



Leadership and diversity in the New Zealand Ecological Society

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Published online: 3 April 2019

Abstract: The New Zealand Ecological Society (NZES) was formed in 1951 by government and academic researchers keen to foster the newly emerging discipline of ecology. NZES membership has now expanded to include many different contributors to ecology and conservation, from research scientists to conservation practitioners through to environmental policy analysts. Our aim was to examine how diversity in NZES has changed over time, either as a leader or a follower of trends in society. To do so, we analysed available data on NZES membership, governance structure, and awards, which reflect contemporary concerns about equality, matauranga Maori, and interdisciplinary science. We also searched articles in the New Zealand Journal of Ecology, using terms such as ‘Maori’, ‘culture’ and ‘matauranga’ to track the incorporation of indigenous views and matauranga Maori into New Zealand ecological research. Together, NZES membership, governance and awards show a shift in membership and governance towards greater gender equity. Early NZES governance and membership was dominated by men with some notable exceptions largely derived from the field of botany. However, the data provide only a sketchy picture of members, as neither ethnicity nor gender data are collected. As yet, very few published journal articles reflect bicultural values, concerns or management of New Zealand’s biodiversity. We discuss possible interpretations of the data, including the changing value of service to societies like ours, and consider pathways to support and value diversity in the NZES.

I whakatūngia te Rōpū Hauropi o Aotearoa i te tau 1951. Nā etahi kairangahau mai i te Kāwanatanga rātou ko ētahi kairangahau ngaio te Rōpū i whakatū i runga i te pirangi kia whakatūtinahia te akoranga hou e kiia nei ko te hauropi. I ēnei rangi kua whānui kē noa atu ngā momo mema o te Rōpū nei, ā, he maha hoki o rātou e tuku kōrero ana ki te akoranga hauropi, tiaki taiao hoki. Hei tauira, ko ētahi o rātou he kaupūtaiao. Ko ētahi anō he kaimahi tiaki taiao. Ko ētahi he kaitātari kaupapa-here e pā ana ki te taiao. Ko te whāinga o tēnei rangahau, he titiro ki tēnei mea te kanorau o ngā momo tāngata i roto i te Rōpū, ā, kia pātaihia e pēhea ana te whakarerekē haere o te kanorau momo tangata o te Rōpū i roto i ngā tau. Ka tirohia pēnei te Rōpū nei hei kaiārahi, hei kaitautāwhi rānei o ngā ia i roto i te hapori whānui. I pēnei mā te āta tātari i ngā raraunga e wātea ana mō ngā mema o te Rōpū, te hanganga kāwanatanga me ngā tohu i whakawhiwhia. Ko ēnei āhuatanga katoa ka whakaatu i ngā waiaro o te wā e pā ana ki te mana ōrite, te mātauranga Māori me te kaupapa whakakao whakaaro i roto i te pūtaiao. I kimihia hoki ngā tuhinga i roto i te Pukapuka Rātaka Hauropi o Aotearoa. Ko ngā kupu i kimihia pēnei i te ‘Māori’, te ‘ahurea’ me te ‘mātauranga’ hoki kia kite ai mehemea i whakatōpūngia ngā tirohanga me ngā waiaro o te iwi taketake ki roto i ngā rangahau hauropi o Aotearoa. Mehemea ka tirohia tahitia ngā momo mema, te hanganga kāwanatanga me ngā tohu ka whakawhiwhia, ka taea te kite atu kua piki ake te mana o te wahine kia noho ōrite atu ki tō te tāne. I te timatanga o te Rōpū, i whakatuanuitia ia e te hunga tāne, haunga atu i ētahi wāhine inati (ko te nuinga nō te ao mātauranga hauota). Engari kei te hapa tonu ētahi wāhanga mōhiotanga nā te mea kāore i kohia raraunga e pā ana ki te whakapapa a-mātāwaka nei o ngā mema, mehemea rānei he wahine he tāne rānei aua mema. I tēnei wā he ruarua noa iho ngā whakaputanga o te pukapuka rātaka nei e whakaata ana i ngā kaupapa whakahirahira a te Māori, i ngā tikanga kākanorua rānei e pā ana ki te whakahaere o ngā momo koiora kanorau o Aotearoa. Ka matapakingia ētahi whakamārama pea o ngā raraunga, tae noa ki te whakarerekē haere o te uara o te tuku ratonga ki ngā rōpū pēnei i tēnei Rōpū. Ka whakaarongia hoki ngā ara hei whai atu kia tautoko kia whakamana hoki i te kanorau o ngā momo tāngata ki tō tātou Rōpū.

