### ECS representation on executive boards

The first step to fostering a welcoming and healthy ECS community is to provide a voice for ECSs on the governing board or council of the organization. While it is typical for many scientific societies to include a student representative (usually a graduate student) on their governing body, they often overlook post-docs, early tenure-track faculty members, lab or field technicians and research associates.

Post-doctoral researchers, field technicians and other non-student ECSs share many similarities with students (e.g. seeking

**TABLE 1**  
**Early-career initiatives or existence of ECS/student representatives or committees by professional scientific organizations**

Professional scientific organization	Representative		Committee		None	Additional programs for ECSs not associated with symposia/conferences
	Student	ECS	Student-related	ECS-related		
<i>American Chemical Society</i>				x		Younger Chemists Committee — provides resources and professional mentoring for early-career chemists
<i>American Fisheries Society</i>			x			Hutton Junior Fisheries Biology Program — Mentoring program and paid summer internship for high school students Emerging Leaders Mentorship Award Program
<i>American Nuclear Society</i>					x	
<i>American Ornithologists' Union</i>			x	x		Committee for career development for ECSs AOU Early Professionals Committee — host a social event for all individuals in the beginning stages of their careers. Early professionals get the opportunity to mingle with each other and senior scientists from academia, government agencies, and the private sector. AOU Ned K. Johnson Young Investigator Award — recognizes the accomplishments of an outstanding early-career professional
<i>American Physical Society</i>					x	
<i>American Society for Microbiology</i>	x					
<i>American Society for Parasitologists</i>	x					
<i>American Society of Mammalogists</i>			x			Committee for African Student Research Fund
<i>American Society of Plant Biologists</i>				x		Career Center — a program that provides individuals looking to develop their careers in the professional scientific job market with related resources
<i>The American Society of Plant Taxonomists</i>					x	
<i>Animal Behavior Society</i>					x	
<i>Association for the Sciences of Limnology and Oceanography</i>	x			x		Currently has two student board members Early Career Committee for development of ECSs
<i>Botanical Society of America</i>					x	
<i>British Ecological Society</i>			x	x		Committee dedicated to education and career development Hosts career conferences for ECSs
<i>British Ornithologists' Union</i>	x		x	x		Career development bursary for ECSs and students Free conference entrance for students
<i>Cell Stress Society International</i>					x	
<i>Cooper Ornithological Society</i>			x	x		Student Affairs committee Society now merged with American Ornithologists' Union The AOU Early Professionals Committee
<i>Ecological Society of America</i>					x	Large society with chapters, in which individual chapters have ECS/student activities and representatives Developing a formalized mentoring program ( <a href="http://esa.org/earlycareer/">http://esa.org/earlycareer/</a> )
<i>The Engineering Institute of Canada</i>					x	

*continued*

Professional scientific organization	Representative		Committee		None	Additional programs for ECSs not associated with symposia/conferences
	Student	ECS	Student-related	ECS-related		
<i>International Society for Computational Biology</i>					x	
<i>The International Society for Ecological Economics</i>					x	
<i>International Society for Ecological Modelling</i>					x	
<i>International Society for Chemical Ecology</i>				x		Early Career Award in Chemical Ecology
<i>International Union of Biological Sciences</i>					x	
<i>Materials Research Society</i>					x	
<i>Pacific Seabird Group</i>	x					
<i>Phycological Society of America</i>	x					
<i>Radiation Research Society</i>				x		Scholar-in-Training Committee — provides career mentoring for ECSs
<i>Sino-Ecologists Association Overseas</i>					x	
<i>Society for Applied Spectroscopy</i>	x					
<i>Society for Conservation Biology</i>					x	Large society with chapters, in which individual chapters have ECS/student activities and representatives
<i>Society for Ecological Restoration</i>	x		x			Student Relations Working Group — Committee
<i>Society for Economic Botany</i>				x		Student Committee, including 2 student members
<i>Society for Freshwater Science</i>				x		Large committee for student resources
<i>Society for Integrative and Comparative Biology</i>			x	x		Student Support Committee — provides grants and travel awards for students
<i>The Society for Mathematical Biology</i>			x	x		Mentoring committee for students and ECSs Half-day mentoring workshop
<i>Society for the Study of Evolution</i>					x	
<i>Society of Nematologists</i>				x		Ad hoc student committee
<i>Society of Systematic Biologists</i>					x	
<i>Society of Toxicology</i>				x	x	Endowment for ECSs Web seminars for ECSs
<i>Society of Wetland Scientists</i>	x					
<i>The Wildlife Society</i>	x		x			Career development pages on website and online courses through universities Job and internship posting board Large society with many local chapters that engage in various ECS or student activities

