

How do we know ourselves?

Recent surveys of the Aotearoa New Zealand science workforce

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It is vital that discussions of the future of our research and science system are grounded in understanding of both how it functions now, and how it has changed over time. This article serves as an overview of available information about the Aotearoa New Zealand research and science workforce, considering surveys and workforce analyses published in the last thirty years. It illustrates the need for more systemic data capture in the future to support in-depth analyses over time of the scientific workforce and the trajectories of graduates of our university system into and out of that workforce. Such data and subsequent analysis will allow better allocation of resources, better design of education and training, better understanding of the science and research landscape, and informed appraisal of the career paths that emerge from PhD study in the sciences.

Introduction

Perhaps the most critical part of envisioning futures for our research and science sector is understanding the scientific workforce - who is part of it, where they come from, what they do, and how this aligns with our needs and desires for our research and science system as a nation. In other nations this is part of the remit of national-level science organisations such as the National Science Foundation (NSF) in the United States (National Science Foundation, 2021) or the Office of the Chief Scientist in Australia (Office of the Chief Scientist, 2020). The New Zealand Association of Scientists (NZAS), a volunteer-run organisation founded in the 1940s to advocate for scientists and the science system, has historically taken surveys and directories of the scientific workforce as a major activity (Gregory, 2017). In more recent years this work has been done by the responsible Ministry (currently the Ministry for Business, Innovation, and Employment (MBIE)).

In general, surveys have been relatively sparse given how much political focus is placed on 'high-skill jobs' and their value to Aotearoa New Zealand (AoNZ). The research and science workforce fit naturally into the category of 'high-skill', given the amount of training required for most positions. Notably, however, as of writing this article only three science or research roles were present on the 'green list' of skilled jobs with a shortage of workers in AoNZ (Immigration New Zealand, 2024). Furthermore, a recent publication describes the realities of doctoral students as 'grim', drawing attention to disparities between advertised and realised PhD durations with associated funding gaps,

the ambiguous nature of work/employment during the period of a PhD, and the lack of post-PhD opportunities (Patel et al., 2022). This is particularly notable given the high proportion of international students in our PhD cohorts and the significant increase in overall PhD student numbers in the last three decades (Royal Society Te Apārangi, 2020).

The research and science workforce is a focus for questions around opportunity, equity, efficiency, and globalisation. What is an appropriate target balance of local versus international training in our scientific workforce? What is the effect on workforce stability? Are historically underserved and underrepresented groups moving into it, and are efforts to bring them in successful? How has movement into and through the workforce changed over time? What bearing does that have on the recruitment of students and decisions made by universities about which subjects will be taught? When we talk about the research and science workforce, who counts? Most crucially, are postgraduate research students, who make up over a third of the overall 'research workforce' (Royal Society Te Apārangi, 2020), part of it? And what actually happens to those students once they graduate?

These are all questions well worth addressing - and in my experience, they are often asked whenever a case is made for change in our research and science system, and/or change to the conditions of and support for postgraduate student researchers. But they can be surprisingly hard to answer. For example, important recent work examining the ethnic makeup of university staff (Naepi et al., 2020) had to rely upon Official Information Act requests. In contrast, perhaps the gold standard of research workforce information is the NSF doctoral recipients' survey, an ongoing longitudinal sample-based survey of all US doctoral recipients since 1973 (National Science Foundation, 2021), giving a very clear picture over time of where this workforce comes from, goes, and what they are doing (albeit excluding people who now work in the US but studied outside it). This has allowed in-depth examination of the sorts of questions above, sometimes with confronting results (Bernard and Cooperdock, 2018).

Here, I list the major surveys and analyses of the AoNZ science workforce available as a starting point for quantitative discussions.

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Major surveys

There have been four major surveys of the science workforce in the last thirty years, all dating after the formation of the Crown Research Institutes in 1992. The NZAS, which also published “Directories of New Zealand Science” from 1945 to 1975 (Gregory, 2017) conducted two surveys in 1994 and 2006. The Royal Society of New Zealand commissioned a follow-up survey in 1996, as well as unpublished surveys in 2000 and 2007 of a panel of respondents from the 1996 Survey (Sommer, 2010). The Ministry for Business, Innovation and Enterprise (MBIE) again surveyed the scientific and research community in 2021-2022, conducting an opt-in survey of both organisations and individuals. Table 1 provides an overview of these major surveys.

Early career surveys

Some surveys specifically targeting early and mid-career researchers have also been carried out (Table 2). The 2021 Precarious Academic Work Survey of precarious workers at universities sponsored by the Tertiary Education Union (not exclusively about, but certainly including many scientists) found significant disparities in security of work on the basis of ethnicity and immigration status (Simpson et al., 2022). A 2018 survey by the Royal Society Te Apārangi Early Career Researcher Forum focused on demography and job security of early career researchers - a group strongly overlapping with, but not identical to, precarious workers at universities - and found that early career researchers were a highly diverse group who almost universally wanted to stay in research careers in Aotearoa, but were not confident that they would be able to (Nissen et al., 2020).