Keywords: diversity, gender bias, inclusivity, local ecological knowledge, Maori, matauranga, women in STEM

Introduction

The recruitment and retention of under-represented groups is a major concern in science, technology, engineering and mathematics (STEM) disciplines (e.g. Bell et al. 2015; White 2015; Prinsley et al. 2016). It is estimated that at current rates, it will take decades before gender equality is achieved at a senior level in the sciences, even though the proportion of women entering science has been at 50% since 2001 (Hargens & Long 2002; SAGE 2016). Data also indicate that although women are now equally represented in training at undergraduate, graduate and postgraduate levels in some areas of STEM, equal representation is not the case at faculty level where women disproportionately leave science (including biology) at every career stage (for example, Martinez et al. 2007; National Science Foundation 2012; Shaw & Stanton 2012; Glass et al. 2013; Arismendi & Penaluna 2016). Similarly, non-white minorities also have low representation in science, have less grant success, and are likely to face systemic barriers and cultural barriers (Ginther et al. 2011; Arismendi & Penaluna 2016). Tracking progress on achieving equity is critical to ensure that initiatives to improve outcomes for target groups are effective. However, equity data are often lacking particularly for people of colour and indigenous peoples (for example, Torres 2012). Biology, particularly environmental science, ecology and conservation, is frequently identified as one of the sciences most attractive to women and minority groups, including indigenous people. Thus, ecology as a discipline is likely to be at the forefront of membership and leadership changes in diversity for under-represented groups.

In academia, work culture, mentoring and leadership are important for the advancement and retention of a diverse membership base (Blau et al. 2010; Horner-Devine et al. 2016). Xu (2008) suggests that higher turnover rates for women globally are mainly due to dissatisfaction with departmental culture, lack of advancement opportunities, flawed faculty leadership and inadequate research support. Research indicates that opportunities to develop leadership and experience may be restricted for women and minority groups in scientific workplaces; for example, scientific journals tend to appoint more men than women to editorial boards, and editors tend to select reviewers of the same gender as themselves (Helmer et al. 2017; also see Fox et al. 2016; Lerback & Hanson 2017). Leadership of societies and plenary addresses are two key pathways for scientists to gain visibility and recognition, and to role model leadership for the next generation of scientists. In New Zealand, it is unclear whether an apparent increase in the proportion of female or indigenous Māori students entering ecology has resulted in diverse representation in ecology related disciplines, equitable opportunities as plenary speakers at conferences, or in membership and leadership of societies such as the New Zealand Ecological Society (hereafter NZES).

Other significant issues around recognition of scientific research by both women and other under-represented groups occur. Women and minorities remain under-represented globally in many science awards. For example, women across 18 STEM disciplines were significantly under represented among recipients of scholarly and research awards and over represented in service and teaching awards relative to the proportion of PhDs, Full and Associate Professors between 2001 and 2014 (Lincoln et al. 2011; also see Holmes et al. 2011). One common explanation is that unconscious bias (by both men and women) limits recognition of work by female and minority scholars (e.g. Moss-Racusin et al. 2012), and

is in turn reflected in low nomination rates for scholarly and research awards. For example, scientists tend to rate writings authored by men higher than those authored by women (Knobloch-Westerwick et al. 2013; Bradshaw & Courchamp 2018), although an analysis of New Zealand Journal of Ecology submissions indicated no bias in publication success rates (Buckley et al. 2014), a finding repeated in Functional Ecology (Fox et al. 2016). Nevertheless, women scientists are consistently under-represented in ecology textbooks compared to baseline assumptions of no bias (Damschen et al. 2005). Women also often have high engagement in service activities that do not contribute as strongly to their overall success. In the United Kingdom, evidence indicates that women academics in science, engineering, and mathematics have more administrative duties on average than men, and hence, less time to do research (Aldercotte et al. 2017). As well, regardless of their representation in the nomination pool for awards, in these studies men were twice as likely as women to win scholarly awards.

Unconscious biases stem from repeated exposure to pervasive cultural stereotypes that portray women or indigenous scholars as less competent (Yurkiewicz 2012). Certainly, cultural mismatches between language and expertise in scientific interactions result in underestimation of expertise in women, and in people from collectivist cultures (such as Māori) (Thomas-Hunt & Phillips 2004; Hirschfield 2017). The competence and knowledge of individuals from these groups are commonly underestimated, with resulting effects on recognition and success (Hirschfield 2017). Because scientists are increasingly judged by the number of their publications, citations, research grants, awards, plenary speeches and membership of elite academies, this underestimation of ability effectively constrains career choices and progression (Xie 2014). Therefore, we wished to examine recognition of female and indigenous Māori ecologists in the NZES awards, to determine whether any patterns were evident.

