

How the Marsden Fund has failed to achieve its full potential in the ESA panel: evidence of limitations in scope, biased outcomes, and futile applications

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Abstract

We have analysed the scope of proposals funded by the 'Earth Sciences and Astronomy' (ESA) panel of the Marsden Fund for the period 2004 to 2013. The scope of proposals funded is very limited and does not reflect the full remit of the panel: the successful projects fail to encompass the quality and quantity of research being undertaken within the Earth sciences community in New Zealand, and a number of sub-disciplines that seek to address fundamental and important problems within the Earth sciences are largely excluded. Moreover, nearly 50% of the funded proposals for the past decade have been made to just two institutions. To address these limitations, we suggest that: (1) a review is undertaken to examine and widen the scope of the panel to encompass sub-disciplines that demonstrably are never or rarely funded; (2) the composition of panel members be examined and modified to reflect a much wider scope of sub-disciplines within the Earth sciences; and (3) a review of the wide discrepancies in funding distributions on an institutional basis be undertaken. We want to ensure that a more representative range of sub-disciplines, in keeping with modern and realistic definitions of the Earth sciences, is funded through this panel, and so we also recommend the formation of a new panel for 'Environmental and Earth-system Sciences' that could encompass the research involving modern-day processes so that applications in these sub-disciplines are not pointless. In addition, it is clear that a very substantial increase in funding to the Marsden Fund must be sought.

Introduction

We have analysed the scope of proposals that were funded (generating contracts) by the 'Earth Sciences and Astronomy' (ESA) panel of the Marsden Fund for the period 2004 to 2013. We show that the range of such proposals/contracts is very narrow and does not reflect the full remit of the panel, and that some sub-disciplines and some institutions are funded much more than others. We examined possible reasons for these apparent biases, including an examination of the distribution of unsuccessful proposals, and report and discuss them below, together with recommendations to improve the current situation so that future applications to the Marsden Fund in a wider range of subjects have a better chance of success.

Our preliminary findings were sent to the Marsden Fund Council and the ESA panel convenor, Professor Jarg Pettinga, in August 2013, in the form of a letter signed by 10 scientists representing two departments of the University of Waikato and the National Institute of Water and Atmospheric Research (NIWA) in Hamilton. The intent of our letter was supported by scientists at other universities and other Crown research institutes, and subsequently by the Council of the New Zealand Society of Soil Science following the tabling of our paper (as submitted to *New Zealand Science Review*) at its meeting on 8 November 2013. We received a reply from Prof Pettinga, which is appended (Appendix A).

Our article begins with a brief examination of the defined remit of the ESA panel and how that compares with the dist-

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Professor David J. Lowe is a volcanic ash specialist who 'fingerprints' and traces volcanic ash, or tephra, layers across the landscape, providing a unique tool to connect and date past geological, climatic, and archaeological events. He uses tephra to construct time-frames to support wide-ranging applications including studies of abrupt climate change, timing of Polynesian settlement of New Zealand, volcanic eruption histories and hazards and societal impacts, and the origins and unique properties of volcanic ash-derived soils and palaeosols. David is president of an international tephra group (INTAV), he serves on editorial boards of three international journals, and he was associate editor for *Soil Science Society of America Journal* for six years. A fellow of both the Royal Society of New Zealand and the New Zealand Society of Soil Science, David was awarded the McKay Hammer Award by the Geosciences Society of New Zealand in 2011 for meritorious publications in geology.



tribution of the funded contracts. We then evaluate the composition of the ESA panel in terms of sub-discipline and institutional affiliation. Next, we look at the quality and importance of modern Earth-surface processes research in New Zealand, and how the range of contracts awarded by the ESA panel has largely failed to encompass such research. We conclude with recommendations that address and rectify the shortcomings we have identified.

Scope of the ESA panel

According to the description of the panel provided on the Marsden Fund website for 2013, the panel should cover the nine sub-disciplines of geology, geophysics, physical geography, oceanography, hydrology, meteorology, atmospheric science, earth sciences, and astronomy and astrophysics.

Although part of a continuum, the first two categories involve the study of rocks and the lithosphere, and typically relate to processes that evolve on geologic timescales. Oceanography, hydrology, meteorology, and atmospheric sciences relate to current-day processes that act at the surface of the Earth.