mentorship, looking for permanent jobs, less familiar with other work in the field than established professionals, relatively unknown within the community, building professional networks). However, these individuals tend to be further advanced in their careers than students and are looking for opportunities to become more active members, but are not officially represented by any person who could speak to their needs. Thus, we recommend societies create a separate position specifically to represent non-student ECSs, or rename the student representative “ECS representative.” Creation of an ECS representative is an easily implemented option for societies to directly seek the involvement and participation of ECSs. Some societies may opt to merge the student and ECS representative positions if the workload is reasonable. Societies have had a particularly challenging time retaining ECSs (Musante & Potter 2012), but we believe the addition of or restructuring of the student position to include ECSs will provide extra support for these individuals and facilitate their retention.

The implementation of such a position would vary based on the organization, its specific bylaws and the responsibilities and duties associated with the position. We envision that, once a position is created, the ECS representative would be elected and would report directly to the board members, or hold a position on the board. Obviously, the ECS representative should be an ECS and should be elected or appointed by fellow ECS members. The length of time which an ECS representative serves would be based on the organization’s by-laws; however, terms of no longer than two years seem reasonable.

*Role of the ECS representative.* The ECS representative may have a variety of responsibilities, but we believe the bulk of their responsibilities should focus on the needs, professional development and activities targeted for ECSs. This includes maintaining an up-to-date list of ECS members, acting as a liaison between the ECS membership and the executive/governing board, acting as a liaison with other ECS representatives in sister organizations, and communicating relevant current events within the field and recent topics of interest (e.g. newly formed working groups, new research/methodology, career development opportunities, etc.) with the ECS membership (see Inception and active perpetuation of an ECS communication center). To help with communicating this information, the representative should maintain a social media feed (currently Facebook or Twitter) dedicated to ECSs (see Inception and active perpetuation of an ECS communication center). Most of the representative’s responsibilities will probably be centered on the organization’s annual meeting or conference. The ECS representative will therefore play a major role in coordinating and chairing special ECS and mentoring activities during those conferences (see ECS mentor/mentee program).

*Anticipated benefits.* We believe societies that create a position representing ECSs send a very clear message to their ECS membership that they understand that this demographic group has unique circumstances (e.g. searching for or starting new positions, wanting to feel included, looking to build a network of peers), and that they are committed to ECSs and place a priority on their inclusion and involvement within the society. Demonstrated commitment from the governing board of a society helps to create a more welcoming atmosphere for ECSs that, in our experience, encourages further involvement and participation.

*Example.* None of the societies examined had a specific position for an ECS representative; however, 12 had committees for ECS development. Comparatively, nine societies had positions for student representatives and 12 had committees focused on student development. Surprisingly, of all the societies (excluding the large organizations with many local chapters), 15 did not have a listed position for either a student or ECS representative or committee (Table 1).

### **Inception and active perpetuation of an ECS communication center**

In our experience, the primary means of communication among ECSs is through online tools (e.g. social media, email and discussion forums). Therefore, we recommend that organizations maintain an active Internet-based communication center implementing the latest in social media and communication tools. Such tools could be maintained by the ECS representative, or made available via society homepages (e.g. Seabirds.net). This communication center should focus on ECS members and could be separate from the main communication channel of the society but still encourage active participation from senior members. If a student-oriented communication forum currently exists, we recommend it be extended to include all ECSs. Communication centers should be designed to allow new ECS members to quickly and easily join and participate in professionally relevant discussions and to communicate informally online. In addition, they can be used in concert with conferences to highlight events relevant to ECSs and to encourage participation in activities associated with the conference and service to the society. Depending on the specific goals and needs of the society, this could be a moderated system, in which communications are limited by an individual, or an unmoderated one, in which communications are allowed to occur unfiltered. The communication center would also serve to facilitate many of the other recommendations we propose (see the following sections).