The NZES was initially formed in 1951 by government and academic researchers keen to foster the newly emerging discipline of ecology. We sought to determine how NZES has changed over time, either as leaders or followers of these global trends, and how its governance and awards reflect contemporary concerns about equality, mātauranga and interdisciplinary science. Our aim was to evaluate the degree to which NZES membership, governance structures, plenary speakers and awards reflect the diversity of NZES and of the New Zealand population as a whole.

Methods

Building on the inspiring efforts of Dave Kelly, a long-time stalwart of the Society, we collated historical data on the NZES – including its governing board and award recipients – from the NZES website <https://newzealandecology.org/>. To investigate membership data, we searched recent computer records provided by NZES officers, as well as archival records stored at the Canterbury Museum. Currently, membership records for most years are incomplete, so we were unable to constructively analyse these data. However, we did identify the list of inaugural members of NZES, published in the first issue of the New Zealand Journal of Ecology. We were able to assign apparent binary gender to those on this list, largely because the honorific Mrs or Miss was applied to all women without Doctorates. We used our shared knowledge, and

the knowledge of long time New Zealand ecologists (see Acknowledgements section), to identify one further female NZES member with a Doctoral degree on this list. Because ethnicity is not recorded in membership data, we again used our shared knowledge to identify ecologists of Māori descent, as well as those from a mostly white (Pākehā) background, although this knowledge is unlikely to be exhaustive.

We analysed data for awards with the longest time series in the NZES and assigned apparent binary gender to the names in these data wherever possible, based on publicly available information, our knowledge of individuals and the knowledge of older NZES members (see Acknowledgements section), while recognising that some gender diverse members may not be recognised using this method. Te Tohu Taiao is the NZES's premier award and is presented annually to 'recognise individuals who have made an outstanding contribution to the study and application of New Zealand ecological science' (see <https://newzealandecology.org/awards-grants/> for more details of awards). The Ecology in Action award was established to 'recognise individuals who have made outstanding contributions to the application of ecological knowledge, including communication, education and transfer of ecological science at the grass roots in NZ or the Pacific'. The Award for Best Paper published by a student or a researcher who has graduated within the last 3 years was first made in 2001. However, from 2010, criteria were altered for this award so that only papers published in the New Zealand Journal of Ecology were considered. Best Student Paper Awards are awarded to recognise excellent research talks and posters presented at the NZES annual conference. We estimated the proportion of female plenary speakers by searching New Zealand NZES conference programmes online. We excluded speakers who addressed the audience as a consequence of receiving an award the previous year from this count. We collected data on journal editors, who are generally ex-officio members of council, as editors are an important service role.

As a proxy for cultural diversity in New Zealand ecology, we searched articles published in NZES using the terms 'culture', 'mātauranga' and 'Māori' (both with and without

macrons) to find articles that might incorporate Māori knowledge or worldviews. Current best practice is to write Māori words correctly within English text formats, that is, with the inclusion of macrons, but many papers do not include them. We compared the findings against a set of issues that were hand checked for relevant articles, to ensure that the search terms were robust. From the results of the search, ten papers were excluded as not relevant; for example, if 'maori' was part of the species name and there was no other connection to Māori or mātauranga Māori.

All analyses were completed in R version 3.5.1 (R Core Team 2018). Chi-squared tests were used to test if proportions were the same across genders for awardees.

Results

Membership and inclusion

It quickly became clear that NZES membership records do not indicate ethnicity or gender, although we were able to allocate gender for the membership at the inception of the NZES. The first publication of the New Zealand Journal of Ecology included a membership list of 162 members, of whom 36 (23.4%) were women. However, we were unable to directly evaluate how the gender and racial composition of the NZES has changed through time since its inception, given the current difficulties in compiling accurate records.

Our search of articles in the New Zealand Journal of Ecology from 1953 to 2017, using the terms 'Māori', 'culture' and 'mātauranga' as a proxy for increased diversity and potential inclusiveness in NZES, revealed 27 papers out of 1412 published papers, presidential addresses and policy submissions (but excluding abstracts) that included one or more of these terms. These 27 papers had a variety of contexts and topics from cultural harvesting of kererū to palaeoecology, with approximately 17 that included some relevance to Māori (Fig. 1; see Appendix S1 in Supplementary Material for a list of relevant articles). Topics included customary use and management of species (for example, Wright et al. 1995; Lyver



Figure 1. Topics identified from the titles of 17 papers published in the NZ Journal of Ecology that included the terms mātauranga and/or Māori. Large words appear most frequently in the titles. The top 50 results only are shown here. Function words such as 'and' and 'the' are excluded, as is the phrase 'New Zealand'. Abstracts were not used because some papers did not have abstracts.

