A place for knowledge and excellence

the ROYAL SOCIETY of NEW ZEALAND
TE APĀRANGI

THE ROYAL SOCIETY OF NEW ZEALAND

INVESTMENT IMPACT REPORT

DECEMBER 2011

CONTENTS

EXECUTIVE SUMMARY

The Royal Society of New Zealand's vision is to offer a unique contribution to research and scholarship by cultivating positive relationships with the public, the media, youth and their teachers, as well as emerging and established scientists and researchers, governmental agencies and international academies. To fulfil part of this vision, the Society acts as a funding and investment agent administering the Marsden Fund and the Rutherford Discovery Fellowship on behalf of Government.

In this report we highlight our delivery of support for the Marsden Fund Council, and our administration of the nascent Rutherford Discovery Fellowship. We present outcomes of the administration of these research funding schemes over the past two years. Highlights described in this report include:

- The two highest award rounds to date occurred in FY09/10 and FY10/11 with allocations of $58.8M and $52.5M of the government's investment in the Marsden Fund.
- Examples of excellent research funded detailed over the past two years by the Marsden Fund, showing the diversity, depth and quality of the research conducted by Marsden Fund recipients.
- The increase in high impact journal publications per year by researchers funded by the Marsden Fund. (8 in 2001–03 up to 28 in 2009–11). The Fund continues to produces highly cited publications; within New Zealand's research output, Marsden-attributed publications achieve ~60% higher average citations, and are ~20% more likely to be cited than non-Marsden items.
- Reiteration of the findings of the Focus on Research Excellence (FoRE) project. The study has shown that the direct opportunities arising from investigator-initiated research projects, many of which are Marsden Fund projects, is estimated to exceed $120 million per annum.
- The number of Principal Investigators (PIs) and Associate Investigators (AIs) in 2010 increased by 20% and 27% over 2006. However, the number of Post-doctoral researchers the Fund supported over this timeframe remains low with an increase in, much cheaper, Post-graduates FTE on contracts.
- The Fund continues to foster an extraordinarily high level of international collaborations, both as contracted investigators and through linkages formed as a consequence of the supported research programme. National collaborations however remain relatively modest.
- The initial rounds of the Rutherford Discovery Fellowship have been successfully completed selecting a total to 20 Fellows to date. In the time period of this IIR, no Fellow has been contracted long enough to provide an annual report, however early signs of positive impact on the Fellows and their research programmes are described; notably in terms of retention of exceptional researchers in New Zealand, and the Fellows achievement in having already leveraged an additional $2.3M in external research support.
- Emerging issues include an analysis on the rising costs of research contracts putting pressure on the Fund and a proposal to add value to the Marsden process through efficient and effective use of the information gained through the proposal and assessment stages to inform future investments. For the Rutherford Discovery Fellowship, the workshop/networking aspects of the programme appear to be working even better than envisaged; any decrease in the number of Fellows would put the value of this activity at risk.

ROYAL SOCIETY OF NEW ZEALAND – OUR ACTIVITIES

This report covers a subset of the Society's activities over 2010 and 2011. In this, the second of the biennial Investment Impact Reports, the outcomes and impacts of the Royal Society's administration of the Marsden Fund and the procedural characteristics of the inaugural Rutherford Discovery Fellowships are described as a requirement of the Society's agreement with Government.

As contracts for the other programmes administered by the Society on behalf of the Ministry are updated, their reporting will being incorporated into future reports against a schedule to be agreed between the Society and MoRST.

A selection of the additional activities of the Society supported in furtherance of the obligations of our Act over the period 2010–2011 but not included in this report include:

AWARENESS AND COMMUNICATIONS

Science Media Centre
Royal Society of New Zealand Book Prize and Manhire Prize for Creative Science Writing
Talking Heads — in partnership with RadioNZ
Ever Wondered?— in partnership with TVNZ 7

TEACHING AND LEARNING – INSPIRING OUR YOUNGER GENERATIONS

Endeavour Teacher Fellowships and Primary Science Teacher Fellowships
Talented Secondary School Students Travel Award
CREST Awards promoting creativity in science and technology projects
Realise the Dream – principal sponsor Genesis Energy; supported by Dairy NZ and UNESCO
Advancing Primary Science
BP Challenge
BayerBoost Scholarships and the Bayer Primary School Science Fund
Freemasons New Zealand Travel Award
International Senior Secondary Science Opportunities

POLICY AND EXPERT ADVICE

Expert Panels and consultations, and the Society's External Affairs Team
Emerging Issues publications
Science Meets Parliament — The Speaker's Science Forum

SUPPORTING EXCELLENCE

James Cook Research Fellowships
Rutherford Foundation

SUPPORTING THE PROFESSION

Publishing the eight New Zealand scientific journals
Support for our 70 constituent science organisations, affiliates and branches
Medals, national awards event and professional science week
Promoting a Code of Professional Standards and Ethics for researchers

INTERNATIONAL ACTIVITIES

Bilateral exchange programme with the USA, Japan, Spain, Germany, South Korea, and France
Membership of international scientific unions
ACCESS4EU:NZ — partnering with the International Bureau of the BMBF, Sigma Orionis, and the University of Canterbury

MARSDEN FUND

PURPOSE AND OBJECTIVES

The Marsden Fund provides funding for investigator-initiated research aimed at generating new knowledge. It supports research projects that advance and expand the knowledge base and contribute to the development of researchers by giving them new knowledge and skills. The Marsden Fund is regarded as a hallmark of excellence; encouraging New Zealand's leading researchers to explore new ideas and fostering creativity within the research, science and innovation system. The Royal Society administers the Fund on behalf of the Marsden Fund Council in accordance with a Memorandum of Understanding. It operates under Terms of Reference issued by the Minister of Science and Innovation.

The primary objectives of the Marsden Fund are to: enhance the quality of research in New Zealand by creating increased opportunity to undertake excellent investigator-initiated research; support the advancement of knowledge in New Zealand; and, contribute to the global knowledge base. A secondary objective of the Marsden Fund is to contribute to the development of advanced skills in New Zealand including support for continuing training of post-doctoral level researchers and support for the early careers of new and emerging researchers.

GOVERNANCE

The Fund is operated under a Terms of Reference issued by the Minister of Science and Innovation, updated in 2008. An independent Council of eleven eminent researchers, appointed by the Minister, has responsibility for allocating funds to projects and overseeing the progress of the research and supported researchers. The Fund is administered by the Royal Society of New Zealand who organise the selection process, manage the disbursement of funds, monitor progress, evaluate the outcomes from the research, and provide secretariat services to the Marsden Fund Council. A Memorandum of Understanding agreed between the Royal Society and the Marsden Fund Council describes the separation of the roles and performance expectations.

SCOPE AND SCALE

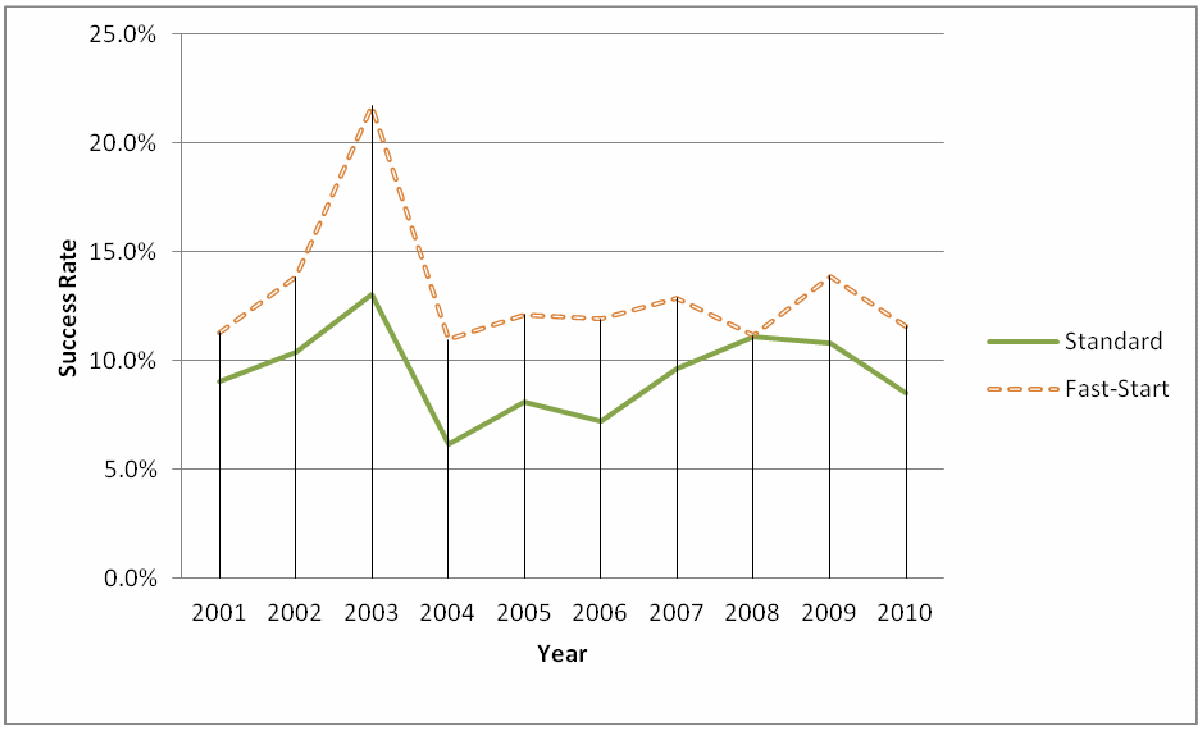
The Impact Investment Report will report on activities related to the Marsden Fund from 1 July 2009 to 30 June 2011, covering the past two Fiscal Years. The Marsden Fund operates as a separate Output Class under the Ministry of Science and Innovation, Non-departmental output classes. In FY 09/10 and 10/11, the Marsden Fund output class had investment budgets of $46,755,000 per annum (GST exclusive) after the large $9 million increase announced in 2009. During the same timeframe, over 400 research contracts were operational, covering the sciences, mathematics, engineering, social sciences and humanities.

Over the past two years the Marsden Fund Council have begun to reduce the Marsden Fund bank balance by awarding more funding than received. This has led to a large number of new contracts over the reported timeframe. There were 109 contracts funded in FY09/10 at a cost of $58,760,000 and 102 contracts funded in FY10/11 at a cost of $52,522,000. The overspending has reduced the Marsden Fund bank account from its peak of $14,582,250 in January 2010 to $9,921,000 by June 2011 with a projected balance of $330,000 by January 2013. The success rates for Standard and Fast-Start proposals has fluctuated around the 10% level over the years, as shown in Table 1 and Figure 1 below.

Table 1. Success rates for Standard and Fast-Start proposals

	Standard			Fast-Start		
Year	Proposals	Contracts	Percentage	Proposals	Contracts	Percentage
2001	707	64	9.1%	177	20	11.3%
2002	671	70	10.4%	130	18	13.8%
2003	612	80	13.1%	129	28	21.7%
2004	744	46	6.2%	228	25	11.0%
2005	701	57	8.1%	198	24	12.1%
2006	722	52	7.2%	210	25	11.9%
2007	693	67	9.7%	217	28	12.9%
2008	593	66	11.1%	224	25	11.2%
2009	675	73	10.8%	259	36	13.9%
2010	796	68	8.5%	293	34	11.6%

Figure 1. Success rates for Standard and Fast-Start proposals 2001 – 2010.



More detail on the historical growth of the Fund and the support given to discipline areas in the past three years is given in Appendix 1.

HIGHLIGHTS

The goal of the Marsden Fund scheme is to enhance the quality of research in New Zealand by creating increased opportunity to undertake excellent investigator-initiated research; and support the advancement of knowledge in New Zealand, and contribute to the global knowledge base. A secondary objective of the Marsden Fund is to contribute to the development of advanced skills in New Zealand including support for continuing training of post-doctoral level researchers and support for the establishment of early careers of new emerging researchers. Measurements of how well the Fund is accomplishing these goals relate to international collaboration; research recognition for New Zealand; and knowledge and human capacity development.

INTERNATIONAL COLLABORATION

The proportion of Marsden contracts that begin in collaborations has grown from 33% of the grants in 1997 to 66% in 2010. Most of the collaboration growth has been with international partners. This is a direct consequence of the international esteem of Marsden Fund investigators. International collaboration growth is further enhanced as a Marsden project progresses through its lifespan. Marsden grants beginning in 2007 started with 44% of them having international collaborations. In 2010 as stated in their final reports, the percentage of grants with international collaborations had jumped to 94%. Appendix 2 has further statistics on international collaborations.

RESEARCH RECOGNITION

Research publications have remained very high for Marsden grant recipients with total publications, patents and software reported at 1481 for the past two years. Along with publications, the number of invited talks has increased from 224 in 2008 to 303 in 2010. Since most of these invited conference talks are international, this shows an increased level of international recognition for New Zealand researchers. A selected list of publications and statistics on the overall publications and conference talks is given in Appendix 2.