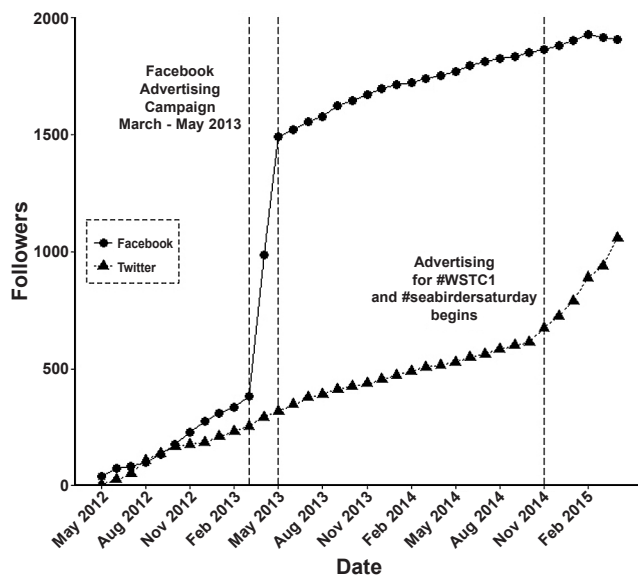
Given the many existing online outlets, an ECS communication center can be developed free of cost (if using social media outlets), would require little effort to implement and maintain, and would be able to reflect the interests of current participants, while being flexible enough to evolve as participants and issues change. However, if a society has the resources to fund a more customized communication center, websites can be developed at a range of costs. For example, ready-made options can be created for free (e.g. Google Sites), but are often quite limited in flexibility. More complex web applications can be developed, but can cost upwards of tens of thousands of dollars, depending on agreements with web developers. There is also a cost of time involved, as members must volunteer to maintain these sites. Therefore, having individuals with web-development experience to volunteer their time would be of great benefit for any society.

*Anticipated benefits.* Benefits include the low-cost and open access of social media outlets, their widespread reach, and ease of use. The use of social media also allows societies to take advantage of the preferred modes of communication of ECSs. Worldwide, over 66% of individuals connected to the Internet use social media (e.g. Facebook, Twitter, Instagram, Pinterest and Google +). Of these, the most common users are university-educated individuals between the ages of 18 and 29, an age range that matches the demographic for many ECSs (Duggan & Brenner 2013). Thus,

we believe using some form of social media is the most effective method of attracting, communicating with and encouraging the active participation of ECSs.

No studies to date have shown whether there is a direct relationship between participation in communication channels and enrollment in scientific societies. However, these channels do two things: 1) they allow a society to draw in new members through online activity (i.e. making the society more obvious and engaging, which could encourage new membership); and 2) they solidify existing relationships within the community of interest.

*Example.* The WSU, via its “seabirds.net” website, facilitates a “Research Spotlight” post that asks a selected member of the global seabird community (e.g. individuals who research or manage seabird populations as a career) to write a short blog post on their research or recent publication. New members, particularly ECSs, are encouraged to contribute a submission as an introduction to the society at large. The WSU has also implemented a discussion forum on its website. This site is open access to all seabird researchers and, to date, the forum has been used by many individuals in the seabird community, including ECSs. In particular, several ECS have asked for advice and guidance on various field techniques, on admission to graduate programs as well as on contacting potential employers. Responses from established and more senior members have encouraged good science and collaboration between senior scientists and ECSs. For example, in August 2015, a PhD student from Melbourne asked the seabird community for description of penguin “play” behavior, which received a response from three individuals within a few days. One of these individuals was a senior researcher who agreed to send video documentation to that student in order to advance the student’s thesis (Penguin play behavior 2015).



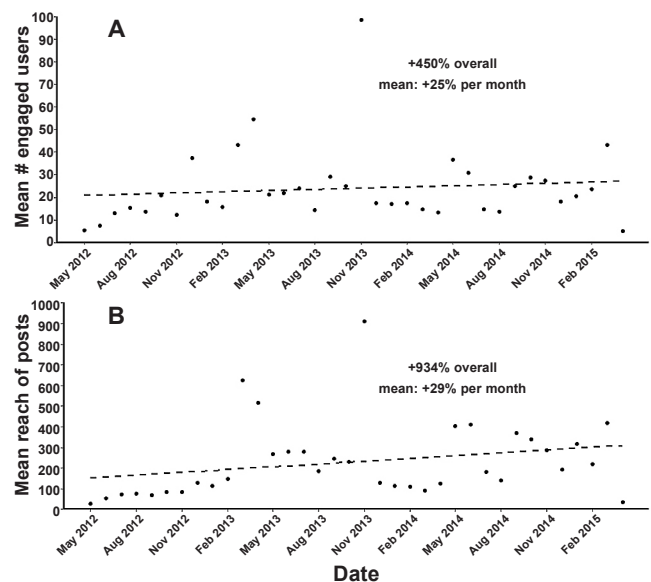
**Fig. 1.** Total number of followers on the World Seabird Union (WSU) Facebook ([www.facebook.com/world.seabird.union](http://www.facebook.com/world.seabird.union)) and Twitter pages (see key on figure) since May 2012. Vertical dashed lines show when significant advertising campaigns began, which increased the trend in the number of followers.