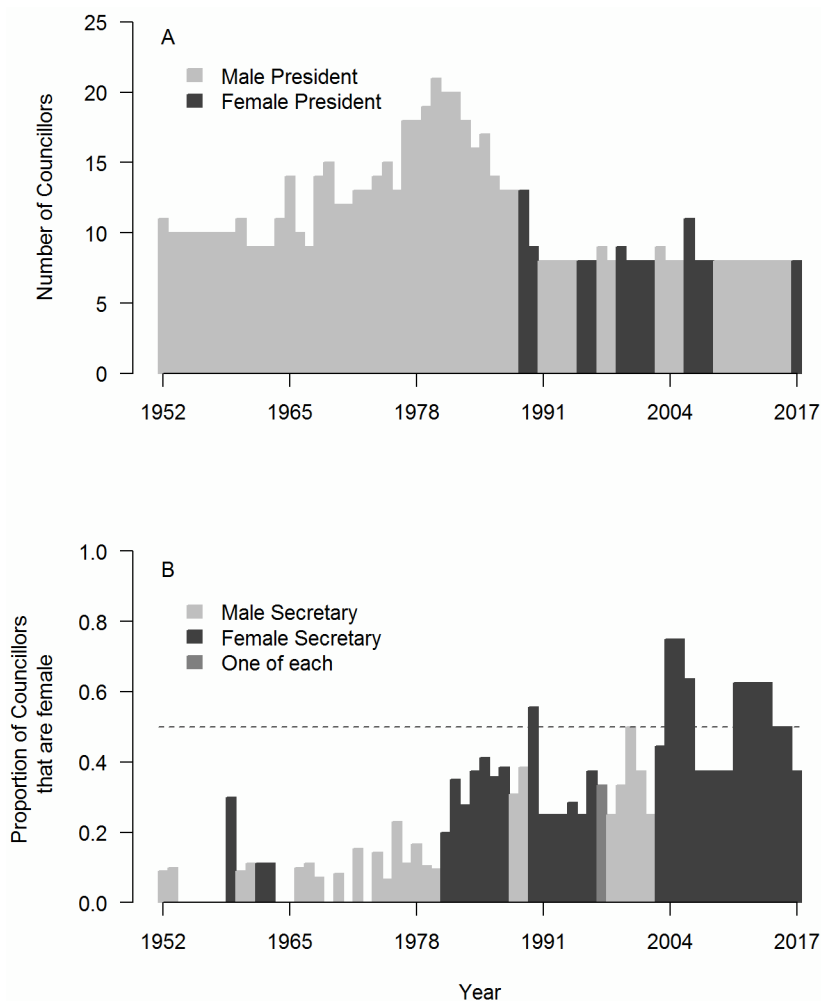


Figure 2. Leadership, secretarial service, and councillors in the NZES from 1951–2018 by gender. 2A. The total number of councillors each year of the NZES from 1951–2018, and their apparent binary gender based on public records and knowledge. The colour reflects the gender of the president each year, with grey representing male presidential leadership of the council, and black representing female presidential leadership. 2B. The proportion of women on the NZES council annually increases steadily through time. Grey represents a male secretary in that year (or, male secretaries in 2006), and black represents a female secretary or secretaries. Dark grey represents a year with two secretaries, one of whom was male and one female.

2000; Lyver et al. 2008); ecological management that noted or focused on species highly valued by Māori (for example, Bellingham et al. 2010); and Māori effects on landscapes within a palaeoecology framework (McGlone et al. 2005). Nonetheless, categorising most of these papers as ‘including a Māori worldview or mātauranga Māori’ is tenuous. A notable inclusion was the policy submission by the NZES Council on Māori customary use in 1995. The number of papers that had some relevance to Māori were spread across the time period, with two from the 1980s, two from the 1990s (related to the Department of Conservation call for submissions on Māori customary use), seven from the 2000s, and six (to date) from the 2010s. Although the total number of papers published in the journal increased over time from 13 in 1953, through to 31 in 2017 (mean 22 per year, range 9–46 papers), the percentage of papers that met our criteria of relevance to Māori and mātauranga Māori was low throughout, with <5% in all years except 2004 and 2014, in which 2/30 (6.7%) and 2/35 (5.7%) respectively met the criteria.