KNOWLEDGE AND HUMAN CAPACITY DEVELOPMENT

Over the past five years the total number of separate individuals acting as Principal Investigators or Associate Investigators on current Marsden grants has increased from 942 to 1123. During this same period of time the percentage of grants with postdoctoral fellows has remained constant at 40% to 41%. However, the percentage of postgraduate students on grants has increased from 54% to 62%. Awards and prizes have also been recorded at a record level during the last two years of reporting. Distinction awards include, Professor Jeff Tallon receiving the Prime Minister's Science Prize, Professor Matt Visser becoming a Fellow of the American Physical Society, Professor Tim Naish being appointed Lead Author to IPCC 5th Assessment Report and Professor Peter Schwerdtfeger awarded the Fukui Medal. Building human capacity is further explained through statistics in Appendix 2.

Over the past two years, there have been a number of excellent research projects and outcomes. The Marsden Fund has received, evaluated and signed-off on 146 contracts during this period of time. Below is a small sample of the research projects that have been funded are creating very exciting and innovative outcomes for New Zealand.

Baker's Yeast Key to Human Protein Research

It took simple baker's yeast and a hunch about the mysterious behaviour of a protein.

Now, a Massey University scientist's research has paved the way to understanding how the protein Gcn2, which resides in all living organisms, affects memory, immunity and diseases such as cancer, dementia and obesity. The research is supported by the Marsden Fund.


Dr Sattlegger at work in the lab

Dr Evelyn Sattlegger, and her research group at the Institute of Natural Sciences at the Albany campus, along with collaborators in the United States and Brazil, have discovered that the protein eEF1A (a protein synthesis factor) keeps Gcn2 in check – a finding that provides a better understanding of finely tuned cell interactions that ultimately underpin our health.

The study has just been published in the international *Journal of Biological Chemistry*, and was selected as paper of the week for October 21, ranking it in the top one per cent in terms of overall significance.

Dr Sattlegger says she and her colleagues have provided insights into a new mechanism of Gcn2 regulation, adding to the theoretical framework that maps the mechanisms of how Gcn2 functions properly. Understanding this function will provide a basis for further applied medical research, she says.

The study has wide ranging implications for understanding human health, and prevention of disease, says Dr Sattlegger, who has long been fascinated by these proteins that have been poorly understood by scientists to date.

"We've been able to open a door into the complexities of how the two proteins work together to allow cells to know when they are short of amino acids – the building blocks of proteins which are needed for almost all biological functions – and how to cope with the problem." "Knowing how cells detect and regulate amino acid levels will be very useful, particularly because Gcn2 is implicated in a number of diseases, and in diverse processes, like long-term memory function, viral defence and in silencing the immune system," she says.

Researchers carried out a variety of genetic and biochemical analyses using baker's yeast. "We used basic yeast because it closely mimics the same process in human cells," says Dr Sattlegger. The experiment led to the "novel" discovery that Gnc2 is involved in a sort of reciprocal regulatory process with protein synthesis. "Precise knowledge of Gcn2 regulation will allow us to develop measures against Gcn2 associated diseases," says Dr Sattlegger. "In particular Gcn2 has been proposed to be a promising target for anti-cancer drugs."

Legacy of US Occupation in the Pacific

Letisia, of Guadalcanal in the Solomon Islands, with Judy Bennett. Letisia is one of the few surviving mothers of a child fathered by a WWII US serviceman.

Between 1942 and 1945/46, over 2 million US servicemen occupied New Zealand and the South Pacific. Around 2000 children were fathered by the servicemen who formed relationships with indigenous women. War histories, especially in the Pacific Islands, have little to say on social consequences of the US Occupation and these children are hardly mentioned in the few official government records.

A study funded by the Marsden Fund and led by Professor Judith Bennett and Dr Angela Wanhalla of the University of Otago, aims to discover the histories of these children. Around 80 participants have already been interviewed, and the research team expects more will come forward.

The rich oral histories uncovered in these interviews reveal a wide spectrum of life stories. They provide glimpses of how societies grappled with the American presence and the consequences of intimate relations. Regardless of the culture, there were varying reactions to the birth of these children. For example, where rights to land are determined through the paternal line, marriage to a man with access to lands and even land purchase sometimes overcame this. In some cases there was a sense of shame in having a child without a father; in others certain compensatory payments or gifts removed any stigma.

Early in the war a few marriages occurred when a baby was expected, but that quickly changed. There is documentary proof that the US military did not allow marriages of personnel with indigenous women because they were aware of the discriminatory marriage and immigration laws of the various American states and of the US federal government. In New Zealand, many Māori women were able to prove part European ancestry and thus marry their sweethearts. Research in New Zealand has benefited by the government's established record keeping of basic data such as births, deaths and marriages as well as engagement announcements in newspapers. In the Pacific Islands, few centralised records were kept until after the war, but baptismal registers sometimes provide clues.

In an affective sense, this research is immediately relevant to the lives of people. Some participants want their stories recorded for their families, especially their children. Others want to just talk about it to someone who is interested. Almost all those spoken to so far want to know more about their American father and his family. But finding such information is difficult if participants do not know or have lost the record of their father's name. Some may only have a first name and knowledge of whether he was African American or Caucasian American.

People will soon be able to undertake their own search, via a website with the working title 'US Fathers of Pacific Children'. Those without computer access can ask the research team to help. However, with the commonness of some names and detailed service records being normally only available to family members, this can be difficult. Another stumbling block is that records of the US Marines are not yet on line. Photographs of people seeking fathers and American men thought to be fathers will be posted on the website, with the participants' permission.

A book will provide selected narratives and will include contextual summaries with details that may be unknown to study participants. For example, why a US garrison was stationed on the west coast of Guadalcanal after the Japanese were expelled from that island. These back-stories may help them put their own histories into context.

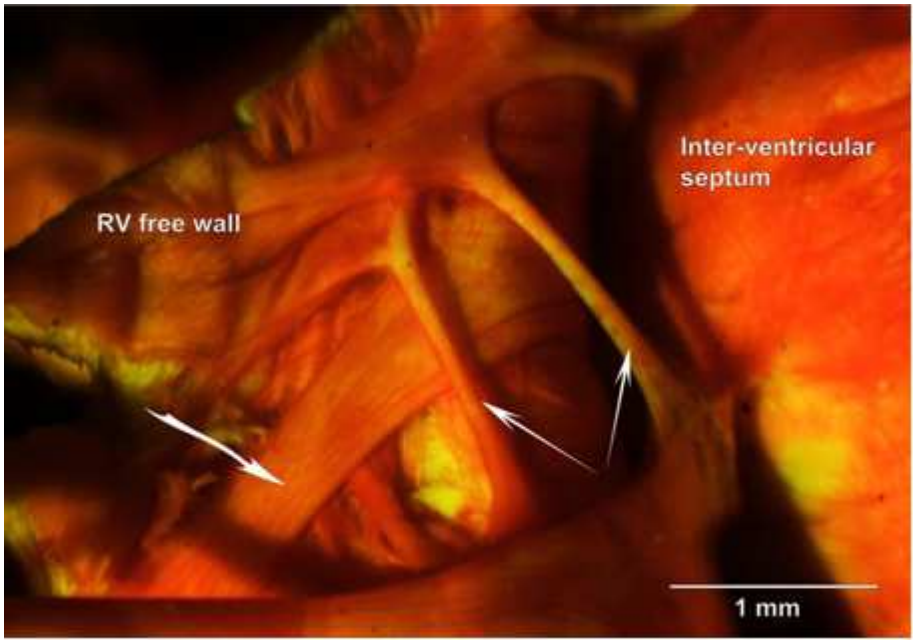
As well as Professor Bennett and Dr Wanhalla, the project team includes Jacqueline Leckie and Marsa Dodson of the University of Otago, Alumita Durutalo of the University of the South Pacific, Phyllis Herda of the University of Auckland, and Louise Mataia of the National University of Samoa. Together they are collecting histories from people in the Solomon Islands, Vanuatu, Kiribati, New Zealand, Fiji, Tonga, the Cook Islands, Samoa and American Samoa.

The Tell-Tale Heart: Interrogating a Thermodynamic Machine

Despite all romantic notions, the heart is a thermodynamic machine. It is fuelled by aerobic metabolism and, with each beat, it generates arterial pressure and ejects a volume of blood. It might seem logical that the energy used should be strictly proportional to the amount of work that the heart performs, but this is not so and we have yet to fully understand how it functions.

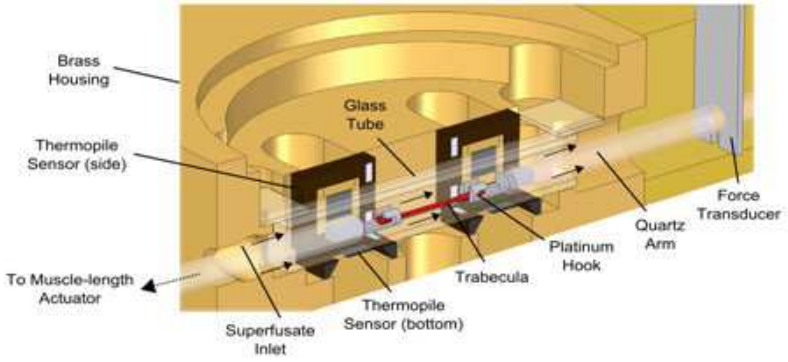
The conversion of energy to work in muscles is rather inefficient, so heat is produced. By measuring work and heat, a complete characterisation of the energetics used in muscle movement can be achieved. This is the goal of Dr Denis Loiselle's work on the heart. A new device developed by Dr Andrew Taberner (now part of Dr Loiselle's team), in collaboration with Professor Ian Hunter at MIT, will help.

Unique to the Auckland Bioengineering Institute, the flow-through microcalorimeter allows the simultaneous measurement of heat and force of a muscle. The research team exploits the presence of particularly convenient heart muscles: ventricular trabeculae (see photo below). These are the smallest, naturally-arising collections of linearly-arranged cardiac muscles in the heart, typically about 3 mm in length and with the diameter of a human hair (about 100 µm).



A selection of trabeculae located on the free wall of the right ventricle of a heart.

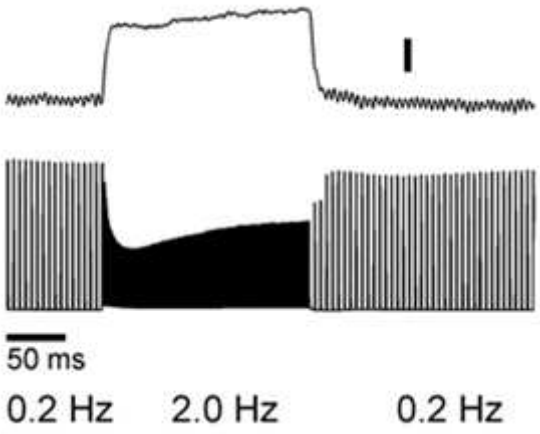
By fixing a trabecula between two platinum hooks in the microcalorimeter (as in the schematic diagram) and providing an electrical stimulus, it is possible to make the muscle "twitch", developing force which can be measured by a force transducer. The muscle is bathed in a flowing solution and the difference between temperatures upstream and downstream of the muscle provide a measure of the heat produced in this process. Series of stimuli result in series of twitches along with a concomitant production of heat, which eventually reaches a steady state.



Cut-away diagram of the microcalorimeter.

The complete microcalorimeter.

A series of this nature can be seen in the diagram below, an original record of the twitch force development and simultaneously measured heat output, recorded by Mr June-Chiew Han (PhD student). Dr Loiselle and his team have shown that it is possible to measure microwatts of heat production that result from micrograms of muscle developing micronewtons of force. By varying factors such as the frequency of stimulation (as can be seen in the middle segments of the two traces), the concentration of extracellular ions, or the length of the muscle, it is possible to gain data that provide information about the thermodynamic behaviour of a healthy heart.



Original records of isometric twitch force development (lower traces) and simultaneously measured heat output of a trabecula (upper trace). The vertical calibration bar represents 1.6 mW and 100 mN.

Once we better understand the behaviour of a healthy heart, an extension of this work will be to study the corresponding behaviour of a failing heart, potentially providing vital information for the medical profession.

The Politics of Truth in the Courtroom: Knowing about DNA Evidence

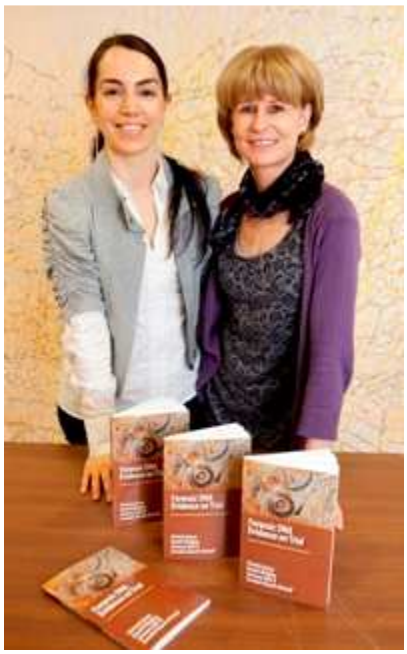
The labyrinthine maze of Bayesian statistical reasoning is hardly something that an average jury member could be expected to successfully navigate. Yet this is exactly what is expected when forensic DNA evidence is presented in the courtroom. The baffling nature of the evidence, which is read out only once, would likely intimidate even the most educated members of our communities.