Twitter provides a simple and effective communication platform that can reach tens of thousands of people around the world (see Shiffman 2012 for a list of benefits). The Twitter hashtag #seabirdersaturday, while not run by any society, has drawn in seabird scientists and enthusiasts alike from around the world. The WSU Twitter handle (@Seabirders) had 1761 followers as of 23 March 2016.

The WSU also hosts a Facebook page that has 2111 followers (as of 23 March 2016). Both Twitter and Facebook accounts have had a steady increase in the number of followers since their respective inceptions (Fig. 1). The effectiveness of these communication channels is also reflected in the mean number of engaged users and the mean reach of posts (Fig. 2). Most importantly, more than 50% of those who follow the WSU Facebook page are between the ages of 18 and 34 (Fig. 3). Demographics of users are also shifting, as those under 34 are maintaining accounts and may do so into their 40s, 50s, and older. Thus, we expect an expansion of the reach of both social media platforms, demonstrating the importance of maintaining these programs for scientific societies.

### ECS mentor/mentee program

To maintain a scientific community, it is important for ECSs to establish professional contacts, both with other ECSs and established scientists. Some organizations have begun to address this by holding mentoring sessions during annual meetings and by hosting “meet and greet” events between senior scientists and ECSs (most often students). During these events, mentors meet with interested students to discuss how their own experiences affected their career, and to provide guidance and suggestions on



**Fig. 2.** Mean monthly number of engaged users (A) and post reach (B) on WSU Facebook page since May 2012. Engaged users are the number of users who interact with the Facebook page by liking, commenting on, or sharing posts. Each figure shows the total percentage increase since the inception of the Facebook page, and the mean increase in activity per month. Dashed lines show trend in increase. Anomalous points in October 2013 were likely associated with the advertising campaign (Fig. 1).

how to have a successful career in research. We believe this to be an important part of the annual meeting for students. While we believe mentoring sessions are extremely beneficial in their current form, they could be further improved through expansion to include all ECSs, and by extending the experience through the entire meeting and in an informal capacity for an indefinite period of time outside of the meetings.

We envision a system in which interested mentors with sufficient experience to provide guidance (e.g. active society members who have attended five or more meetings/conferences of the society) are teamed with three to four mentees for the duration of the meeting. Potential mentees include individuals attending their first or second meeting/conference, interested ECSs or other attendees seeking a more formal mentoring interaction. This would be maintained for the duration of, and ideally beyond, the meeting. Before a conference, the ECS representative would solicit mentors and mentees from the general membership and match mentors with several mentees. Online registration through the ECS communication center or society webpage would simplify implementation of the aforementioned system. Relevant mentorship matches could be made based on study species, data type, research interests, career aspirations, common language or personal interests. Ideally, mentors and mentees would be matched before the conference. Additionally, the ECS representative could coordinate a welcome mixer to introduce mentors to their mentees, or mentors and mentees could be notified of matches online and coordination be left to the participants.

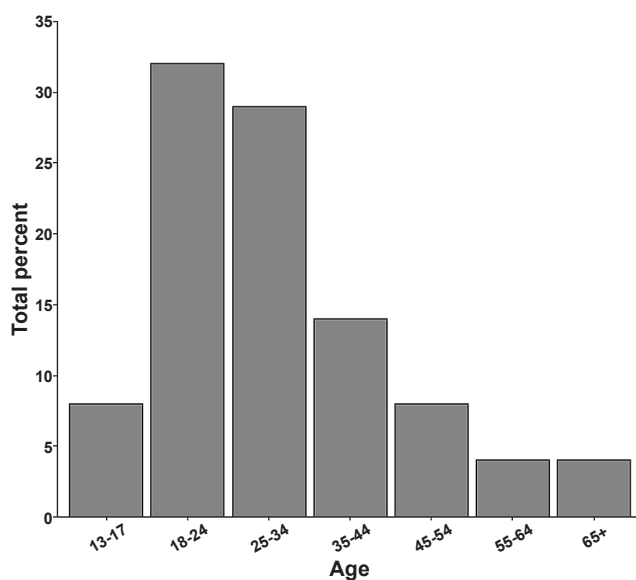
*Mentor's role.* Ideally, mentors would be individuals who are familiar with a large proportion of society members and are thus comfortable acting as a liaison for mentees. They would also have professional experience in management, research and/or policy, in order to help give advice to mentees on job searches. We believe more experienced or advanced ECSs, in particular, would make strong mentors. Mentors would greet their mentees at the beginning of a conference and would build the mentor-mentee relationship throughout the meeting by introducing mentees to senior members