Scope of funded proposals

To assess the scope of the funded contracts, lists of successfully funded contracts were retrieved from the Marsden Fund website for the period 2004 to 2013 (i.e. a 10-year record) and classified according to the above sub-discipline categories. The detailed classifications within these sub-disciplines (listed below and also provided on the Marsden Fund website), namely the 2008 Australian and New Zealand Standard Research Classifications (categories), were used to provide insight into which class a contract should be assigned. The contracts were also classified according to the research speciality of the lead principal investigators (PIs) derived from information provided on their websites. In most cases, investigators provided clear labels as to their speciality (such as, in the case of GNS Science, the name of the section with which they were involved or led).

- Geology: basin analysis; extraterrestrial geology; geochronology; igneous and metamorphic petrology; marine geosciences; mineralogy and crystallography; ore deposit petrology; palaeontology; petroleum and coal geology; sedimentology; stratigraphy; structural geology; tectonics; volcanology.
- Geophysics: electromagnetics; geodynamics; geophysical fluid dynamics; geothermics and radiometrics; gravimetrics; magnetism and palaeomagnetism; seismology and seismics.
- Physical geography: geomorphology and regolith and landscape evolution; natural hazards; palaeoclimatology; Quaternary environments; surface processes.
- Oceanography: biological oceanography; chemical oceanography; physical oceanography.
- Hydrology: surface-water hydrology; glaciology; hydrogeology.
- Meteorology: cloud physics; atmospheric dynamics; meteorology.
- Atmospheric science: atmospheric aerosols, atmospheric radiation, climate change processes; climatology; tropospheric and stratospheric physics.
- Earth sciences: all other.
- Astronomy and astrophysics (included in 'Physical Sciences: astronomical sciences and space science' category).

Applications in geochemistry were assigned to the nearest class (e.g. geochemistry of ocean water was assigned to oceanography). This analysis shows that approximately 45% of the contracts were in the geology sub-discipline (Figs 1A and 1B), and only approximately 5% were in each of physical geography, oceanography, meteorology, and hydrology (19% in these categories together). Moreover, contracts in areas outside geology and geophysics were often funded when the lead scientist's research area was in geology or geophysics (note the difference between the red and the blue bars in Fig. 1A). It was often the case that contracts in physical geography and oceanography awarded to PIs who had non-oceanography and non-physical geography backgrounds were worth more than the contracts that were funded to PIs in their core speciality. The opposite was true of the geology and geophysics sub-disciplines. (The difference between the red and blue bars is greater in Fig. 1B than in Fig. 1A.)

It might be argued that there are simply more proposals written in some sub-disciplines than others, and the success rate is simply a reflection of proposal pressure. When Marsden proposals are submitted, the proposers must select three descriptors for their proposals. We have obtained these descriptors for all successful and unsuccessful proposals from 2004 to 2013. Indeed, geology-based proposals do have a much greater proposal pressure than those of other sub-disciplines. However, the percentage of geology and geophysics (and astronomy) descriptors in successful contracts (red bars in Fig. 2) is greater than in descriptors used in proposals (blue bar) whereas the percentage of hydrology, meteorology, oceanography, and physical geography descriptors is lower in successful contracts compared with those of the proposals. In some cases applicants used descriptors that were not in the Earth science category at all (e.g. biodiversity, molecular biology). For interest, we split these into topics related to environmental and soil sciences and all others. This split showed that environmental/soil sciences descriptors very rarely feature in successful proposals. Also, as argued by Bardsley (2013), scientists in those sub-disciplines that are rarely or never funded are, after a while, likely to give up all hope of success and decide not to bother submitting proposals.

Panel composition and institutional success

We emphasise that we are not questioning the integrity of the panel members, and their efforts to provide an impartial opinion of proposals. However, in the case of a close competition, when all other factors are equal, it is our view that it is likely that a panel member would choose a familiar subject matter over an unfamiliar subject. The Royal Society of New Zealand has provided data on the panel compositions from 2003 to 2013. We have classified these data according to the institution that the panel member was employed at during his/her tenure on the panel, and also according to his/her field of expertise (classified using the panellists' web-pages). We then weighted the panellist's tenure on the panel by the number of people on the panel in each year, so that each panel member was assigned a weighting based on a percentage of the panel in each year (hence if there were seven panel members, each would get a 1/7 weighting for that year). We identified significant correlation ($r^2 = 0.41$, $p > 0.05$) between the institutional affiliations of the panellists, and the number of successful proposals from that institution. If the institutional affiliation was correlated against the number of successful proposals divided by the number of submitted proposals (to