In New Zealand, forensic scientists analyse DNA samples at the request of the Police. A sample may be taken from a crime scene, the DNA extracted and then compared to a 'reference sample' taken from a known individual to establish whether or not the DNA could have come from the same source.

Scientists provide their expert findings on this question. This may sound simple enough, however, this apparent simplicity is highly misleading. Where the scientific meaning of DNA evidence becomes a pawn in the adversarial legal process of prosecution and defence, it then becomes imperative to track how the probabilistic nature of evidence fares in the politics that structure this encounter. After all, the 'safety' of the jury's judgement is at the heart of our criminal justice process.

A research team led by Professor Victoria Grace from the University of Canterbury and Professor Gerald Midgley (formerly ESR, now University of Hull), and including Johanna Veth from ESR and Annabel Ahuriri-Driscoll from the University of Canterbury, has been investigating what various interested parties within the criminal justice system actually make of DNA evidence, what they think it means and how they evaluate it.

Qualitative research revealed some notable differences in the way forensic DNA evidence is interpreted across a range of professional groups and members of the lay public. Professionals were asked to respond to a prototype of evidence as presented in New Zealand courts. Forensic scientists were clear about the probabilistic nature of the evidence, and understood that the claim of correspondence between samples is ultimately a judgement or opinion based on an assessment of the evidence (which may be extremely strong). However, this was not the predominant understanding for other professional groups nor for the lay public.



Annabel Ahuriri-Driscoll and Victoria Grace

Police detectives, scene of crime officers, and crown prosecutors were more inclined to view the evidence as a simple matter of fact. There was a clear pattern of interpreting the scientist's opinion about the interpretation of the statistical 'likelihood ratio' as one representing *certain truth* that the samples are from the same source. Case closed.

Members of the lay public discussed a crime scenario in focus groups, so were presented with the same statement of evidence but in a different context. Here a clear pattern of response indicated that their *expectation* was one of certainty from the science. Yet when the evidence was presented in terms of probability (even using unfathomably low ratios like one in a million, million), their confidence in this certainty was shaken.

This led to significant problems in interpreting the evidence. Although there was a sub-group for whom the lack of absolute certainty was unproblematic, the dominant responses ranged from baffled and confused to hazarding wildly erroneous

interpretations. This in turn undermined focus group members' ability to integrate the evidence into what would be a judgement about guilt or otherwise in an actual trial.

Analysis of the juxtaposition of these responses alerted researchers to the structural positioning in which jury members might be placed. That is, being vulnerable to the influence of legal adversarial rhetoric guiding the assessment of scientific evidence. Also, when the legal defence is not equipped with the knowledge and resources to sustain a counter argument to the prosecution about the meaning of the DNA evidence, then the result potentially diminishes the contribution of science to justice.

The research team rejects the view that debate about the meaning of DNA evidence should be removed from the courtroom, as some commentators suggest. They argue that to do so would present the appearance to jurors of removing the 'politics' from knowledge, and science would falsely resume its popularised mantle of truth and certainty.

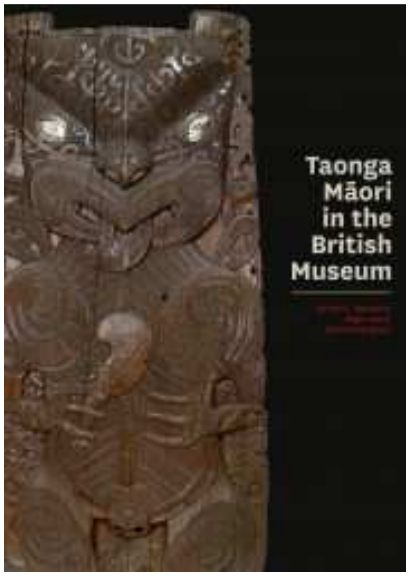
Instead, improvements in the wording of evidence and greater education in the critical nature of science and the meaning of the statistical evidence presented in court is suggested for members of non-scientific professional groups, including lawyers. Jurors also need information on the meaning of probability statements, prior to trial.

Without such education and improved understanding there is a risk that evidence is made to say what it does not and cannot say, thus potentially compromising justice. While the researchers would not expect that trials involving DNA evidence would necessarily be judged differently in terms of outcome, they do advocate a process whereby juries are strengthened in their assigned task of providing independent judgement.

Forensic DNA Evidence on Trial: Science and Uncertainty in the Courtroom by Victoria Grace, Gerald Midgley, Johanna Veth and Annabel Ahuriri-Driscoll (2011) has just been published by Emergent Publications, and presents these research findings in detail.

New Book: Taonga Māori in the British Museum

For the first time a book that catalogues the more than 2,300 Māori cultural items held in the British Museum is being published.



The book came about as a result of a promise made after a major exhibition, "Māori: Art and Culture", held in the British Museum in 1998. The promise was to publish "a definitive catalogue to show exactly what items are in the British Museum and what is known by the Museum about them."

Taonga Māori in the British Museum, is the result of over a decade's research by leading specialists from both New Zealand and the United Kingdom. It is co-authored by Dorota Starzecka, Roger Neich and Mick Pendergrast. It is being published in Aotearoa by Te Papa Press.

Part of the book's research was supported by a Marsden Fund grant, led by Professors Karen Nero and Roger Neich, allowing Professor Neich to conduct research on the Māori Collection at the British Museum. The grant, entitled 'Bringing Together Indigenous Knowledge and Museum Practices', examined the joint management of Māori museum items. Professor Neich was formerly curator of Ethnology at Auckland War Memorial Museum and Professor of Anthropology in the University of Auckland. He passed away in 2010, shortly before the book was published.

Neil MacGregor, Director of the British Museum, says "The Māori collections are among the most frequently visited in the department of Africa, Oceania and the Americas. We hope this catalogue will be useful, most of all, to Māori. There is still much research to be done, for example on the Cook Collection, the material acquired from the Royal United Services Institution, or the Wellcome Collection, and we would welcome any corrections or additional information about the catalogued items."

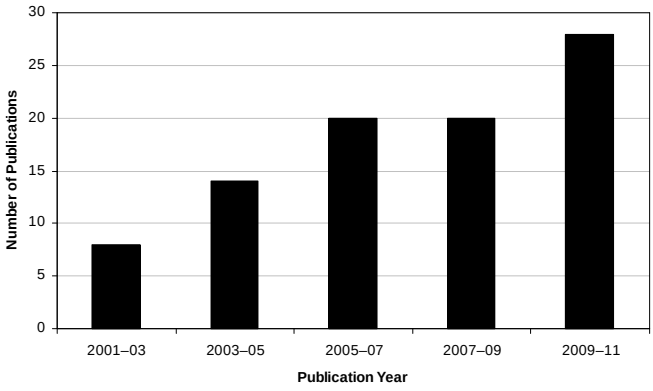
The collection began with items obtained during Captain James Cook's three voyages of exploration. Other items were collected and sold or gifted to the Museum by colonial administrators, missionaries, members of the British armed forces, or their descendants. Consequently the collection contains mainly small, easily portable objects, and includes woodcarvings, model canoes and paddles, domestic equipment, cloaks, baskets, jewellery, musical instruments, ceremonial objects, fishing and hunting equipment, tools and weapons. Some of the items are believed to be the only examples of their kind remaining in existence.

The collection reflects the individual collectors' personal tastes at a time when curators were interested mainly in completing series of objects of similar types, and were less concerned with the provenance of those items.

RESEARCH PRODUCTIVITY AND QUALITY

The contracts under the Marsden Fund continue to produce high quality outputs through refereed journal articles, books, invited presentations (international and national) and public outreach. The high standard of outputs over the past two years has been maintained and the quantity has stabilised, as can be seen in Appendix 2. The level of Peer Reviewed Publications (PRP) has decreased per dollar spent from approximately 19 PRP/ $million in 2006 to 14 PRP/$million in 2009. However, the overall standard and quantity still remain extremely high at the international and national level (highest of any fund within the Vote: S & I for New Zealand). Figure 2 represents the number of articles published in the top 2% of Journals, as ranked by the SJR SCImago system. As can be seen in the table, the total number of published articles in the top journals has steadily increased over the past ten years.

Figure 2. Number of articles in top journals supported by the Marsden Fund.



Along with this increase in top journal publications, data from Scopus shows that Marsden publications continue to outperform the New Zealand's typical research output in terms of both citation impact (Table 2) and the proportion of works that are cited (Table 3).

Over 2008–2009, Scopus has indexed 18494 publications with authors affiliated to a New Zealand address. Of these, 1020 were attributed to the Marsden Fund though contract reporting and explicit acknowledgement of the Fund's support.

Table 2. Citations received by New Zealand's research publications

Year of	Marsden			Non-Marsden			Marsden/non-Marsden
publication	Cites	Records	Cites/ record	Cites	Records	Cites/ record	Relative impact
2008	4915	528	**9.3**	52522	8602	**6.1**	1.52
2009	3084	492	**6.3**	33644	8872	**3.8**	1.65
All	7999	1020	**7.8**	86166	17474	**4.9**	1.59

Data sourced from Scopus, September 2011

Table 3. Proportion of New Zealand's research publications that were cited

Year of	Marsden			Non-Marsden			Marsden/non-Marsden
publication	Records	Uncited	%cited	Records	Uncited	%cited	ratio cited
2008	528	73	**86%**	8602	2199	**74%**	1.16
2009	492	97	**80%**	8872	3001	**66%**	1.21
All	1020	170	**83%**	17474	5200	**70%**	1.19

Data sourced from Scopus, September 2011

For New Zealand's 2008 and 2009 research publications, Marsden items had a ~60% higher citation impact than non-Marsden records, and were ~20% more likely to be cited than the typical non-Marsden research publication.

TANGIBLE SOCIO-ECONOMIC BENEFITS

There is a great deal of interest internationally and nationally in the return on investment from government in research. For example, the Australian Research Council (ARC) commissioned a study on research returns in 2003, 'A Wealth of Knowledge: The Return on Investment from ARC Funded Research'. They argued that because they were funding projects at the earliest and riskiest stages, they were more important than other research investments made. It defined areas of benefit categorised by Buxton-Hanney and used econometric methods to establish rates of return for Australia to six different categories as shown in Table 4.

Table 4. Econometric rates of return from funded research (ARC)

Source of benefit	Estimated rate of return
Building basic knowledge	10% social rate of return
Benefits from commercialisation of IP	3% with a 10 year time lag
Development of the skills base	12.5%
Benefits from better informed policy	6%
Improved access to international research	7.5%
Health, environmental and other socioeconomic benefits	Too complex to calculate.

To help better understand how fundamental research investment in New Zealand has contributed to socio-economic benefits, over 2008 to 2009, a similar study was conducted on a number of Marsden Fund-supported projects. This study has shown that the direct opportunities arising from this sub-set of research projects exceed $120 million per annum. This total was arrived at by including only financial and other benefits that directly accrue to New Zealand, and where the opportunities were expected to persist over an extended period, i.e., at least 15 years.

METHODOLOGY OF THE NEW ZEALAND STUDY

Most of the research analysed in this study was performed by university investigators because of the rather low uptake from Crown Research Institutes (10%) of the Marsden Fund and HRC. The study consisted of interviews with researchers who had completed their projects as long as 10 years before and as short as only in the previous year. The data set obtained produces some striking results. It should be acknowledged however, that many of the results are qualitative and approximate. Most of the fundamental research projects were transferred into applied projects before direct benefits could be seen. However, without this initial investment, the applied work would not have been done. Another outcome from the interviews was that many of the results which had led to tangible benefits were surprises to the investigators unanticipated when the original application of funding was made.

RESULTS OF THE ANALYSIS

The results from the analysis of 65 projects are summarised in Table 5 below.

Table 5. Financial opportunities per year (2008 $ millions)

Financial Opportunities	Total ($M)	Projects	% of Total	Hi/Lo
Directly from commercialisation	$124	22	34%	15/0.1
Estimated indirect benefit	>$2,000	14	22%	600/1
Improvement in skills	>$8	56	86%	.6/.02
New methods/instrumentation (Y/N)		46	71%	
Build basic knowledge (No. papers)	2,417	62	95%	38.7 ave
Better inform policymakers (Y/N)		29	45%	
International knowledge		63	97%	5.5 ave
Unexpected outcomes (Yes)				
Unanticipated knowledge		58	89%	
Unanticipated application *		43	93%	

*Out of a total of 46 with commercial or indirect benefits

Table 6 gives the direct benefits for five different sectors and the time lag for applications arising from the research to appear in the marketplace, in government policy, as productivity improvements, environmental interventions and in social benefit.

Table 6. Sectors studied and their direct benefits and time lags

Results by Sector	Direct ($M)	Total Projects	Time lag Average (yrs)
Agriculture	31	4	6
Health	50	23	9
Energy	7	4	5
Manufacturing	34.5	12	7
Social	1.6	18	6
Total	124.1	65	

Direct opportunities are significant at over $124M when compared with an Australian study where in 2003 only a total of A$88M was found in this category from all research funded by Australian Research Council to 2000. In the project there appeared to be a bigger spread of contributors to this category but this may be deceptive because of the project selection method. The largest contributor to this category was $15M. While indirect opportunities are clearly the most significant contributing category, they are extremely difficult to measure. In New Zealand because agriculture is a very large industry, productivity improvements can make significant annual contributions. In health also, because it is so universal, a small improvement in productivity can make a substantial net contribution. It is to be noted that four projects make up a large percentage of the total in this category.