of the society and integrating mentees into social events. We would also encourage individuals to adopt a broad mentorship role tailored to the needs of the mentee. This relationship might well continue indefinitely on the basis of a positive rapport developed between mentor and mentee. However, in cases where no rapport is created or a negative experience arises, the mentee can leave the program at any time. Further to this, a feedback system (e.g. via Google Sites) would allow mentees to rate mentorship for quality-control purposes. Such a program would require some level of oversight from the executive board of the society to provide records of interactions and activities, which could prove onerous depending on how the organization's leadership decided to pursue the endeavor. Ideally, the positive interactions and relationships established between mentors and mentees would allow mentees to explore the many benefits of society membership, which may encourage long-term ECS participation.

*Anticipated benefits.* For any ECS entering a professional society for the first time, a nurturing environment and good first impression are critical to ensuring that that individual feels welcome. A mentor/mentee system would provide such an environment, assisting in the navigation of the culture of different societies and facilitating networking. The cost of a mentor/mentee system would revolve around any activities the society would be willing to fund to facilitate the program (e.g. mixers or ice-breaker events with drinks and food). A substantial amount of time would have to be invested on behalf of mentors and any administrators of the program. The likelihood of ECS retention should increase, as a mentorship program would get ECSs involved and help them become invested participants in the society. It also can help foster both professional and personal connections between society members who may not otherwise interact. Additionally, mentors would benefit through discussions with young scientists to help them understand the changing needs of the society, the added experience of mentoring a group of ECSs from varying backgrounds and cultures, and thus an additional "service" entry on their *curriculum vitae*. Benefits for mentees include having help in the initial steps of meeting new scientists, and having an experienced point of contact who can help both at the conference and as they move on in their careers.

*Example.* Mentoring programs have become common at society meetings as a way to help ECSs prepare for careers. For example, the Pacific Seabird Group runs a student mentoring session at its annual meetings where students have the opportunity to meet and talk with senior scientists about various career paths. These sessions are highly anticipated. This program led many of the co-authors on this paper to long-term involvement with the Pacific Seabird Group.

Of the 42 surveyed societies, five engaged in ECS mentoring programs outside of the meetings: Society for Mathematical Biology, Ecological Society of America, Radiation Research Society, American Chemical Society and American Fisheries Society (Table 1). APECS has also implemented a mentoring program through its website, and its program provided an excellent guide in making this recommendation. Furthermore, ArcticNet and the ArcticNet student association have organized a yearly ECS event at the ArcticNet meetings, called "student day," for a number of years. From our surveyed societies, the Society for Mathematical Biology hosts a half-day mentoring workshop for members wishing to acquire knowledge on building their careers, and the Ecological Society of America is currently developing a formal version of an ECS mentoring program.



**Fig. 3.** Age groups of WSU Facebook followers (male and female combined) as of 2 April 2015.

### Facilitation of professional development sessions

Development workshops are a common feature of many meetings and offer valuable scientific expertise and methodological skills to all members. Workshops are also commonly hosted by institutions, but, due to the costs of traveling and participation, attending these is often difficult for ECSs, and particularly students. To address this problem, we suggest that societies develop professional workshops that are run as podcasts, online video-conferences, or webinars. Much of the infrastructure required to develop these is already in place, and freely available. Podcasts, which are short audio narratives that can be downloaded to portable media players, are one example. Many free websites offer easy-to-use interfaces for creating and uploading podcasts. Only the Society for Toxicology actively advertised web seminars for ECSs on its website (Table 1).

We envision that these online workshops would be coordinated by the ECS representative, or a delegated group of individuals, based on the interests and requests of the members of the society, particularly ECSs. This group would be responsible for soliciting content and facilitating the development of online workshops. The ECS representative would then advertise the podcast via the ECS communication center (see Inception and active perpetuation of an ECS communication center). Ideally, workshops would be directed or led by other experienced ECSs, but senior members of the society would be encouraged to participate. In some cases, it may be appropriate for the representative to ask experts from outside the society to conduct a workshop. Potential workshop topics of interest to ECS would focus on professional development, career planning and techniques relevant to the organization's discipline. Relevant topics include applying for research funding (e.g. similar to those held by the National Science Foundation), searching for field or professional positions, hiring technicians, applying for tenure-track positions, developing teaching philosophy statements, interviewing techniques, software training, data analysis and/or field/lab techniques.