Figure 1. A. Classification of the 96 proposals in the ESA panel funded between 2004 and 2013, by the number of proposals. The blue bars show the data classified by the sub-discipline of proposal titles; the red bars show the data classified by the sub-discipline of the first listed PIs (as judged by the individual's website). B. Classification of the same proposals by the cost of the proposals. Error bars indicate the standard deviation, which was calculated as $(\sum W_i^2 - (\sum W_i)^2/N)^{0.5}$, where W_i are the weights of each data point within each category, and N is the total number of data points in all categories ($W_i = 1$ in panel A). Information provided on the Marsden Fund website was not adequate to classify pre-2004 proposals.

normalise for proposal pressure), the correlation was reduced to $r^2 = 0.33$ ($p > 0.05$). There was a much stronger correlation between the field of expertise of sub-discipline experts on the panel, and the number of proposals funded in that field ($r^2 = 0.85$). However, this relationship was strongly skewed by the number of geologists on the panel. Therefore we do not have enough data to conclude that the subject areas of the panellists play a strong role but we can conclude that having someone from one's own institution on the panel appears to help.

We observe that 47% of the funded proposals are from GNS Science and Victoria University of Wellington (VUW), and we additionally note that the success rate is much greater at these two institutions (Fig. 3). For example, the 2013 results for the ESA panel matched this tendency: nine out of 13 contracts (69%) were awarded to GNS Science and VUW together. Given that many VUW geology staff are cross-appointed at GNS Science, these researchers can be considered to be part of the same cohort, sharing ideas, networks, and experiences.

Relationship to performance-based research fund (PBRF) scores

We also used performance-based research fund (PBRF) ratings to investigate the number of proposals funded by Marsden as a function of the quality of researchers from different institutions (Fig. 4). If the percentages of A and B grade researchers