The above project grouped benefits into a broad set of categories as shown in Table 4. Improvement in skills, estimated at an annual return of over $8M is a significant contribution. New Methods and Instruments, was found, somewhat unexpectedly in over 70% of the projects which described the development of new methods and instrumentation. The project stated that the outcomes of building basic knowledge were very difficult to measure and it was concluded that they are likely to be more significant than is obvious from the study. The number of projects which inform legislation and or government policy in New Zealand was considerable. Finally, in all but three cases of commercial and indirect benefit, the commercial avenues and other benefit outcomes were not anticipated by the Principle Investigators (PIs) at the beginning of the research programme. Even at the time of the relevant research's completion, for about one third of the projects that eventually gave rise to commercialisation or indirect benefits, these applications were not obvious and had not been appreciated by the investigator.

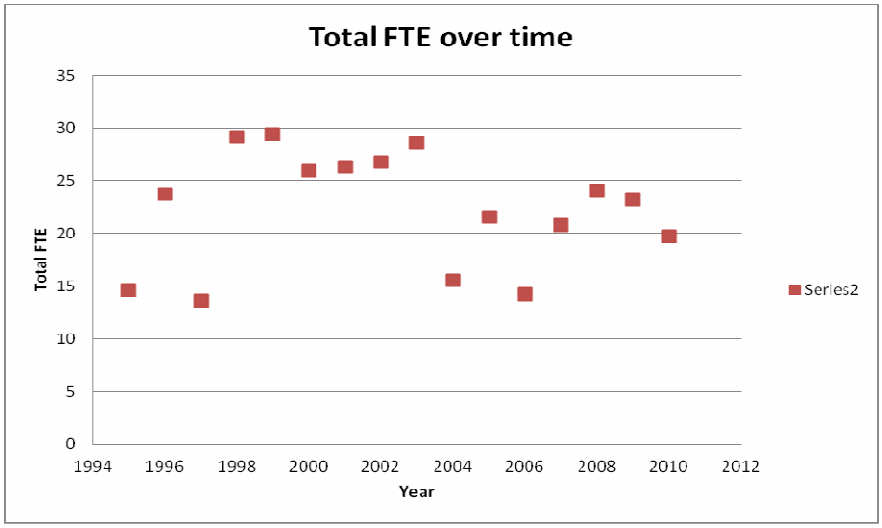
Building Human Capacity

The Marsden Fund has supported established researchers by funding Standard contracts within the Marsden Fund scheme. Over the past five years the number of PIs and the number of Associate Investigators (AIs) has grown from 111 PIs in 2006 to 134 PIs in 2010; and 108 AIs in 2006 to 140 AIs in 2010.

The Marsden Fund continues to strongly support New Zealand's emerging researchers, through the Fast-Start scheme. The Fast-Start scheme has shown great success since its inception in 2001. From its beginning, the scheme has grown from a minimally funded two-year scheme ($50k per year for two years) to a reasonably funded three-year scheme ($100k per year for three years). The three-year lifetime has made a large impact on attracting PhD students for the emerging researchers.

The Marsden Fund has always been a strong support mechanism for Post-doctoral candidates and Post-graduates; however the cost of a Post-doc has risen to ~$180K per year. The Full Time Equivalents for Post-doctoral researchers is shown in Figure 3 for 1994 to 2010.

Figure 3. Full Time Equivalents as Post-Docs from 2001 to 2008 contracts



People Supported by Marsden

Many researchers supported by the Marsden Fund are awarded prizes, appointments, and awards. In the past three years a long list has been created, including the NZ Order of Merit; Rutherford Medals; Pickering Medals; amongst other distinctions (see Appendix 2).

The Marsden Fund supports, on average, a researcher earlier in their career than the average researcher calculated from a profile of New Zealand researchers. This is in part due to the Fast-Start scheme, but is also well documented from the Standard proposals. The 2008 to 2010 contracts has seen a flattening off of the past trend of increasingly younger PIs. However, the past three years show over 40% of the PIs have less than 10 years research experience as opposed to New Zealand's profile, which estimates that less than 20% of the research population has less than 10 years of research experience.

The percentage of PIs who are women has been flat for past two years, but the numbers for the 2011 contracts has jumped dramatically to 35%. This new level of involvement of women in research is an excellent shift in the previous years. Appendix 2 has further statistical information.

Collaborations and Leveraging International Research

At the beginning of contracting, the percentage of international collaborations has slightly increases over the years. However, by the time the contract has been completed the percentage of international collaborators has grown to encompass over 90% of all contracts with the Marsden Fund. The leverage of international research into New Zealand's knowledge base is directly affected by the international collaboration accomplished under the Marsden Fund.

Examples of researchers using equipment and resources unavailable in New Zealand include, research done using the Oxford Bioinformatics Institute to analyse bacterial DNA derived from freshwater communities as part of a study done at Dr Gavin Lear's team at Lincoln University. Along with the use of equipment, often further funding can be leveraged from overseas. Two recent examples of this include; Associate Professor Alona Ben-Tal being named as one of six investigators on a large grant from the National Institutes of Health (USA); and Associate Professor Tony Poole being funded by the Wellcome Trust (UK) research grant for work related to his existing Marsden Fund contract. An entire list of benefits is given in Appendix 2.

Quality counts

The quality of Marsden Fund contracted research is based on a rigorous two-stage peer review process. In the preliminary stage each proposal is read and scored by all non-conflicted panellists. These initial scores are used to begin the discussions on each proposal at an all-day panel meeting. Once a proposal has been discussed a final score is agreed to by the panel and the preliminary proposals are then ranked accordingly. Approximately 25% of the preliminary proposals are recommended for the full proposal round based on ranking.

The full proposal round uses the panels again, however each proposal is also sent out to three international referees for comments and scoring. The referee comments are sent back to the applicants for rebuttal, following which referee comments and rebuttals are sent on to the panellists as further information on each proposal. The panellists score each proposal based on their own opinion of the research and the scores and comments from the referees along with the applicant rebuttals. A panel meeting is held to discuss the scores and a final ranking of all the proposal is agreed to at the meeting. The Marsden Fund Council then goes through all the recommendations from all ten panels and makes a final recommendation for funding.

It is shown in Appendix 2 that projects receiving funding are typically judged by their international referees as excellent/ outstanding. Unfortunately, there are also a number of proposals judged in this category which are not selected because of lack of funding.

Emerging Issues / Recommendations

SUCCESS RATES AND NUMBER OF PROPOSALS

The success rate for the Marsden Fund has been low since its beginning. Figure 1 shows the success rates for Fast-Start and Standard proposals over the years has been at, or around, the 10% level. The low success rate is a combination of under-funding and over-bidding. The problem of under-funding is exacerbated by the full-cost model used by the Fund, in particular the full costing of all salaries (including post-docs) on every contract. An open and informed dialogue on how overheads and salaries could be costed for Marsden Fund contracts would be a start at solving this issue.

REUSING THE MARSDEN FUND SELECTION PROCESS

The amount of time and effort used to select the proposals for contracting for the Marsden Fund is enormous. However, the selection process is beyond a doubt high-quality and the Royal Society is continually approached to give more information about the ranking of all the proposals for other institutes to use for their own processes. To date we have kept the dissemination of this extra information to a minimum. However, to spread the costs of the process further, this could be looked at in the future. To better utilise this information the Marsden Fund executive suggest that some follow-on research funding mechanism either be established formally or informally with the Ministry of Science and Innovation and the Health Research Council (HRC) to take on high performing Marsden Fund research projects.

The projects that are coming to an end and have shown great advancement in knowledge and potential for further benefit in economic, social or environmental areas, through the research assessments and reports, could be taken directly to the next phase of funding without another contestable funding round. Most of the information needed for this process to take place is already gathered through the Marsden Fund assessment process and reported to MSI. Currently, we are unaware of any formal mechanisms for this information to be utilised by MSI or passed on to the HRC. The Marsden Fund executive have a large wealth of information about all the contracts that pass through the Fund and would be more than willing to share this information with MSI and HRC to better utilise the funding costs from the on-set of the Marsden Fund proposal process.

The second portion of research that could be better supported is the research that makes it into the second round of the Marsden Fund process, but is not selected for support. Many of these projects have excellent research ideas and well thought out plans. These projects are often picked-up for internal funding within the universities, but the government could also directly fund these projects, at a reduced amount, to better utilise the proposal process costs, while still supporting excellent research projects, although at a reduced level. The Marsden Fund executive suggests that the possibility of this form of funding be explored.

.

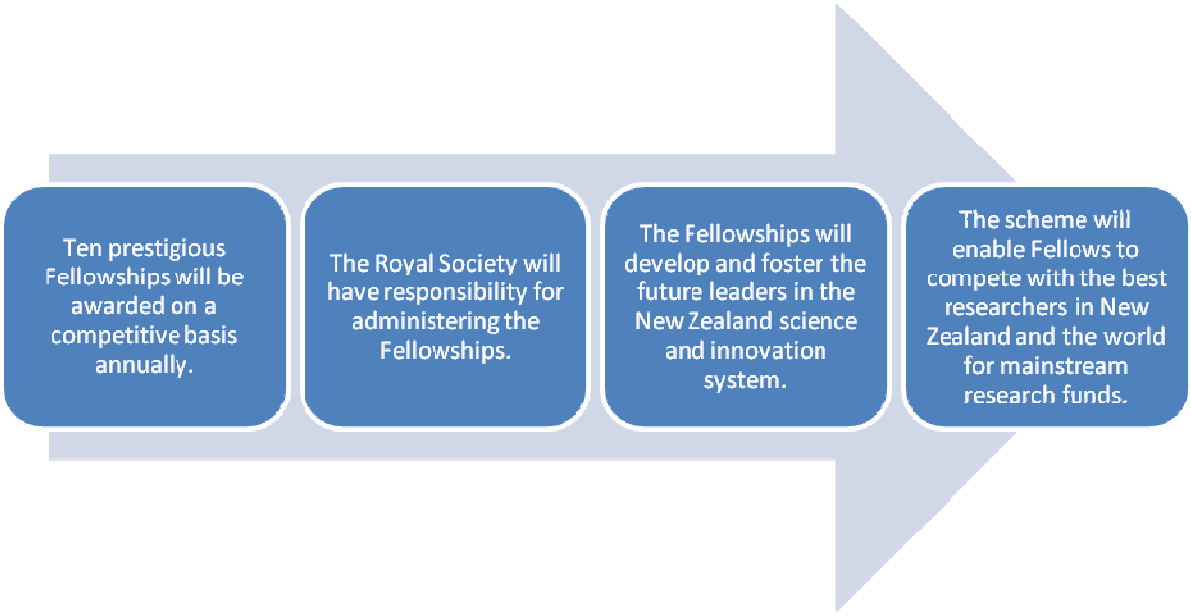
RUTHERFORD DISCOVERY FELLOWSHIP

Purpose and Objectives

The Rutherford Discovery Fellowships were announced by the New Zealand Government in May 2010. With this scheme, the New Zealand Government is supporting the development of excellence and has moved to fill a major gap in career opportunities for the most talented early- to mid-career researchers.

The Fellowships will develop and foster the future leaders in the New Zealand science and innovation system. They will attract and retain New Zealand's most talented early- to mid-career researchers and encourage their career development by enabling them to establish a track record for future research leadership. This new Fellowship scheme also aims to attract top researchers, with international research experience, back to New Zealand.

The application process is competitive, with ten prestigious Fellowships of five years in length, awarded annually. Receipt of a Rutherford Discovery Fellowship is expected to have significant value in the future career of a researcher. It is expected that Fellows, throughout their careers, will contribute to positive outcomes for New Zealand.



Governance

The Fellowship operates under a Terms of Reference as updated by the Minister of Science and Innovation in 2011. In partnership with the Society, the Trustees of the Rutherford Foundation have responsibility for advising how the funding shall be allocated. In making these decisions they are supported by three discipline-based panels of experts. Nominations for these discipline-based panellists are sought from the Champions of the Rutherford Foundation-Royal Society of New Zealand interview panel and approved by the Royal Society of New Zealand. The Fellowship is administered by the Royal Society of New Zealand who organise the selection process, manage the disbursement of funds, monitor progress, coordinate the annual Fellows' workshops, evaluate the outcomes from the research, and provide secretariat services to the Rutherford Discovery Fellowship's Panels and Panellists.

Scope and Scale

The Impact Investment Report will report on activities related to the Rutherford Discovery Fellowships from inception on 11 May 2010 to 31 December 2011. In the 18 months of the scheme's operation, there have been two funding rounds completed and 20 Fellows successfully appointed. Under the current plans, the scheme is expected to grow to support 50 Fellows at any one time by 2015.