*Anticipated benefits.* Online workshops can bridge temporal gaps between society meetings and cover a wide diversity of topics. Furthermore, as podcasts and video webinars can be implemented free of charge and accessed from any part of the world, they increase access for students and ECSs who might not be able to travel to conferences or workshops because of lack of funding. Over time, a society can then develop a dynamic digital “library” of talks and workshops built upon the interests of society members. The dissemination and storage of such a library would be decided by the individual capabilities of the society.

*Example.* The WSU has implemented a “Meet the Masters” online video-conference series on research and professional development topics, during which a small group of ECSs interact via a video-conferencing platform (e.g. Google Hangouts) with two senior seabird scientists. The framework of the “Meet the Masters” series brings two senior scientists with similar or complementary research interests (e.g. spatial ecology, island conservation biology, bio-logging) and allows ECS participants to direct the conversation. Viewers of the live broadcast also submit questions in real-time through social media (Twitter, YouTube, and Google+). In March 2015, the first event was held with two featured senior scientists, two early-career hosts, and five live participants. The hour-long live broadcast was viewed by 36 others with an average view

time of 27 minutes. Archived video recordings of the “Meet the Masters” conversations are stored on a Youtube channel ([www.youtube.com/channel/UCIplZ6Pf\\_1mshnE3u4Ya0F4w](http://www.youtube.com/channel/UCIplZ6Pf_1mshnE3u4Ya0F4w)). As of 14 April 2015, the first event has been viewed by 323 unique IP addresses located in 26 countries across five continents, with an average view time of 12 minutes.

### Hosting social media events

Social media has become a powerful tool for scientists and professional societies, allowing them to publicize research and discuss thoughts openly with large heterogeneous audiences (Bik & Goldstein 2013). It has also allowed for creative communications. For example, Instagram offers a unique way of sharing photographs while connecting seamlessly to other social media outlets. Contests that have traditionally been held offline, such as photo competitions, can now be held online quickly and easily. These competitions could be incorporated into the ECS communication center (see Inception and active perpetuation of an ECS communication center) and further developed to include scientific and creative writing, videos on topics or impact messages that the society may wish to promote (e.g. most creative seabird documentary, or “Dance your PhD” hosted by The American Association for the Advancement of Science, etc.). Competitions could be judged on the basis of both set criteria and votes from society members solicited via social media. These events could be focused primarily on ECSs, separated by categories (students, ECSs, senior scientists), or all-inclusive (public), depending on the specific goals of the event. By using social media platforms, these events would have inherent value for broader outreach by including members of the general public.

*Anticipated benefits.* Because social media and websites are hosted online, they can be accessed by a broad audience from all over the world, without the cost and time commitment required of traditional “in-person” events. They can be developed and delivered in a relatively short period of time. Once the communication center is in place, they would require very little overhead and investment, both in time and money, from a society. These events can be easily shared, further increasing the audience and potential outreach impacts. Because there is a certain level of anonymity associated with social media events, it may help students and other ECSs to actively participate, allowing them to become more comfortable interacting professionally and invigorating the discussion. It also encourages camaraderie and a sense of community through friendly competition and shared interests, as well as highlighting outstanding work by society members. Moreover, hosting an event can increase the overall numbers of followers (see Fig. 1 for Twitter). Following a group on social media involves little overhead from individuals and keeps them aware of the events of societies without commitment to an email list. Thus, after having an online attachment to that group for a period of time, members would be more likely to invest money or time in participation with that society when activities of interest arise. However, it should be noted that these activities are not meant to replace the experience of attending a conference and engaging individuals face-to-face (see ECS mentor/mentee program).

*Example.* The WSU held the first World Seabird Twitter Conference (#WSTC1) on 21 March 2015. This was the first globally scaled event of its kind in the scientific community. It was free to



organize, with the only costs being prizes for the winners (e.g. discounts on conference registration). Logistically, the event was simple to organize with a committee of just five people. The event hosted 42 presentations from 12 countries and had an engaged audience of 450 individuals who tweeted from 19 countries spanning all seven continents (one individual tweeted from the Antarctic). In total, the passive audience (i.e. all individuals who were following users engaged in the conference, representing the social impact of the event as defined by people who would be able to see posts with the hashtag #WSTC1) amounted to ~330,000 people (statistics calculated from www.topsy.com). There were clear benefits, including 1) little effort in time and resources for organization, 2) low cost, 3) decreased carbon footprint, 4) worldwide participation, and 5) high social reach, with audiences rivaling those of actual seabird meetings (e.g. Pacific Seabird Group meetings include up to 400 individuals per year).