Survey name	Organisation	Year	# Participants	Target group	Reference
1994 NZAS survey of scientists’ perceptions of New Zealand science	New Zealand Association of Scientists	1994	837	Scientists	Berridge et al. 1994
Profiles: a survey of New Zealand scientists and technologists	Royal Society of New Zealand†	1996	4341	Scientists and technologists	Sommer 1997
2008 Survey of Scientists and Technologists	New Zealand Association of Scientists	2008	5966	Scientists and technologists	Sommer 2010
Research, Science, and Innovation Workforce Survey	Ministry for Business, Innovation and Employment	2021 - 2022	1451	Researchers	Fanselow et al. 2022

†Now known as the Royal Society Te Apārangi

Table 1: Major workforce surveys, 1994 – 2024

Survey name	Organisation	Year	# Participants	Target group	Reference
Success in Academia? The experiences of early career academics in New Zealand universities	Ako Aotearoa	2013	1151	Early career researchers at universities	Sutherland et al. 2013
Royal Society ECR Forum 2018 Survey	Royal Society Te Apārangi	2018	709	Early career researchers	Nissen et al. 2020
Precarious Academic Work Survey	Tertiary Education Union	2021	760	Academics at universities employed on fixed-term contracts	Simpson et al. 2022

Table 2: Early career workforce surveys, 1994 – 2024

Analysis name	Organisation	Year	Data source	Analysis topic	Reference
The Research Workforce of Aotearoa New Zealand	Royal Society Te Apārangi	2021	Education Counts	Research workforce and research labour market	Royal Society Te Apārangi 2020
New Zealand’s research workforce	Dragonfly Data Science (for Ministry of Business, Innovation and Employment)	2022	OpenAlex, The World Bank, Education Counts, Stats NZ	Publishing activity of researchers in the New Zealand workforce	Cordwell et al. 2022

Table 3: Recent workforce analyses

Workforce analyses

A research workforce analysis by the Royal Society Te Apārangī looked at workforce progression from PhD level to careers using Census data and data from the Education Counts website operated by the Ministry of Education (Ministry of Education, n.d.), identifying issues such as a significant increase in unemployment among PhD-holders between 2006 and 2018 (Table 3). An independent report commissioned in 2022 by MBIE also analysed the research workforce by looking at publications Cordwell et al. 2022, a method which targets the outputs of conventional research but may underestimate productivity of researchers working in transformative and front-line roles. At the Crazy & Ambitious 4 conference for New Zealand's Biological Heritage National Science Challenge it was noted that only 13% of outputs from this major mission-led science programme were traditional academic publications (Young, 2024).

Discussion

A noteworthy experience when compiling this piece was the (in)accessibility of the surveys themselves despite the relatively recent period covered. The mid-1990s surveys are only available in physical publications archived at some institutional libraries, as the NZSR's ongoing digitisation of past issues has not covered this period - although inquiries related to writing it resulted in the volume including the 1994 survey being digitised. The publication of the 1996 survey, which was sponsored by the Royal Society Te Apārangī, is no longer held by its sponsoring institution (Royal Society Te Apārangī, pers. comm.). Existing public data sources only allow specific kinds of analyses, e.g. Education Counts (Ministry of Education, n.d.), which represents snapshots of what students in Aotearoa New Zealand tertiary institutions are studying over time, or the Stats NZ research and development data set, which holds workforce data only at the highest level of number of people/full-time equivalent (FTE) positions employed across government, higher education, and business (Stats NZ, 2022).

In this regard, surveys of the research and scientific workforce seem remarkably like environmental monitoring. Almost nobody wants to pay for longitudinal data collection, but without it, it is very hard to make definitive statements about how things have changed over time, or indeed assess the effects of individual policies. Participation in voluntary surveys has also never been particularly high. The 1996 and 2008 NZAS surveys, following up the trial 1994 survey, managed to attract several thousand participants, but the various early-career surveys and the 2021-2022 MBIE survey are in the range of hundreds to just over a thousand. The reasons for this can only be speculated upon but are perhaps related to the general morale and engagement of the research and science workforce (as well as the ubiquity of surveys in the internet age). Data from the Stats NZ research and development survey is only directly comparable from 2016 on, and only dates back to 2006, but records between 54,000 and 67,000 people employed in the

sector between 2016 and 2022 (33-39,000 FTEs). Surveys conducted by the NZAS as an advocacy organisation, or indeed other advocacy and membership groups, are also vulnerable to accusations of political bias. A 2014 survey of responses to the National Science Challenges (New Zealand Association of Scientists, 2014) was immediately dismissed by the Minister of the day (Radio New Zealand, 2014).

The need for better data collection has not gone entirely unacknowledged. Based on the 2016 Research, Science and Innovation Domain Plan, MBIE announced the creation of a New Zealand Research Information System (NZRIS) which would "hold information about research funding and activity in New Zealand, such as what projects are under way, how they are being funded, what resources are being used, who the experts are in particular fields and more" (Ministry of Business, Innovation & Employment, 2022). This would presumably create a longitudinal dataset over time giving insight into the shape of the research and science system, although it would only provide information on the trajectories of workforce members when they were actively engaged with the system. However, there have been no updates on the progress of this project since April 2023 (Ministry of Economic Development, 2023) and it is unclear when or even if it will be available to the public.

Furthermore, to make good decisions about the future of the science sector and the wider research sector, I argue that we need to understand not just the activities of the research and science system but specifically the scientific workforce, especially (i) the trajectories of graduates of postgraduate degree programmes from which local members of the workforce primarily emerge, and (ii) the role of precarious members of the workforce such as postgraduate students (included in the sector as researchers by some metrics but not others) and researchers who primarily produce non-academic outputs.

On the basis of what has been outlined by this article I make a call for two specific actions:

- The dedicated preservation of survey data by this publication and its editorial board
- The establishment of longitudinal data collection on the research and science workforce, including a cohort of graduating PhD students, by the responsible Ministry

Debates about the scope and appropriate size of research and science funding, and the effects those have on Aotearoa New Zealand's economy, society, and population, have been going on for decades now and are unlikely to be resolved in the near term. To achieve true accountability and enable good decisions, we need reliable, long-term data on our research and science workforce and the outcomes of our science workforce training programmes (i.e. postgraduate science degrees), and we need to ensure the past data we do have remains available. It would of course be better if this had begun years ago - but the best available time to start is now.

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