SELECTION

The Royal Society of New Zealand-Rutherford Foundation interview panel has strived to identify the future leaders in the New Zealand research sector. This scheme's primary purpose is not about funding a project, but supporting a person. The interview panel gives due consideration to the benefits a Fellowship would make to any potential awardees – this includes an account of whether an applicant has tenure or equivalent. There is also considerable interest in ascertaining the contribution to positive outcomes for New Zealand that receipt of a Fellowship could make. The panel follows the selection criteria and gives appropriate weighting to the applicant's calibre, research programme and leadership when making their recommendation for funding. The criteria along with the background and objectives are well defined within the Terms of Reference for the Rutherford Discovery Fellowships. The panels perform their duty under Ministerial instruction adhering to the Terms and following due process.

SUMMARY DATA FROM THE FUNDING SELECTION ROUNDS (2010 AND 2011)

There have been 15 Fellows are appointed at the Tier 1 level; 5 have been appointed at Tier 2. The number of years after doctoral confirmation does not necessarily align with the Tier structure. That is not all Tier 2 candidates are 8-10 years after doctoral confirmation and not all Tier 1 candidates are in the 3-7 year time frame. This allows for the recognition that development of leadership is the principle influence for tier selection, not an arbitrary number of years since doctoral award. This is more refined in that it allows the experience of the applicants and the path for their career trajectory to be assessed on the three criteria (calibre of the applicant, leadership and programme of research) and not have applicants pre-selected into Tier 1 or Tier 2 categories according to time constraints around the award of a doctoral degree (Figure 1).

Figure 4. The percentage of applicants and Fellows with the number of years after the award of their doctoral degree (combined 2010 and 2011 funding rounds)

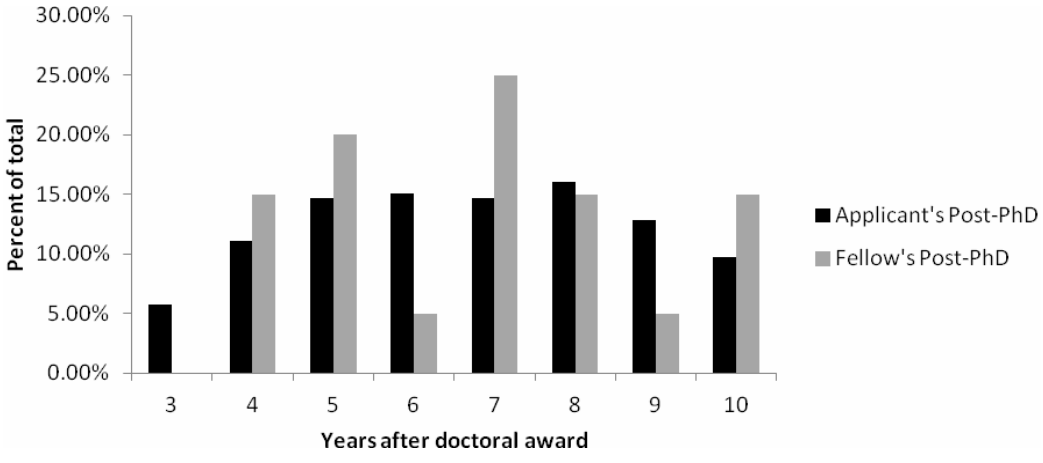


Figure 5. The number of Tier 1 and Tier 2 Fellowships allocated along with the number of years after the award of their doctoral degree (combined 2010 and 2011 funding rounds)

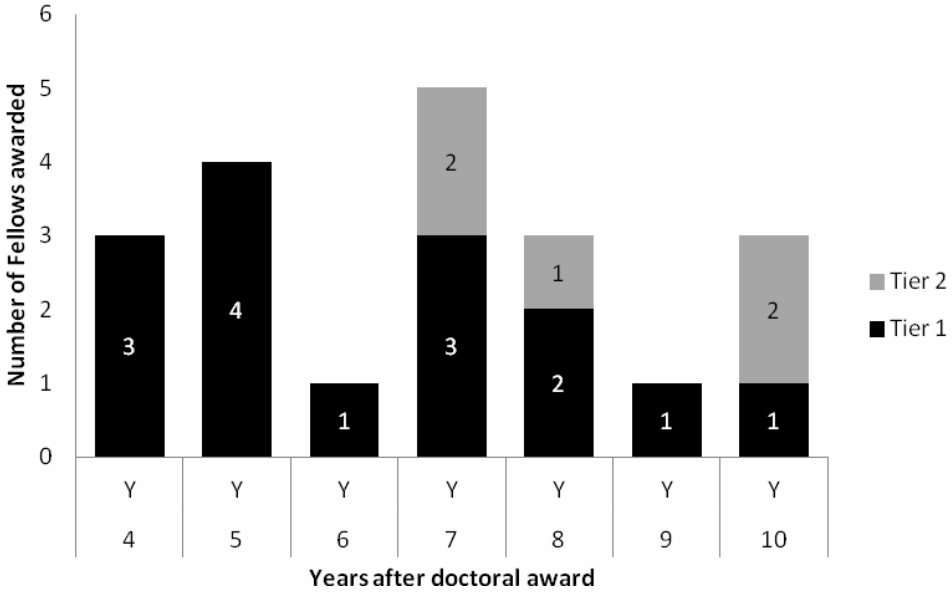


Table 7. The number of applications for the Funding round as defined by the various New Zealand Research, Science and Technology sectors (CRI: Crown Research Institutes; OTH: Other; PRI: Private Business; TEO: Tertiary Education Organisation) * CRI Fellow also associated with TEO

	2010				2011			
Sector	All	Long list	Interview	Fellows	All	Long list	Interview	Fellows
CRI	19	1	0	0	18	3	2	1*
OTH	2	1	0	0	1	0	0	0
PRI	1	0	0	0	1	1	0	0
TEO	93	40	19	10	90	37	18	9
Total	115	42	19	10	110	41	20	10

Table 8. The percentage of applicants who applied and the successful Fellows with detail of their gender

	2010		2011	
Gender	%Applicants	%Fellows	%Applicants	%Fellows
Female	38	20	38	20
Male	61	80	62	80
Not declared	1			

Table 9. The percentage of applicants who applied with detail of their ethnicity

Ethnicity	2010 %Applicants	2011 %Applicants
Not declared	2.5	1
Non-Māori	95	95
Māori	2.5	4

Table 10. The proportion of applicants who applied and the successful Fellows with detail of the panel they applied to (HSS: Humanities and the Social Sciences; LFS: Life Sciences; PEM Physical Sciences, Engineering and Mathematics)

Panel	2010		2011	
	%Applicants	%Fellows	%Applicants	%Fellows
HSS	14	20	23	20
LFS	45	50	42	50
PEM	41	30	35	30

Table 11. The proportion of applicants who applied and the successful Fellows with detail of their chosen tier (2011 data only)

	2011	
	%Applicants	%Fellows
Tier 1	60	80
Tier 2	40	20

FELLOWS' UPTAKE TIME

Successful Fellows have up to a year deferral from the award notification until they are required to begin their programme of research. From the 2010 round, the mean time until the Fellows' commencement of the programme of research was 188 ± 98 days (mean ± standard deviation; n=10) and for the 2011 round this is currently 105 ± 18 days (mean ± standard deviation; n=3).

This order of uptake has affected the rate at which monies are disbursed from the Fellowship funding and accounts for the limited number of interim and annual reports received thus far.

Highlights

The Rutherford Discovery Fellowship scheme has only been operating for 18 months. In this time there have been no completed contracts/Fellowships. The first cohort of Fellows is not expected to complete contractual requirements until 2016.

The Royal Society has received seven interim reports from the Fellows who have been contracted for six months or longer. These indicate successful start of the programme of research and the time relief of 85% being implemented as anticipated.

RESEARCH PRODUCTIVITY AND QUALITY

At this early stage of inception for the Fellowship scheme, we are unable to present any progress information on specific research objectives currently undertaken by the Fellows. Some indication of the productivity of the Fellows and quality outputs resulting from their research should be expected in the next six-to-twelve months.

TANGIBLE SOCIO-ECONOMIC BENEFITS

The Fellows have indicated the potential socio-economic benefits they perceive their programme of research may have. These are indicative only at this stage and will require further investigation and examination as the Fellows complete their contractual requirements from 2016 onward.

Table 12. The socio-economic benefits (SEO) coded by Australian and New Zealand Standard Research Classification (ANZSRC) 2008 and related descriptions highlighted by the Fellows in their proposed programme (combined 2010 and 2011 funding rounds)

SEO	Description	Count
810104	Emerging Defence Technologies	1
850504	Solar-Photovoltaic Energy	1
861502	Medical Instruments	1
861503	Scientific Instruments	1
920111	Nervous System and Disorders	1
920203	Diagnostic Methods	1
920404	Disease Distribution and Transmission (incl. Surveillance and Response)	1
940401	Civil Justice	1
950201	Communication Across Languages and Culture	1
950403	Environmental Ethics	1
950599	Understanding Past Societies not elsewhere classified	1
960305	Ecosystem Adaptation to Climate Change	1
960306	Effects of Climate Change and Variability on Antarctic and Sub-Antarctic Environments (excl. Social Impacts)	1
960308	Effects of Climate Change and Variability on New Zealand (excl. Social Impacts)	2
960310	Global Effects of Climate Change and Variability (excl. Australia, New Zealand, Antarctica and the South Pacific) (excl. Social Impacts)	1
960504	Ecosystem Assessment and Management of Farmland, Arable Cropland and Permanent Cropland Environments	1
960805	Flora, Fauna and Biodiversity at Regional or Larger Scales	2
960806	Forest and Woodlands Flora, Fauna and Biodiversity	1
960808	Marine Flora, Fauna and Biodiversity	1
970101	Expanding Knowledge in the Mathematical Sciences	1
970102	Expanding Knowledge in the Physical Sciences	2
970103	Expanding Knowledge in the Chemical Sciences	1
970106	Expanding Knowledge in the Biological Sciences	8
970107	Expanding Knowledge in the Agricultural and Veterinary Sciences	1
970108	Expanding Knowledge in the Information and Computing Sciences	1
970109	Expanding Knowledge in Engineering	1
970111	Expanding Knowledge in the Medical and Health Sciences	1
970117	Expanding Knowledge in Psychology and Cognitive Sciences	1
970120	Expanding Knowledge in Language, Communication and Culture	1
	Total	39

BUILDING HUMAN CAPACITY

The retention and repatriation of successful early- to mid-career researchers is within the scope of the Terms of Reference.

Repatriation

The Rutherford Discovery Fellowships support New Zealand's most talented early- to mid-career researchers. This new Fellowship scheme also aims to attract top researchers, with international research experience, back to New Zealand.

Table 13. The percentage of applicants who applied and the percentage successful Fellows with detail of their country of origin

	2010		2011	
Origin	%Applicants	%Fellows	%Applicants	%Fellows
International	8	10	9	10
New Zealand	92	90	91	90

The proportion of applicants applying from international locations appears to be well correlated to the proportion of awarded Fellows.

This would indicate an appropriate level of repatriation of scholars to New Zealand, in line with application pressure, is currently being attained by the Rutherford Discovery Fellowship scheme selection process.

Retention

Researchers who have permanent employment in New Zealand are also vulnerable to being lured overseas if the funding streams prove unattractive or inadequate for them. The Rutherford Discovery Fellowship scheme has an important role in recognising New Zealand's future leaders and securing a place for them within New Zealand's science and innovation sector. Recently, the Fellows were asked whether they had been offered realistic opportunities to relocate to overseas host institutions. Of the Fellows present, 12 from 14 had been approached with 1 of the 14 had relocated to New Zealand (source: key informant interviews at the inaugural Rutherford Discovery Fellowship workshop 09 December 2011).

There appears a significant benefit to New Zealand in having the Rutherford Discovery Fellowship scheme in retaining the future leaders within the New Zealand science and innovation system.

LEVERAGING INTERNATIONAL RESEARCH

An objective of the Rutherford Discovery Fellowships is to support excellent early- to mid-career researchers to gain the independence necessary to compete with the best researchers in New Zealand and the world for mainstream research funds. From the seven interim reports available, four reported activity in seeking additional research funds with three Fellows being successful (one Fellow was successful with two different funding streams; another Fellow notified the Society after the funding was awarded). In the first six month period, these seven Fellows reported bidding for a total of NZ$3,295,757 and have been awarded NZ $2,284,333 in research funding.

Table 14. Row data of the research funding sought and received by the Fellows in the first six months – sourced from contract reporting

Details	Region	Result	Amount
2011 Marsden Fund Grant (Principal Investigator)	National	Yes	$779,000
Bio-Protection Research Centre (CoRE Principal Investigator)	National	Yes	$660,000
2011 Marsden Fund Grant (Principal Investigator)	National	No	$836,019
Brian Mason Trust Grant (covers PhD student field work)	National	Yes	$15,333
Neurological Foundation of NZ	National	Awaiting	$175,405
2011 Marsden Fund Grant (Associate Investigator)	National	Yes	$830,000
		Successful	$2,284,333
		Awaiting	$175,405
		Total	$3,295,757

There appears a significant amount of activity from the Fellows in seeking additional research funds coupled with a good degree of success.

COLLABORATIONS

A large number of collaborations have been indicated from the Fellow's proposals. The Full extent and development of these networks, both nationally and internationally, will only be evident at a point when Fellow's have undertaken a significant volume of work toward their proposed programme of research.