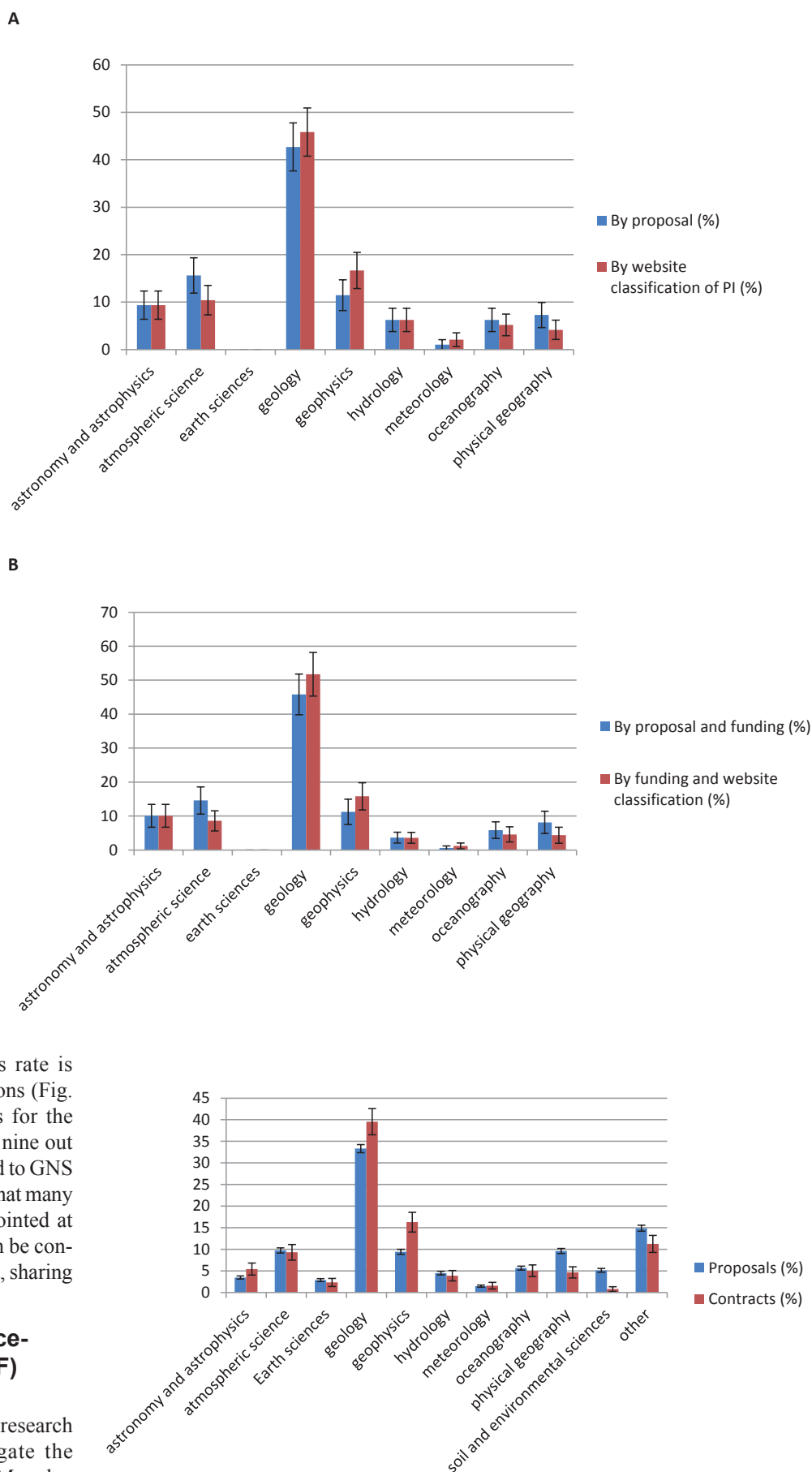


Figure 2. The number of descriptors in each sub-discipline used in proposals (blue bars) and in successful contracts (red bars) between 2004 and 2013. Error bars indicate the standard deviation (see Figure 1).

Figure 3. Red bars: number of proposals funded (contracts) as a function of institution for 2004–2013. Blue bars: number of submitted proposals as a function of institution. The average probability of success, measured as successful proposals divided by submitted proposal, was 10%. GNS Science and VUW had success rates >15%. Error bars indicate the standard deviation (see Figure 1).

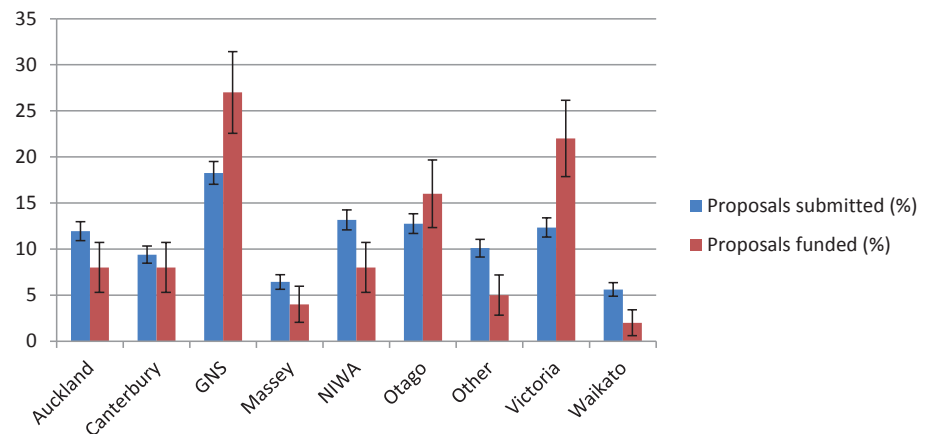
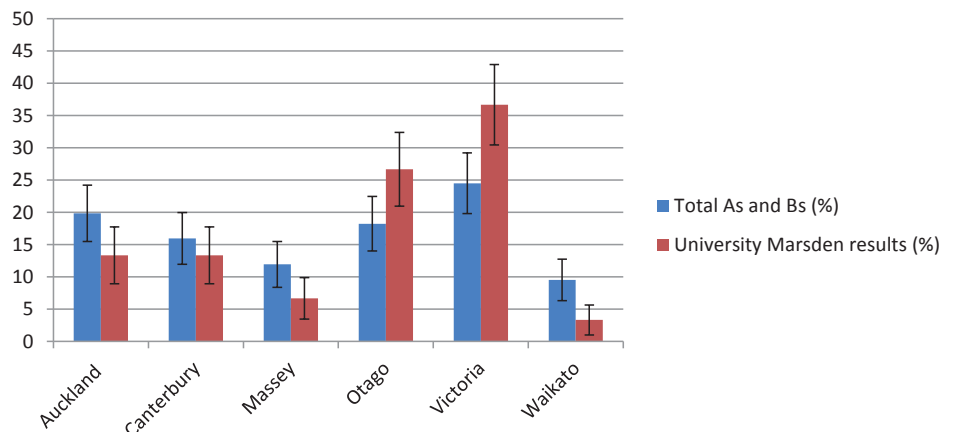