Leadership and service

At the inception of the NZES in 1951, 23.4% of its members were women, but, it was not until 1989 that NZES members voted in the first female president, Judith Roper-Lindsay. Since then six other women have served as president (Fig. 2A). It appears that women were more likely to be elected as president in the second half of the NZES’s existence, than in the first half (Fig. 2A). There are currently 24 life members

of the New Zealand NZES, of which only two are women. Ruth Mason (Fig. 3) was made a life member more than 40 years ago: she was described as a tireless and meticulous worker, and a loyal, quiet person whose opinion was widely respected, as a fine botanist and lexicographer, and as a woman



Figure 3. Photo of Ruth Mason.

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who was always true to her ideals. In 2016, past president Shona Myers was also inducted into life membership. Shona has also served as President of INTECOL, the International Association for Ecology from 2013–2017, and held advisory positions at the Department of Conservation from 1987 and at Auckland Regional Council from 1996, before developing her own consultancy.

From 1951–2018, 223 people have served on the NZES council. From our assignment of apparent binary gender of councillors, 64 councillors were women (28.7%), 156 men (70%), and we were unable to assign gender for three people (Fig. 2B). To our knowledge, there has been relatively little cultural diversity amongst council members, although at least two members of Māori descent have served on council. Of the 64 women to have served on the council, almost one quarter served as secretary (21.8%) compared to only 9% of their male counterparts. Only 10.9% of female councillors were president, 4.7% treasurer and 7.8% journal editor. In contrast, of 156 men who served on council, 18% were president, 11% treasurer, and 11.5% served as journal editor. All the officers of the council (president, vice president, treasurer), except the secretary are significantly more likely to have been male (see Table 1 for Chi-squared tests). This gender effect was also associated with the ex-officio positions of editors (Table 1).

Society awards

Historically, award winners were mostly white men, consistent with trends in New Zealand science more generally through

much of the 20th century. Only four women, one of whom is also Māori (author JB), have won the pre-eminent Te Tohu Taiao award in the 25 years since it was first presented in 1990. Recipients are significantly more likely to be men (20/25 recipients, $X^2 = 9$, $df = 1$, $p = 0.003$; Fig. 4). The proportions were the same across genders for awardees of the Ecology in Action Award (instituted in 2005, $n = 5$ females and $n = 7$ males awarded, $X^2 = 0.33$, $df = 1$, $p = 0.564$). There are indications, though, that a new rank of ecologists is coming through: The 2017 Ecology in Action Award winner was Richelle Kahui McConnell, a female Māori ecologist working in the area of mātauranga Māori knowledge transfer. Best Student NZES Conference Presentation awards are significantly more likely to be women (28/39 recipients, $X^2 = 7.4$, $df = 1$, $p = 0.006$; Fig. 4). For the Best Paper by a New Researcher Award, the gender bias is trending towards females, although this is not significant ($n = 5$ males, $n = 11$ females, $X^2 = 2.25$, $df = 1$, $p = 0.134$). Prior to 2010, male and female researchers won the Award in equal numbers, but since 2010, when judging criteria limited consideration to papers published in the New Zealand Journal of Ecology, almost all recipients have been female. The globalisation of science education is also demonstrated in the recent student winners, with students of many ethnicities winning the Best Student Conference Presentation since 2000. We have no data on award committee membership, or on those who nominate members for awards or leadership positions.

Our records of NZES plenary speakers records are incomplete, with best data from 2000–2017. At the conferences

Table 1. Number of men and women who have served in each of the named council positions, as well as the ex-officio positions of editor. Chi squared values test if equal numbers of males and females have held each role. In all cases, $df = 1$.

Role	Number female	Number male	Chi-squared value	P value
President	7	28	12.6	<0.001
Vice president	9	30	11.3	<0.001
Treasurer	3	17	9.8	0.002
Secretary	14	14	0	1
Journal editor	2	17	11.84	<0.001
Scientific and technical editors	3	2		