### Invitations for ECSs to participate in professional working groups

Formation of working groups and committees that integrate resources towards a common goal, such as research and management techniques and protocols, research initiatives or other society goals, are relatively common in societies and organizations. In the past, it has been typical for ECSs to be excluded from working groups because of their lack of experience, or simply because membership is by invitation only. This has begun to change (e.g. The Wildlife Society) as societies appreciate that ECSs offer new perspectives and may be more familiar with the latest technological and analytical techniques (Hampton & Parker 2011).

To facilitate the involvement of ECSs, the ECS representative could act as a liaison between working groups and the ECS community, and use the communication center to help increase the profile of working groups and the groups' desire for ECS participation. An alternative method would be to revise the by-laws of an organization to specifically include ECSs in professional working groups. This may depend on the size and nature of a society; however, the inclusion of such a by-law would clearly demonstrate the society's commitment to ECSs.

*Anticipated benefits.* Interactions in professional working groups are extremely profitable for ECSs, as they help to build collaborations with established society members who are experts in shared areas of research, and allow ECSs to tackle complex research and management issues that may extend beyond their normal research. Correspondingly, the fresh perspectives offered by junior scientists are often beneficial to decision-making processes traditionally administered by more tenured or experienced scientists. Investment in outcomes by ECSs would likely have a direct impact on long-term society membership of those individuals.

*Example.* In June 2014, 88 ECSs convened at the Third International Conference on Arctic Research Planning to discuss future directions for permafrost research. During the workshop, ECSs developed a series of five important research topics that they believe need to be addressed in future Arctic research (Fritz *et al.* 2015). Because these ECSs have now invested time in the formulation of concepts that could direct their research careers, the likelihood of those individuals continuing Arctic research has increased. Therefore, this is likely to play a role in determining whether those individuals remain members of societies focused on Arctic research.

The Conservation of Arctic Flora and Fauna (CAFF) has also been promoting the involvement of ECSs in working groups. With the help of APECS, CAFF has recruited ECSs into several of its expert groups, including the seabird and marine working groups.

### Establishment of an excellence award for ECSs

A tradition among many existing societies has been to honor and recognize community members through lifetime and special achievement awards presented at society meetings. These prestigious awards are generally selected by a committee. Student awards either for travel or for presentations are also common at most society meetings. In the critical ECS phase, when individuals are deciding which career routes to take, positive reinforcement of their achievements is lacking. Thus, we recommend that the tradition of awards for senior researchers or students be extended to include ECSs by creating an award that honors excellence and encourages research by ECSs.

This award would be determined by a committee comprised of ECSs and senior members who would determine procedures for nominations, commission of the award and ultimately select award recipients. Senior members, student/postdoctoral advisors and/or supervisors would be encouraged to submit nominations highlighting individual ECSs, respond on topics relevant to the nomination and detail reasons for the nomination.

*Anticipated benefits.* An excellence award for ECSs might recognize achievement in research, conservation, management or any combination of these; the potential of receiving such an honor would stimulate participation and the endeavor for excellence by ECSs. Furthermore, the public acknowledgement and recognition of their work and achievements are likely to have appreciable positive consequences, both personally and professionally. This will also encourage senior scientists to introduce themselves to those ECSs, thus increasing their social and professional networks. This opens possibilities to both the experienced scientists and ECSs with regard to future collaborations or career opportunities.

*Example.* Four of our 42 sampled societies actively promote awards focused on ECS excellence (Table 1). The American Ornithologists' Union (AOU) offers the Ned K. Johnson Young Investigator Award, and the Cooper Ornithological Society (COS) offers the COS Young Professional Award. The Ned K. Johnson award is for individuals who have received their doctorate within five years of nomination (falling within our definition of an ECS), and can only be granted to an individual once. Since only members are eligible to receive the award, the potential for recognition could motivate ECSs to join AOU, thereby increasing recruitment. The COS Young Professional Award is awarded to two ECSs every year, who are given the opportunity to present their studies at the Young Professional Award plenary session at the annual meeting. Receiving the award also increases recognition of the recipients and thus the potential for their long-term retention in the society.