Proposed Collaborators

From the proposal forms submitted by the Fellows, the 20 contracts represent 87 collaborations, with at least 26 representing international linkages.

Workshop

As a condition of the Fellowship, Fellows will participate in an annual workshop organised by the Royal Society of New Zealand. A primary purpose of these workshops is to promote multi-institutional and multi-disciplinary links across the science and innovation sector. The inaugural workshop was held on 09 November 2011 which was attended by 14 Fellows and has proved to be a very promising start. The character of the discussions and the progress of the day were lively and animated – a positive sign of engagement with, and between, the Fellows was evident. There have been significant advantages to pooling this group of researchers together with some emergent research themes and collaborations developing as a result of these interactions.

Emerging Issues / Recommendations

SUCCESS OF THE SCHEME

The application process is competitive, with ten prestigious Fellowships of five years in length, awarded annually. The selection of New Zealand's future leaders is meeting the background and objectives as prescribed by the Minister of Science and Innovation in the Terms of Reference of the Rutherford Discovery Fellowships. As such, the New Zealand Government is supporting the development of excellence and providing career opportunities for the most talented early- to mid-career researchers.

The scheme appears to be performing to the remit and enabling support for excellent early- to mid-career researchers.

MAINTENANCE OF THE CURRENT SCHEME

It is essential to maintain a cohort of 10 Fellows per year to ensure the effective operation of the group dynamics underpinning the workshops. This necessity arises as a critical number of Fellows are required in order for the opportunities afforded to them to form substantive sized satellite groups. Thus far two sub-discipline specialities have emerged from the workshops: one centring on evolution; and, another on the brain.

If the number of Fellows appointed were to decrease this could lead to the erosion of quality linkages which can potentially form at the annual workshops.

APPENDICES

APPENDIX 1 - MARSDEN FUND – SCOPE AND SCALE

The Fund has increased in size, almost, steadily since its inception 17 years ago and currently stands at $46.755 million ($53.7M including GST) following its increase by $9 million in the 2009/10 budget (the biggest single increase in both absolute and relative terms since the first years of the Fund).

Each year, approximately one third of the Fund's budget becomes available for new projects. In 2010/11 and 2011/12, funding totalling $53.14 and $46.77 million respectively were awarded to contracts to run over the following three–five years. Figure A1.1 shows the trends in both Government funding and the Fund's disbursement.

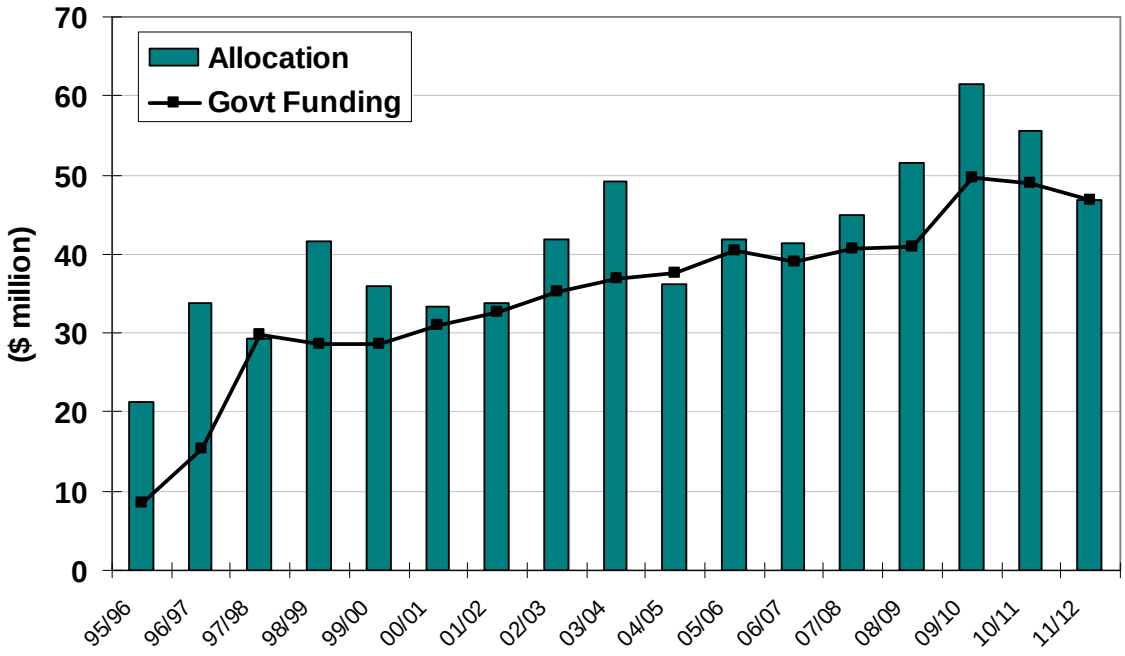


Figure A1.1. Funds allocated to new Marsden Fund projects (in Millions of 2011 dollars, GST-exclusive)

The distribution of the Fund by research area over 2002 to 2012, is shown in Table A1.1 and Figure A1.2. Note that the proportion of the Fund allocated to each area of research is not predetermined, but is a consequence of the numbers of proposals received within each discipline in the current round and the immediate past.

Table 1.1. Distribution of Marsden support by research discipline over time (in millions of nominal dollars).

	Round									
Panel†	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CMP	$ 5.79	$ 6.55	$ 4.67	$ 5.32	$ 4.86	$ 5.16	$ 6.70	$ 8.26	$ 6.43	$ 5.28
BMS	$ 5.61	$ 6.49	$ 4.63	$ 5.13	$ 4.43	$ 5.14	$ 6.82	$ 8.84	$ 6.89	$ 5.63
EEB	$ 5.43	$ 6.13	$ 4.74	$ 5.63	$ 5.75	$ 6.88	$ 7.60	$ 8.48	$ 8.91	$ 7.26
ESA	$ 3.54	$ 3.76	$ 3.42	$ 4.16	$ 3.82	$ 4.32	$ 5.24	$ 6.33	$ 7.36	$ 5.93
PSE	$ 5.38	$ 6.93	$ 4.16	$ 4.75	$ 5.00	$ 5.66	$ 6.21	$ 8.52	$ 6.47	$ 5.33
EIS	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6.21	$ 5.42
MIS	$ 2.26	$ 2.39	$ 2.27	$ 2.52	$ 2.61	$ 2.92	$ 3.63	$ 5.13	$ 3.32	$ 4.09
EHB	$ -	$ -	$ -	$ -	$ 2.47	$ 3.48	$ 3.77	$ 3.69	$ 4.12	$ 3.96
SOC	$ 2.90	$ 4.88	$ 4.03	$ 5.76	$ 3.60	$ 3.80	$ 5.06	$ 6.31	$ 6.64	$ 6.59
HUM	$ 1.60	$ 1.81	$ 1.44	$ 1.76	$ 2.21	$ 2.30	$ 2.84	$ 3.25	$ 3.44	$ 4.30

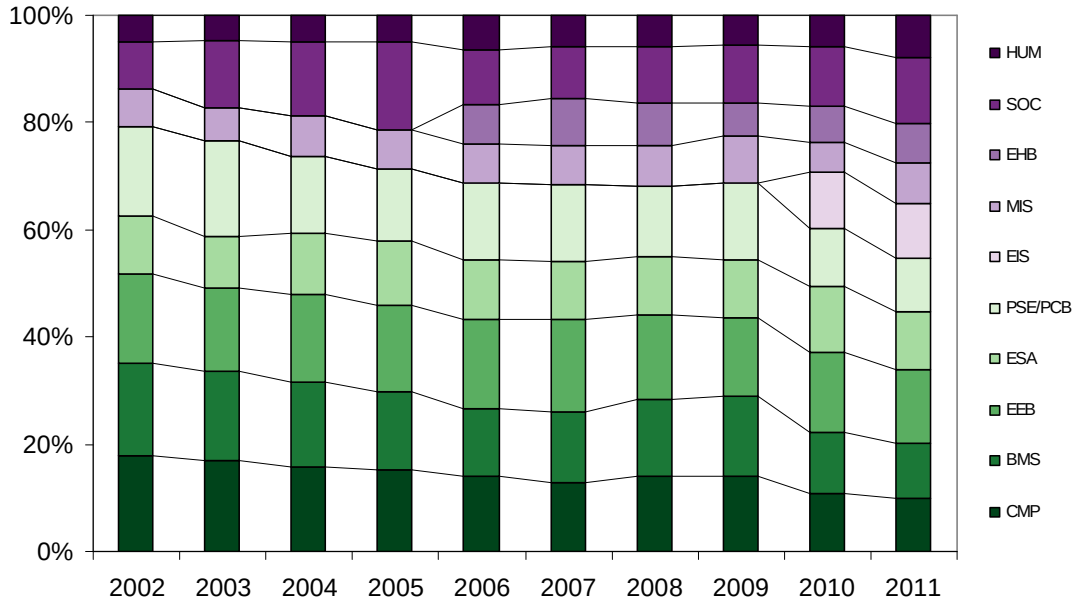


Figure A1.2. Share of funding by research area† for new contracts and year of award

†The research areas are: CMP - Cellular, Molecular & Physiological Biology; BMS - Biomedical Sciences; EEB - Ecology, Evolution and Behaviour; ESA - Earth Sciences and Astronomy; PSE/PCB – from 2010 Physics, Chemistry and Biochemistry, prior to this Physical Sciences and Engineering; EIS – Engineering and Interdisciplinary Sciences; MIS - Mathematical and Information Sciences; EHB – Economics and Human and Behavioural Sciences; SOC - Social Sciences; and, HUM - Humanities.

For the last two rounds of contracts: 36 % of the funding is to the medical and life sciences; 39 % to the physical sciences, engineering and mathematics; and 26 % to the social sciences and, humanities. The disciplinary spread has been relatively constant since the creation of the EHB panel in 2006, although the creation of the EIS panel has shifted funding to the PSEM subjects from the life sciences, with 2011 being the largest year for the humanities (8%)..

APPENDIX 2 – MARSDEN FUND – QUANTITATIVE INDICATORS AND QUALITATIVE ACHIEVEMENTS

BUILDING HUMAN CAPACITY

PRINCIPAL AND ASSOCIATE INVESTIGATORS

The Marsden Fund has supported established researchers by:

Funding contracts that started over 2006 to 2011 that involve 648 principal investigators (of whom 50 were based outside New Zealand) and another 686 associate investigators (of whom 56 % are based outside New Zealand).

Table 1.2. Number of investigators associated with Marsden projects contracted in the year.

Investigators	2006	2007	2008	2009	2010	2011	Individuals
Principal	111	121	127	143	133	107	648
Associate	108	129	132	183	138	147	793
All	219	241	252	320	270	250	1334

NEW AND EMERGING RESEARCHERS

The Marsden Fund continues to invest heavily in New Zealand's emerging researchers.

Over 2006 to 20011, 180 Fast-Start contracts were awarded to researchers who have had no more than 7 years of research experience since completing their Ph.D (25 were awarded in 2006 and 2008, 28 in 2007, 36 in 2009, 34 in 2010, and 32 in 2011).

The Marsden Fund's contracts are associated with a large number of the postdoctoral researchers funded through Vote RST. For the 475 contracts awarded between 2006 and 2010, funding has been available for postdocs in 149, i.e., roughly a third of them. Of note, while this represents the equivalent of 111 full-time 3-year appointments, this level represents an overall decline in the level of post-doctoral support directly attributable to the Fund (cf 48 % for all contracts let between 1996 and 2000, or some 145 full-time 3-year appointments).

For the 563 contracts awarded between 2006 and 2010, 304 requested funding for post graduate students, i.e., 54 % of contracts cf. 52 % of contracts let between 1996 and 2000. In the three most recent years for which contracting has been awarded contracts provide support for a total of 490.5 FTE in postgraduate positions.

Although the Fund gives strong support to those at the very early stages of their research careers, recent years have seen shifts in the type of individual being contracted in supporting roles for Marsden's research. Since the Fund's inception, the level of Post-doctoral and Research Assistant involvement has declined, both as a relative proportion of the FTE supported by the Fund, and to a lesser degree in absolute terms. While recent fluctuations in Post-doctoral support have been mirrored by increases in the proportion of contracted FTE going to post-graduate students, the main changes have been increasing Investigator reliance on the Fund (Figure A2.1).