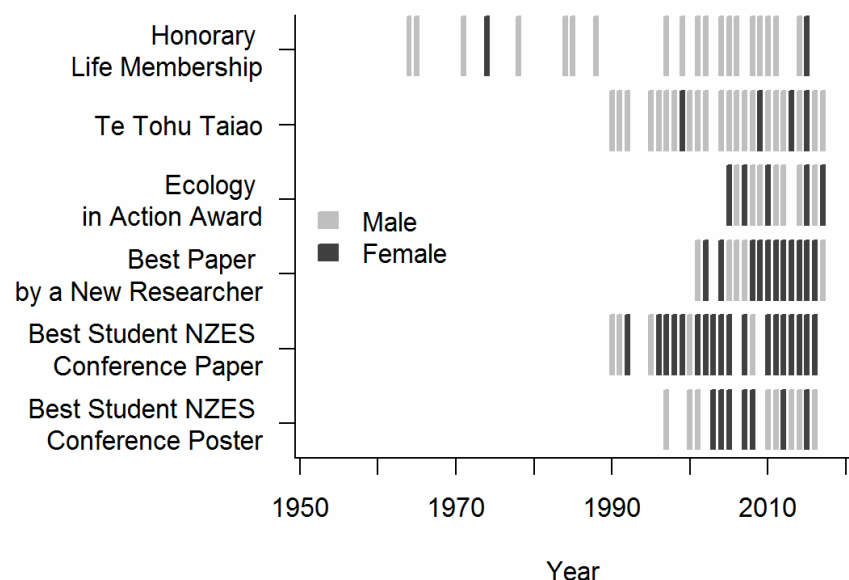


Figure 4. NZES award winners by gender from the inception of NZES until 2017. Honorary Life Membership recognises service to NZES, Te Tohu Taiao acknowledges outstanding contribution to the field of ecology, while the Ecology in Action Award recognises the important role of the transfer of ecological knowledge in changing behaviours and achieving practical protection and restoration of biodiversity. The other awards are to recognise excellence in early career ecologists. Not all awards are awarded every year. See the Methods section for details on Award categories.

for which we currently have data, approximately 21% of plenary / keynote speakers at NZES annual conferences were women, suggesting low gender equity (19 of 86 plenary / keynote speakers, $X^2 = 26.79$, $df = 1$, $p < 0.001$; Fig. 5).

Discussion

A lack of diversity data hindered our analysis of membership trends, something that the NZES should seek to remedy. Such data would provide a useful baseline to setting clear and measurable goals to support inclusion. Similarly, although women have been members of the NZES since its inception and are now likely to represent an increased proportion of the membership, it is currently impossible to determine how this aligns with national demographic data. Māori membership, and mātauranga Māori, remains low profile within NZES and its journal. Without membership data on diversity, it is impossible to detect whether an increase in Māori ecology students at New Zealand universities through time, for example, results in higher numbers of Māori ecologists in NZES. Nevertheless, it is unlikely that current NZES membership reflects New Zealand's demography of 14.9% Māori (Statistics NZ 2014). In addition, as New Zealand demographics are predicted to diversify markedly over the next 50 years, tracking the representation, inclusion and success of minorities more broadly could be useful.

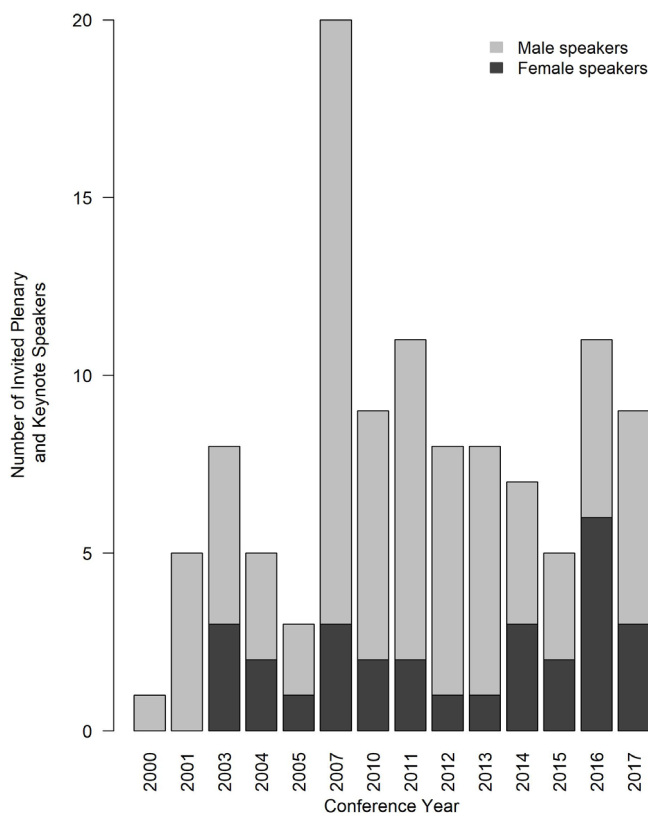


Figure 5. Plenary speakers at NZES conferences by gender. Years where no plenary speakers were listed in the programme (2006, 2008) are missing, as are years for which we were unable to source the Conference Proceedings.