## CONCLUSIONS

Ensuring the recruitment and retention of ECSs is essential for scientific societies and the services they provide. Recruitment and retention of ECSs not only helps to ensure the long-term viability of a society, but also helps the professional development of ECSs. Organizations such as APECS have demonstrated the utility of

many of our guidelines and have contributed many new ideas towards the recruitment and retention of ECSs. The success of APECS supports the concepts we have presented here and can act as a model for scientific organizations to follow. The WSU has also begun adopting some of these concepts, which will enrich the experiences of attendees at upcoming conferences, creating a positive atmosphere and thus supporting retention of ECSs in the global seabird community.

We believe societies that invest in and develop infrastructure geared towards the recruitment and retention of ECSs will experience long-term survival and success. Maintaining a population of ECSs, who are at a crucial stage in their careers, may help guide those individuals into specific fields of research, encouraging them to remain members in the long-term. The knowledge and experience passed from senior society members to ECSs can be preserved as well by maintaining a large population of developing scientists within a society. Furthermore, ECSs tend to be more aware of changes in technology and communication. Retention of ECSs would therefore lead to the integration of new techniques for reaching other ECSs and ensuring continuity of society knowledge.

The recommendations that we, a group of ECSs, make here correspond to what we personally have found to be most important to our involvement in professional societies. We find that these recommendations not only enrich our professional experience within the context of the society, but also encourage our long-term investment as members of a given society. Organizations interested in increasing participation and involvement of ECSs would benefit from our guidelines, ensuring continuity for future generations within the scientific community.

#### ACKNOWLEDGEMENTS

We would like to thank the entire seabird community for many years of encouragement, helpful advice and memorable conferences and meetings. Thanks to D. Irons and J. Croxall for support and helpful comments as we formulated this paper, and to K. Dugger and other reviewers whose comments improved the paper. The authors have been listed in alphabetical order, as all have contributed greatly to the formulation of these recommendations.

#### REFERENCES

- BIK, H.M. & GOLDSTEIN, M.C. 2013. An introduction to social media for scientists. *PLOS Biology* 11: e1001535.
- CARROLL, C. 2014. Can a conservation-oriented scientific society remain relevant in the 21st Century? [Editorial] *Conservation Biology* 28: 1137-1138.
- CARROLL, C., NOSS, R.F., HILTY, J. & TROMBULAK, C. 2009. Solving SCB's Membership crisis by reinvigorating the sections: response to Schwartz *et al.* *Conservation Biology* 23: 5-6.
- DUGGAN, M. & BRENNER, J. 2013. *The Demographics of Social Media Users – 2012*. Pew Research Center. (Available online at: <http://pewinternet.org/Reports/2013/Social-media-users.aspx>. Accessed 7 June 2016.)
- FRITZ, M., DESHPANDE, B.N., BOUCHARD, F. ET AL. 2015. Brief communication: Future avenues for permafrost science from the perspective of early career researchers. *Cryosphere: Discussions* 9: 1209-1225.
- HAMPTON, S.E. & PARKER, J.N. 2011. Collaboration and productivity in scientific synthesis. *BioScience* 61: 900-910.
- HURD, J.M. 2000. The transformation of scientific communication: a model for 2020. *Journal of the American Society for Information Science* 51: 1279-1283.
- LAUBER, T.B., TAYLOR, E.J. & DECKER, D.J. 2010. Factors influencing membership of federal wildlife biologists in The Wildlife Society. *Journal of Wildlife Management* 73: 980-988.
- LESLIE, D.M. 2007. A shifting mosaic of scholarly publishing, scientific delivery, and future impact changing the face of learned societies. *Journal of Mammology* 88: 275-286.
- MUSANTE, S. & POTTER, S. 2012. What is important to biological societies at the start of the twenty-first century? *BioScience* 62: 329-335.
- POTTER, S., MUSANTE, S. & HOCHBERG, A. 2013. Dynamism is the new stasis: modern challenges for the biological sciences. *BioScience* 63: 705-714.
- SCHWARTZ, M.W., HUNTER, M.L. & BOERSMA, P.D. 2008. Scientific societies in the 21st Century: a membership crisis. *Conservation Biology* 22: 1087-1089.
- SHIFFMAN, D.S. 2012. Twitter as a tool for conservation education and outreach: what scientific conferences can do to promote live-tweeting. *Journal of Environmental Studies and Sciences* 2: 257-262.