Figure 4. Percentage of contracts awarded to each university between 2004 and 2013 compared with the percentage of scientists who received A and B ratings in the ESA panel of 2012 PBRF. Error bars indicate the standard deviation (see Figure 1).



working in the fields in the remit of the ESA panel are grouped and used as a measure of quality, Auckland, Waikato, Massey, and Canterbury receive a lower share of Marsden funding. We consider this to be a direct reflection of the demonstrable bias towards funding geology within the ESA panel. Moreover, the number of A and B grade researchers in these fields has decreased at these universities between the 2006 and the 2012 PBRF ranking exercises. We suggest that this decrease is partially a reflection of the bias toward the funding of geology within the Marsden panel. Marsden funding directly improves PBRF ratings through peer esteem, funding for higher-quality science, ability to buy out teaching, and the provision of quality research time to academic staff.

Quality and importance of modern Earth-surface processes research in New Zealand

A study of international publications (produced for Australia and New Zealand by Adams *et al.* 2010) showed that New Zealand researchers working in the field of geology publish 3.1% of the world's research papers according to the ISI Web of Knowledge. However, scientists in oceanography, physical geography, and soil science publish together 6.8% of research, comprising 2.45, 2.40, and 1.95%, respectively. Of the top 100 research fronts of science for 2013, the subjects of ocean acidification and marine ecosystems, models and impacts of land-use change, climate change and precipitation extremes, and black carbon emissions and air pollution, are all considered to be at the forefront of science challenges (King & Pendlebury 2013). This area of integrated surface processes and products has also

been called the 'critical zone' because of its importance (e.g. Chorover *et al.* 2007).

Modern-day Earth-surface processes are essential to the functioning of our economy and for evaluating the environmental effects of growth. For example, maintaining the quality and productivity of soils, whilst minimising environmental degradation, underpins our successful agriculture and horticulture industries. Innovating ways to reduce coastal erosion by a better understanding of coastal processes will reduce expenditure on coastal protection. Understanding the conditions that lead to our rivers having insufficient flow to generate electricity is essential to providing a predictable and sustainable electricity supply. Earth-surface processes are fundamental to at least three of the National Science Challenges ('Our land and water', 'Sustainable seas', and 'Resilience to nature's challenges'). The Ministry of Business, Innovation and Employment (MBIE) provides funding to translate process-based research funding into tools that can be used to manage resources sustainably. However, there is very little funding into understanding the processes from which these tools have been developed. In order to sustain and/or increase our economic viability, we suggest that it is essential that Marsden funds more processes-based, fundamental research that is directly applicable to these areas.

Modern-day Earth-surface processes are often considered under the category of 'environmental science'. Where is environmental-science research funded in the current Marsden Fund structure? According to the research classification provided on the Marsden Fund website, environmental science includes soil science, carbon sequestration, environmental monitoring, land

capability, soil biology, soil chemistry, and soil physics. Under what panel do applications relating to these areas get funded?

Our analysis shows that proposals with descriptors in these areas are much less likely to get funded than *any* other area of Earth sciences. An understanding of soil processes and other factors is essential to enhancing agricultural production whilst reducing environmental risk and mitigating environmental degradation. More widely, the discipline of soil science has an increasing role in seeking solutions for burgeoning real-world problems such as climate change, hunger alleviation, and the decline of soil and water quality (Hartemink & McBratney 2008; Churchman 2010). Regarding environmental degradation, particularly relating to soil and water quality, a mountain of evidence shows that for New Zealand the '100% Pure brand couldn't be further from the truth' (Joy 2011, p. 19). We consider that scientific endeavours in understanding ecosystem functioning and soils as providers of natural capital cannot continue to be marginalised in New Zealand (e.g. see Blum *et al.* 2006; Robinson *et al.* 2009; Clough *et al.* 2013; Morrison 2013).