When we sought to identify how or when Māori values may have been incorporated into publications, there was little visible indication of mātauranga Māori, or bicultural approaches to ecological problems, with the exception of a very few papers. Even when we considered whether relevance for Māori, more broadly, was addressed in any way in papers, the number of papers was extraordinarily small. This finding aligns with work we have undertaken on the representation of mātauranga Māori topics at the Otago school science fair (Wehi et al. 2014), which also highlighted economic inequality as an issue for students and schools engaging in the science fair. However, there has been some representation in both leadership positions and awards by Māori, a positive sign that leadership diversity is growing. At the joint 2017 conference with the Australian Ecological Society, at least two of the nine plenary speakers were indigenous (although NZES may have less say in plenary speakers in joint conference years). The 2018 diversity statement from the NZES council clearly states the council is thinking about inclusivity and diversity, and supports inclusivity. On the other hand, we note that none of the current editors of the journal appear to have expertise in mātauranga Māori.

In the first half of the NZES's life, there were no female presidents. However, since the mid-1980s, women and men have led the NZES as president for almost equal time periods. This shift may reflect changing demographics in the NZES, with increased participation of women in more recent years, but we do not have definitive data to back up this assertion. The change is consistent with a hypothesis that those with extensive experience are generally those who take on leadership roles, taking into account that a gender balance in leadership positions will likely lag behind average demographic changes in membership. However, an alternative explanation might be that in more recent times, leadership and council positions within NZES are seen as less of an honour, and more of a service role, by both members and the organisations they work for. This change also could explain greater representation of women in these positions over the last 10 years, consistent with other global data on academic women and service.

Only two women in the NZES have received prestigious honorary life membership awards. Interestingly, the citation for the first award is also notable for its gendered language, no doubt reflecting common practice in that era. However, such descriptions impact how the calibre of applicants is perceived (e.g. Trix & Psenka 2003; Dutt et al. 2016).

As is common throughout STEM, the number of awards for men increases disproportionately with career stage. It could be argued that demographic inertia (a consequence of historical lower proportions of women; Shaw & Stanton 2012) could explain the high number of recent women recipients of early career awards, and an insufficient number of women have reached the stage of their career to be nominated for the more prestigious awards, such as Te Tohu Taiao. However, given the large numbers of women who have been entering biology and attaining PhDs in recent years, it is likely that disproportionate attrition of women compared to men along the career ladder (the 'leaky pipeline') remains an important contributor to the patterns (see, for example, Shaw & Stanton 2012; Arismendi & Penaluna 2016). This is of particular concern, as there are no signs that the 'leaky pipeline' is changing. A key issue for women remains the difficulty of combining parenthood and career. Nonetheless, other factors are also likely to be involved. Research indicates, for example, that committees chaired by men are more likely to choose male recipients (Lincoln et al.

2011). Practices for selecting awardees generally have few guidelines, and there may be little attention to conflicts of interests (Lincoln et al. 2011). Despite these issues, in 2017 the first award was made to an ecologist who is a Māori woman, and also works with knowledge transfer of mātauranga Māori, an encouraging sign.

We have no data on award committee membership or decision-making in NZES, but recommend that addressing the diversity of all committees, and undertaking unconscious bias training, would be proactive steps to ensure considerations of equity. Nor do we have data on nominations relative to success for awards. Fostering committee gender and ethnic diversity, establishing selection criteria before reviewing nominees, and initiating discussion on implicit bias and its impacts prior to selection all assist recognition of work that might otherwise be insufficiently considered within dominant paradigms. In addition, because success rarely occurs if only one candidate from an under-represented group is considered (Johnson et al. 2016), other measures, such as keeping all nominations ‘live’ for five years could be useful to reduce bias. In addition, this might encourage nominations, especially for ecologists with non-traditional skills or perspectives. There is also a potential advocacy and education role for NZES here; women and other

under-represented groups are less likely to nominate themselves for awards, and many nominators or assessors are unaware of their own implicit biases. It is clear that although conference plenary addresses provide valuable visibility and kudos for scientists, the number of female ecologists who have had this opportunity at NZES conferences remains low overall. Implementing equal opportunity guidelines for conferences as well as ensuring women or other under-represented groups are included on conference organising committees are two effective measures for improving the diversity of invited and keynote speakers (Débarre et al. 2018). Aiming for at least 50% female plenary speakers at every conference would be a credible goal for conference organisers.

Gender bias continues to hold traction in the NZ science system (A. James et al. unpub. data) and inequalities still exist in funding, publishing and citation rates (Cameron et al. 2013). Furthermore, women only comprise 13% of current 406 elected Fellows of Royal Society Te Apārangi (RSNZ, a statutory organisation for advancing and promoting science, technology and the humanities in New Zealand, <https://royalsociety.org.nz/assets/Uploads/Diversity-Stocktake-2016-2017.pdf>). NZES is a constituent organisation of RSNZ, paying an annual membership. Describing science as a meritocracy and denying

Table 2. Actions to reduce bias and support excellence and diversity in ecology.