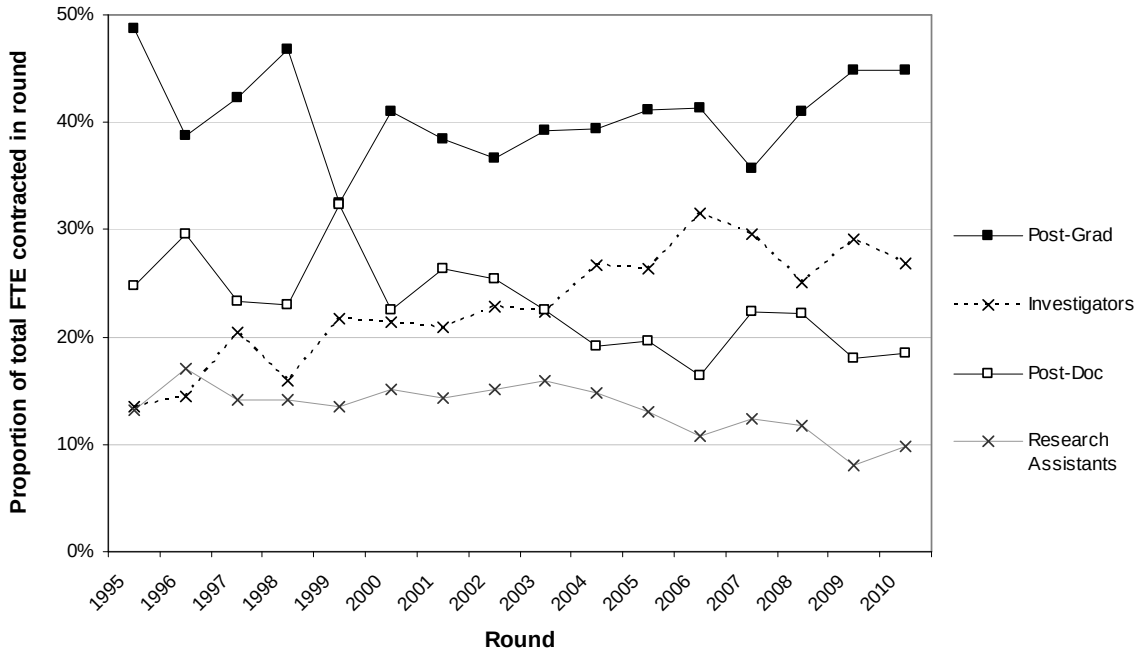


Figure A2.1. Relative proportions of the FTE contracted by Marsden grants going to different roles

Over 2006 to 2011, 46 % of principal investigators, and 33 % of associate investigators, were within 10 years of completing their Ph.D (that is, in most cases, are assumed to be under 37 years of age).

Since 92 % of contracts are in the sciences, this distribution for principal investigators has been compared with the distribution of ages of New Zealand scientists, from "Profiles – A Survey of New Zealand Scientists and Technologists"[12]. The participation of emerging researchers is significantly greater than would be expected from demographic considerations alone (Figure A2.2).

[1] Sommer J (2010) "2008 Survey of New Zealand scientists and technologists"
New Zealand Science Review 67(1):1–40.

[2] Note: the horizontal variables (years since highest degree and age, respectively) have been matched by assuming that the highest degree is obtained at 26 years of age.

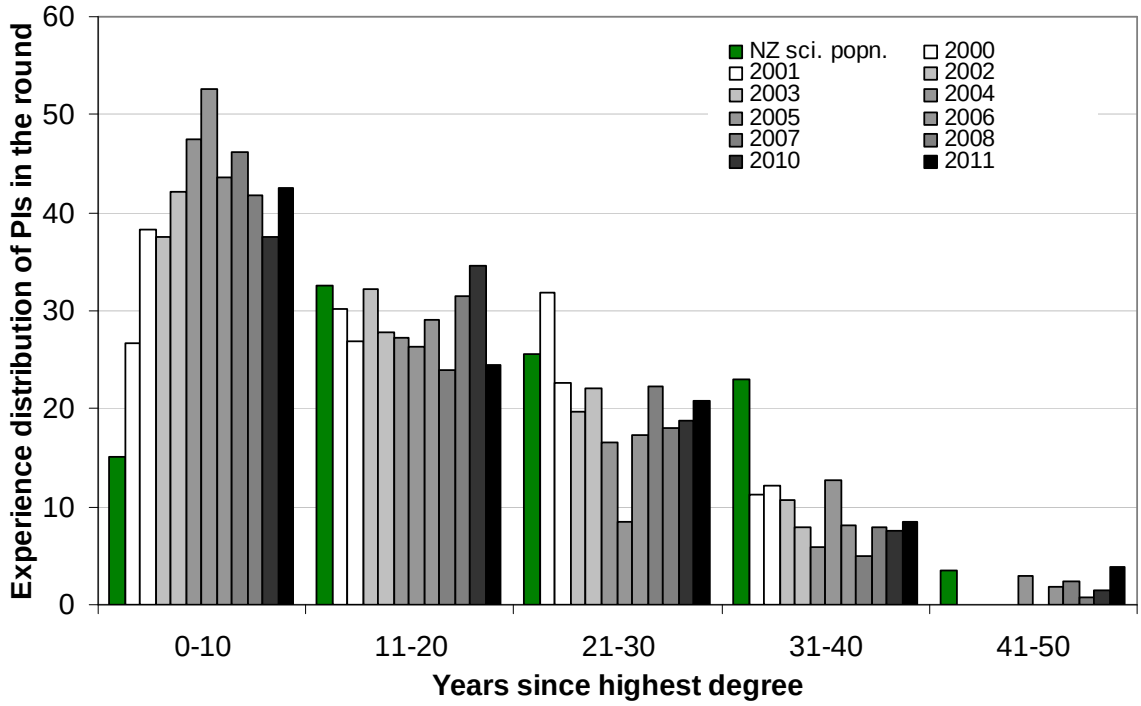


Figure A2.2. Experience of principal investigators (PIs) on contracts awarded from 2000–2010, as estimated from the number of years since the principal investigator obtained their highest degree.

WOMEN RESEARCHERS

In the 2011, 34.6 % of the principal investigators on successful applications are women, making this the highest year to date[3].

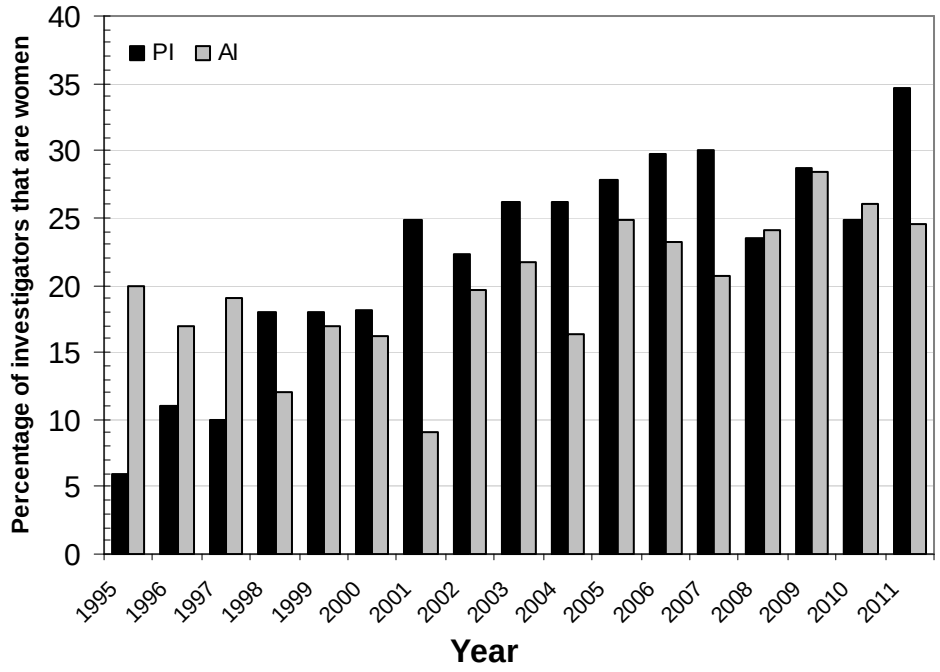


Figure A2.4. Percentage of principal, (PI) and associate (AI), investigators who are women.

Table 1.2. Proportion of proposals at each stage having a female principal investigator.

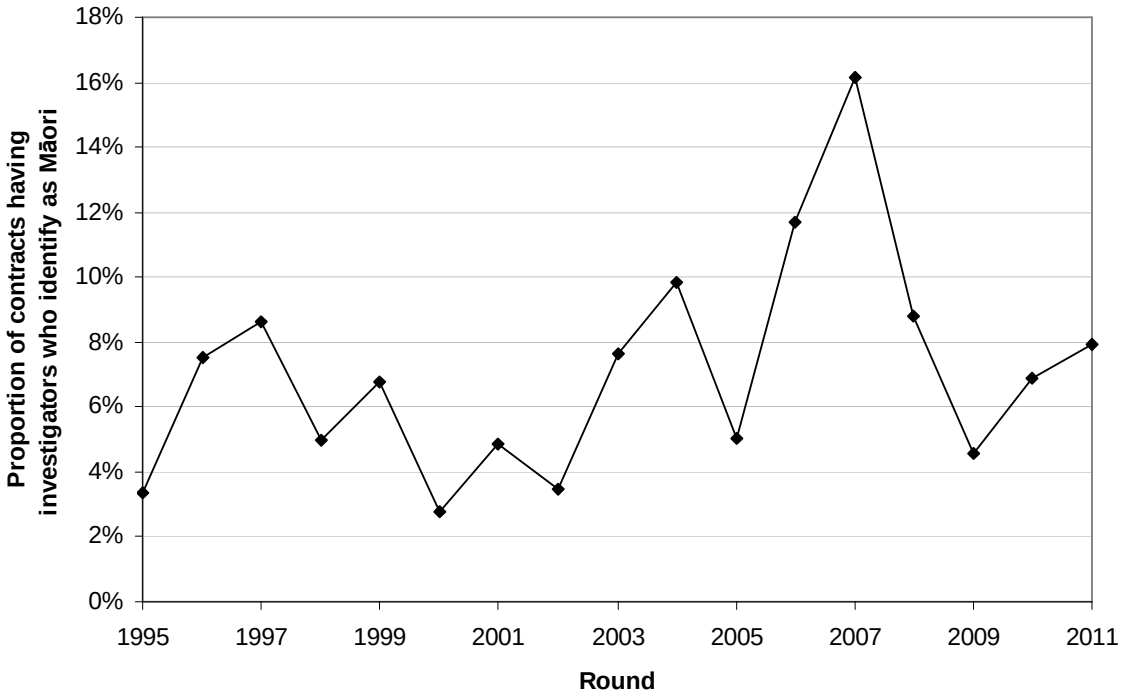
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	All
Preliminary	25.9%	29.9%	31.0%	30.1%	31.3%	32.7%	33.8%	34.2%	35.5%	35.7%	34.1%	32.4%
Contracts	27.8%	29.3%	30.2%	33.3%	38.0%	36.7%	37.7%	35.5%	30.8%	32.1%	31.4%	32.9%

As can be seen from Table 1.2, proposals to the Marsden Fund are awarded to female PI's at approximately the rate at which they apply (i.e., probability that yearly success rate is independent of PI-gender, χ^2 p~0.87).

[3] Of the respondents to the gender question in the "2008 Survey of New Zealand scientists and technologists", 28.8% were women, while data from the 2001 Census shows that, excluding computer science professionals, 27.5% of scientists are women. The corresponding figures for the 1996 survey was 22.8%, and the 1996 Census was 24.0%. Note not all scientists are researchers.

MĀORI RESEARCHERS

For contracts initiated throughout 2006–2011, Māori researchers were involved with 12 % of the projects as either a PI or an AI. Over the same period, the percentage of investigators who self-identify as Māori was 4.1 %. In the 2008 survey (referred to above), 1.7 % of scientists self-identified as Māori.



SUMMARY-PEOPLE SUPPORTED IN MARSDEN CONTRACTS

Table 2.1. Participation in Marsden grants.

Building human capacity	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10
Investigators – Number of separate individuals acting as principal[4] and/or associate[5] investigators on current contracts	769	791	923	896	924	942	943	964	1056	1123
Emerging and early career researchers – Percentage of PIs on contracts awarded in the funding round who have received their highest degree within the last 10 years	38%	38%	43%	48%	53%	44%	46%	42%	46%	38%
Postdoctoral fellows[6] – Percentage of Standard contracts in the year's funding round having FTE for postdoctoral fellows	48%	47%	45%	46%	51%	40%	41%	40%	36%	41%
Students[7] – Percentage of contracts in the year's funding round which support postgraduate students	55%	57%	56%	56%	58%	54%	53%	62%	62%	62%
Women – Percentage of PIs on contracts awarded in the funding round that are women	25%	22%	26%	26%	28%	30%	31%	24%	29%	25%
Māori – Percentage of PIs and AIs on contracts awarded in the funding round identifying as Māori	4.0%	1.3%	5.6%	4.1%	1.8%	4.6%	6.6%	4.4%	2.8%	3.0%

[4] PIs – Principal Investigators –researchers who lead the research, contribute the main ideas and are responsible, with their institution, for the achievements of the objectives and the management of the contract

[5] AIs – Associate Investigators – researchers who play a lesser role than principal investigators and sometimes are involved with only limited aspects of the work.

[6] Postdoctoral fellows – emerging researchers who have completed a Ph.D., usually within the last few years, and are employed on contract (often 2-3 years). They do much of the day-to-day work on the research programme, and are looking to gain experience to establish themselves as permanently employed researchers.

[7] Postgraduate students – researchers who are working on a Masters or Ph.D. thesis.