The narrow focus of funded research within the 'Earth-surface process' sub-disciplines

The proposals that are funded within Earth-surface processes are often funded for work that is more related to geology. Seven per cent (and seven in number) of all contracts funded by the ESA panel were in physical geography within the Marsden panel, and of these seven, six were classified as paleoclimatology and one was a study of natural hazards (relating to volcanic eruptions). Moreover, the PIs who were successful with these proposals classified themselves as marine chemists (2), palaeontologists (3), and a marine geophysicist (1). Physical geography according to Wikipedia is defined as geomorphology, soil study (including pedology and edaphology), hydrology, meteorology, climatology, and biogeography. The 6% of all ESA contracts that were funded in hydrology (six in number) relate in reality to the nature of transport of viruses in groundwater (one proposal), palaeoclimatology and glaciology (four proposals), and one proposal studying the impact of geological events (earthquakes) on hydrology (Bardsley 2013). Funding for one of these four proposals went to a PI who classified himself/herself as a sedimentologist. Work in this sub-discipline appears to be funded only when it is more similar to the most common expertise of the panel (which is geology). Often when a physical geographer is included in a panel, his/her area of expertise is in palaeoclimatology, rather than in modern-day processes or environmental sciences. Moreover, there is a common misconception that Earth sciences and geology are interchangeable terms, leading to the misunderstanding that all Earth sciences research is undertaken by institutes that are strong in geology (such as GNS Science and Victoria University of Wellington), neglecting the wealth of high-quality Earth-sciences research that is being undertaken at institutes more strongly known for environmental sciences, hydrology, oceanography, and physical geography (e.g. NIWA, Landcare Research).

Conclusions and recommendations

Our hypothesis is that the bias towards geology within the proposals funded by the ESA Marsden panel is because there is a bias in the panel composition. We recommend that the panel selection processes be guided by firmer rules so that these biases do not continue or evolve over time. It is clearly evident from

the results of the past decade that applications to this panel in a number of sub-disciplines have a very low chance of success.

We recommend that the Royal Society of New Zealand (RSNZ):

1. Note that panel member affiliation is correlated with institutional success, and thus the RSNZ needs to ensure that there is a fair representation of institutions on the panel so that funding success does not become dominated by the research strength of one or two institutions.
2. Explicitly include environmental science and soil science research in the title and remit of one of the panels so it is clear where proposals in these disciplines can have a fair chance of success.
3. Consider creating a new panel for 'Environmental and Earth-system Sciences' to include the research involving modern-day processes in marine sciences, biogeography, coastal science, hydrology, soil science, climatology, and oceanography, which are very poorly represented in existing funded work. A similar proposal was made by Bardsley (2013), who suggested firstly that astronomy-based proposals should be excluded from ESA (and instead encompassed in the 'Physics, Chemistry, and Biochemistry Sciences' panel), and then two new panels should be established – 'Earth Sciences' (ES) (dealing with geology and 'geology-like' projects) and 'Earth Processes' (EP) (dealing with projects about surface and near-surface processes).
4. Consider always including a modern-day environmental or Earth-systems scientist on the panel every year (as occurs currently with the sub-discipline 'astronomy and astrophysics').

In addition, serious attempts to significantly increase the total level of funding support for the Marsden Fund are urgently needed to complement these recommended actions.

Every year institutions around New Zealand invest a large fraction of their research time preparing applications to the Marsden Fund (e.g. see Gluckman 2012). Successes are not so much about the money, but about the quality rating that a successful Marsden bid provides to the researcher and the change in career pathway that ensues. Staff undertake this process enthusiastically, driven by the understanding that everyone publishing in top-quality journals has a fair chance, and that the overall success rate is about 10%. Our analysis clearly shows that the success rate is likely to be substantially lower if one's research is in physical geography, hydrology, soil science, and meteorology, and, assuming past outcomes inform the present, such applications border on futility. If changes to the panel are not considered, or the establishment of a new panel is not investigated and evaluated, we strongly encourage the Royal Society of New Zealand to publish tables of the breakdown of successes by sub-discipline so that geoscientists can assess their potential success rates more realistically and act accordingly.