Issue	Possible solutions
Tracking and supporting diversity in membership	Collect membership data Bicultural models for managing meetings Working group to determine best actions for mitigating leaky pipeline issues Accountability: Presenting indicators of diversity data at every AGM
Updating strategies with innovative thinking	Liaising with other societies to identify and share innovative solutions
Diverse leadership	Co-leadership models that support diversity
Supporting excellence	Advocacy role by senior ecologists (and in particular men) to publicly educate our membership on equity and diversity issues in STEM, and to increase male representation in service roles such as secretarial positions Ecological society conference workshops on issues such as bias and the effects of language in recommendation letters; implicit bias in review; etc Sharing service roles broadly amongst the membership Encouraging initial questions from under-represented groups
Award committee biases	Implicit bias training for award committees Ensuring diversity in committee members Establishment of visible guidelines that discourage bias Two tier processes for awards if numbers are sufficient, to ensure adequate representation of diverse candidates in final consideration Applications ‘live’ for an extended period to ensure diverse representation for judging
Lack of diversity in applications	Soliciting and mentoring nominations from under-represented groups Ensuring calls for award nominations use inclusive language Reduce the burden on nominators by ensuring nominations remain ‘live’ for up to 5 years Ensure a diverse judging panel is visible
Speaker diversity at conferences	Setting clear equity targets for conference speakers, both invited and otherwise Setting equity targets for conference organizing committees Establishment of visible equal opportunity guidelines that are systematically mentioned
Diverse material published in the NZ Journal of Ecology	Ensuring diversity in editors and their ability to handle diverse subject material Ensuring diversity in reviewers Implicit bias training for editors and reviewers Highlight diverse authors in social media and editorials Raise the profile of under-represented areas of ecology, e.g. mātauranga Māori, through special issues, te reo Māori abstracts, forum articles Setting clear and measurable goals

workplace inequality equates to modern sexism (Johnson 2017). Meta-analyses consistently reveal higher ratings for men than for women in occupations, or leadership positions that confer high status, power and pay (Hoyt 2012; Moss-Racusin et al. 2012). Therefore, we need deliberate actions to recruit and mentor those from under-represented groups as well as actively seeking to counter implicit bias, for example through the use of implicit bias tests prior to award selections. It may also be important to consider whether gendered language in nominations for positions and awards might hinder women's chances (Trix & Psenka 2003). Transparency in selection processes is also beneficial. Although employment breaks are now often recognized by award bodies in New Zealand, the implications of these breaks remain serious, including impeding career growth, depreciation of skills, and difficulty in re-establishing one's career (Hewlett et al. 2008; O'Brien & Hapgood 2012). A list of key recommendations to reduce inequalities and diversity issues identified here are listed in Table 2.

Finally, if there is one clear message in this research, it is that collecting data is critical if we want to evaluate the impact of efforts to recruit and support underrepresented groups, and increase equitable decision-making within the NZES. Given the calibre and strength of the NZES and its members, we are hopeful that this will be the case in future.

Acknowledgements

This research was funded by the Royal Society of New Zealand via Rutherford Discovery Fellowship (12-LCR-001) to BJA and (14-LCR-001) to PMW. JRB is supported by the University of Auckland. We have built on the inspired efforts of Dave Kelly, who has collated historical data for the NZES, including data on leadership, governance, journal editors, and award recipients. These data are available on the NZES website <http://newzealandecology.org/>. Many thanks to Gretchen Brownstein for assistance with data and references, Ella Hayman for assistance collating data, Cate Macinnes-Ng, Mick McCarthy, Tim Curran, Bill Lee, and Deborah Wilson for constructive comments, and Bill Lee, Alan Mark, Peter Wilson and Rowley Taylor for help identifying early members and councillors. Many thanks to Holden Hohaia who translated the abstract.

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Received 30 July 2018; accepted 29 January 2019

Supplementary material

Additional supporting information may be found in the supplementary material file for this article:

Appendix S1. Papers identified in a search of articles in the *New Zealand Journal of Ecology* from 1953 to 2017 that included some relevance to Māori (n = 17).

The *New Zealand Journal of Ecology* provides supporting information supplied by the authors where this may assist readers. Such materials are peer-reviewed and copy-edited but any issues relating to this information (other than missing files) should be addressed to the authors.