Our evaluation shows clearly that in our eagerness to continue to fund established and traditional areas of Earth sciences in New Zealand at the expense of environmental and Earth-system sciences, we are effectively contributing to the degradation of our soils and waterways. It is our opinion that very small groups of panellists are playing a disproportionately large role in determining the future of Earth sciences research in New Zealand, and that the time has come to ensure that panellists and the

choices they make better reflect the urgent priorities that face us as a country to allow a broader suite of geosciences – including environmental science and Earth-systems science – to be funded more equitably. Our comments strongly echo elements of the report by Gluckman (2012), who discussed the difficulties of the peer-review processes and of assessing interdisciplinary science, and inherent biases on panels. Gluckman (2013, p. 6) concluded that ‘It is timely to have a more objective look at the processes underpinning the contestable system, as this is the most important element in matching our research community to the changing shape of our innovation system; when all is said and done, funding decisions determine both careers and what and how science will contribute to our nation.’

We could not agree more.

Acknowledgements

Although comments received regarding our original letter, and this paper, have been both positive and negative, generally they were well meaning and helped us to crystallise our views and suggestions so that our proposed improvements can be considered rationally. We also recognise that many projects funded by the ESA panel over the past 20 years have been truly excellent and well supported by Marsden Fund staff. Jarg Pettinga is thanked for his response to our letter, and a reviewer, the journal subcommittee, and the editor are all thanked for their helpful comments on our paper. Marsden Fund staff provided data essential for our analyses. We record that one of us (DJL) has received Marsden Fund support for two proposals from the ESA panel, one as an AI (2003) and the other as PI (2010).

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20 August 2013

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Dear Assoc Prof Bryan,

Re: Letter 5 August 2013

Thank you for your letter on 5 August detailing your concerns about the scope of the proposals funded by the Earth Sciences and Astronomy (ESA) panel and the panel's composition. In response to your requests we have gone back through the recorded information from 2009 – 2012 funding rounds. We have also looked at the panel compositions as disclosed through panel member's associations with their previous proposals to the Marsden Fund, in order to find their sub-disciplinary coverage in their role on the ESA panel.

The data which you are not privy to is the number of proposals received in the different sub-disciplines within the ESA panel, with that information available we have gone through and looked at the success rates for the sub-categories (Astronomy, Atmospheric sciences, Earth Sciences other and Geochemistry, Geology, Geophysics, Hydrology, Meteorology, Oceanography, and Physical Geography). Using these sub-disciplines we receive a double the average success rate for Astronomy and higher than normal success rate for Geophysics but for all other areas we are within the acceptable error limits of the data provided to the average success rate. Hydrology and Meteorology account for a very small number of proposals 17 and 13 respectively of the total 380 proposals received and therefore one more proposal funded in either of these disciplines would have pushed them above the average success rate. Soil science is a tricky area, which is covered by more than one panel. In fact, the two soil science proposals funded by Marsden over the last four years have proposed to the Ecology, Evolution and Behaviour (EEB) panel.

The data on panellist coverage and composition shows large overlap in expertise and no area under represented by the ESA panel composition over the 2009 – 2012 timeframe. There is however an institutional bias as you have pointed out and this will be looked at and rectified with new panel members. We do ask a large number of individuals from all institutes each year to be members of all the Marsden panels and many people for various reasons are unable to commit to our requests. Last year a total of 126 people were asked to be panellists and 42 agreed in total. The ESA panel had three new panellists this year and we asked a total of 14 people for these three positions, one of which is a signatory to your letter. We have received an offer from the Universities New Zealand Research Committee to help us with suggestions for panel membership in the future and we will be using their expertise in the future for our panel membership search.

Finally, I will add that the procedures around the panel scoring, discussions and conflicts are taken very seriously by the Marsden Fund Council and the Marsden Fund Executive. For the ESA preliminary meeting this year, there were three Marsden Fund Executive members and the Chair of the Marsden Fund Council in attendance to maintain a high level of compliance to the procedures set out in the assessment process.

Kind regards,

A handwritten signature in black ink, appearing to read "J. Pettinga".

Professor Jarg Pettinga
Convenor, Earth Sciences and Astronomy panel

Cc Professor Juliet Gerrard (Chair, Marsden Fund Council)