ENHANCING GLOBAL CONNECTEDNESS

The proportion of Marsden contracts that involve institutional collaborations continues to increase. Projects involving investigators from a single institution comprised 77 % of contracts in 1995, and now stands at 34 % in 2010 (see Figure A2.5). The bulk of contracted collaborations is of an international nature, while national linkages remain comparatively modest; i.e., for projects with contracted collaborations, typically, at least three quarters involve international investigators while in recent years only a third possessed national collaborations.

While approximately half of the contracts that were let over 2009 and 2010 involved overseas investigators at their onset, as is typical for Marsden-funded projects, additional collaborations were reported to have been developed throughout the course of the research. For the 153 projects with final reports received in 2009–2010, 52 % included overseas researchers at their inception; but the time they had finished, 85 % had reported, one or more, additional international collaborators.

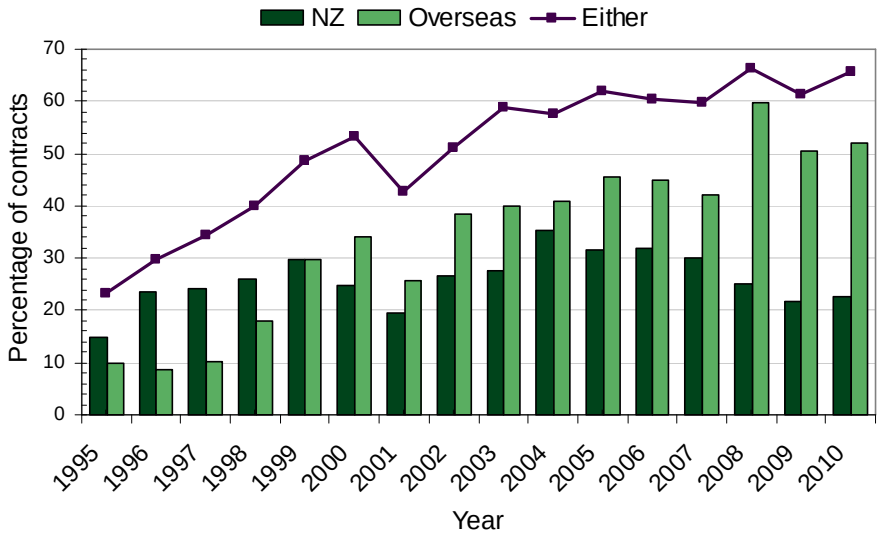


Figure A2.5. The percentage of projects for which a principal or associate investigator is from outside the contract's host institution, categorised according to whether the collaborations were national, international, and either.

Table 2.2. International collaboration and communication on Marsden grants.

International collaboration and communication	2004	2005	2006	2007	2008	2009	2010
Contracts awarded having investigators overseas	41%	48%	44%	43%	58%	51%	52%
Contracts completing in the year with international investigators	47%	36%	48%	40%	50%	52%	50%
Contracts completing in the year reporting additional international collaborations	89%	83%	92%	96%	92%	91%	94%

BUILDING NEW ZEALAND'S KNOWLEDGE BASE

RESEARCH PRODUCTIVITY AND DISSEMINATION

Table 2.3. Publications, patents and software reported as directly attributable to Marsden grants.*

Year of Publication	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	All Years
Papers	306	418	440	441	436	482	478	558	540	559	485	575	6267
Refereed Conference Proceedings	41	58	75	105	76	107	84	105	86	95	95	73	1077
Book Chapters	27	42	53	67	67	75	73	65	67	79	73	84	819
Books	2	3	10	10	16	11	13	11	11	16	15	17	139
Edited Volumes	3	2	10	10	6	13	8	13	8	9	13	7	104
Reports	22	12	15	7	16	9	14	7	8	7	19	14	183
Patents	4	1	3	5	4	4	5	3	3	3	1	2	39
Software				3	2	1	3	4	3	2	4	4	27
Total	405	536	606	648	623	702	678	766	726	770	705	776	8655

*either published or in press, and either wholly or partially attributed to the Marsden Fund. Represents a minimum estimate, as publications from previous years continue to be reported.

Figure A2.6. Count of the published output of the Fund (papers, refereed conference proceedings, books and book chapters), and output expressed as the ratio of published output to nominal Govt investment.

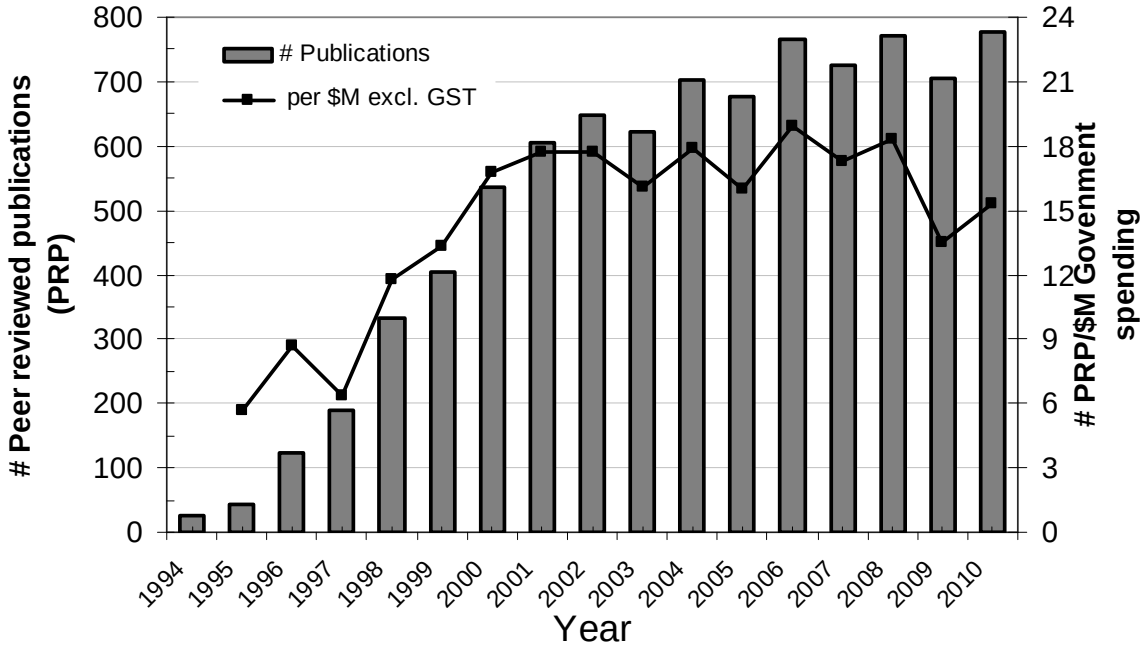


Table 2.4. Dissemination of Marsden results through conferences and other channels.

Year of Activity	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	All Years
Invited conference talk	63	96	109	128	175	214	229	208	235	224	216	303	2356
Contributed conference talk	248	313	410	286	319	286	329	299	439	318	354	359	4259
Conference poster	155	99	88	91	119	142	176	177	140	151	126	167	2003
Other†	11	28	36	45	58	89	102	88	117	87	116	130	953
Total	477	536	643	550	671	731	836	772	931	780	812	959	9571

†Types of other output include: articles in non-specialist journals, gene sequences deposited in public databases, reagents developed, documentaries, radio interviews, websites, online databases, CDs distributed, and editorials and letters in specialist journals.

BENEFITS TO NEW ZEALAND RESEARCH FROM MARSDEN-FUNDED INTERNATIONAL COLLABORATION

Using techniques, equipment or resources that are unavailable in New Zealand, often at no cost. Examples include:

- Professor Field (Oxford Bioinformatics Institute) gave assistance with bioinformatic techniques to analyse bacterial DNA derived from freshwater communities to Gavin Lear's team
- Assistant Prof. Ruedl's (Nanyang Technological University) provision of cell line critical to Franca Ronchese's research programme
- Professor Kessler's (Feinberg School of Medicine) supply of, and training Colin Green's team with the use of, nanofibre technology for spinal cord repair

Visiting overseas laboratories to learn new methods not available in New Zealand. Examples include:

- Richard Jones visit Rome to learn techniques with Professor Fabio Babiloni (IRCCS Santa Lucia Foundation) for estimating neural connectivity in the brain
- Tina Summerfield utilised microarray technology developed by Professor Sherman's lab (Purdue University) to examine gene expression changes under low oxygen conditions, and the role of a signalling kinase in this response.
- Mr Andrew Martin (then at the University of Tasmania) collaborated with Marti Anderson on the use newly developed methods of beta diversity to analyse variation in Antarctic microbial systems

Drawing on overseas researchers' knowledge by hosting conferences, workshops and individual visits. Examples include:

- UOO0510 PI Maria Stubbe co-organising of symposium on healthcare interaction with Dr Marisa Cordella (U. Melbourne) for the International Pragmatics Association Conference 2009
- MAU0804 PI Steffen Libbert's organisation of workshops on the microeconomics of organisational structure by Prof. Guido Friebel (Goethe University Frankfurt) and the economics of networks and coalition formation by Prof. Francis Bloch (Ecole Polytechnique).
- For a project growing Peter Davis's Marsden UOA0416, Prof. Klaus Troitzsch (U. Koblenz-Landau) was recruited to be a member of International Scientific Advisory Group for the MSI funded project 'A Modelling Tool to Improve the Policy Response on Issues Concerning Children and Young People'.

Hosting young researchers and students from overseas to build links for the future. Examples include:

- UOO308 PI Vernon Squire's team continues to work with Dr Alison Kohout (NERSC Norway), who gained her PhD with the project and continues as a Post-doc, while a former Post-Doc Malte Peter (now U. Augsburg) continues to collaborate with the team
- Training of four junior doctors from Fudan University (China) in laboratory and research techniques in UOA0713.

Leveraging Marsden funding with overseas funding. Examples include:

- MAU0607 PI Evelyn Sattlegger secured '2010-35 Sattlegger E, Auckland, New Zealand. Revealing regulators of the nutrient sensor Gcn2' from the Nutricia Research Foundation (The Netherlands)
- MAU0808 AI Alona Ben-Tal was one of six investigators named in '5R01NS069220-02 Multiscale Model Of Neural Control Of Breathing' granted by the National Institutes of Health (USA)
- UOO0605 Post-Doc Sam Lucas was awarded the Physiological Society's (United Kingdom) International Junior Research Grant to visit Liverpool John Moores University
- UOO0611 PI Keith Gordon was a named investigator in 'Porphyrin arrays - Light Harvesting in three dimensions', and UOO0915 PI Sian Halcrow was named in 'From Paddy to Pura: the origins of Angkor', both granted by the Austrailian Research Council (Australia)
- UOA0906 PI Mary Sewell named in '#1026358 US-NZ Dissertation Enhancement: Biochemical consequences of ocean acidification on larval development in a temperate sea urchin' pursuing research in the award '#0944201 Effect of Ocean Acidification on Early Life History Stages of the Antarctic Sea Urchins Sterechinus Neumayeri' from the National Science Foundation (USA)
- UOO0712 PI Tony Poole funded by the Wellcome Trust (United Kingdom) Research Grant, 'The chondrocyte primary cilium - a purinergic mechanoreceptor ?'

- In addition, another eight Marsden researchers have indicated that they are currently in the process of pursuing international funding with their collaborators

Influencing overseas institutions by providing expert advice. Examples include:

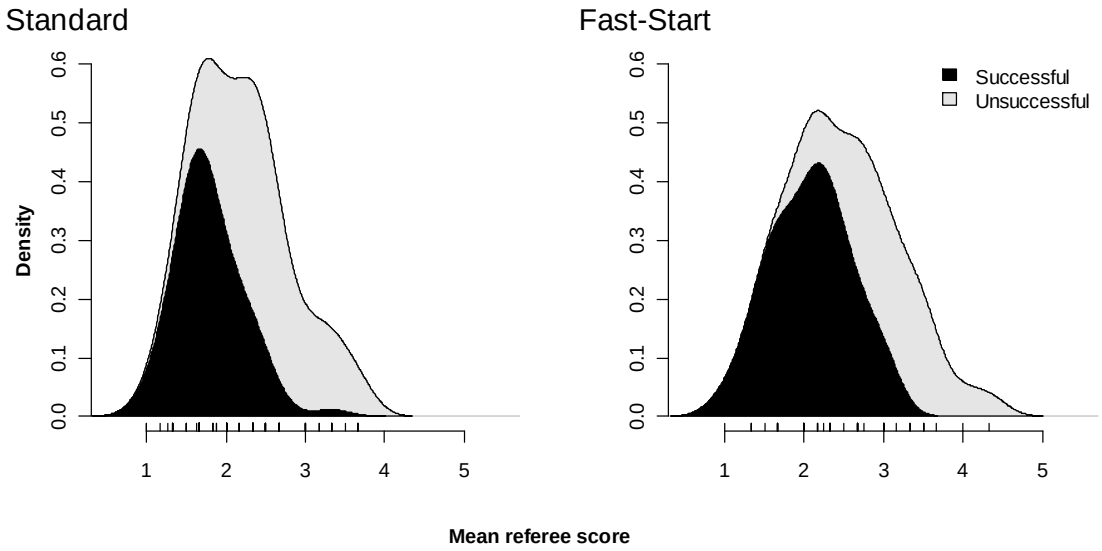
- ESR0601 PI Gerald Midgley's membership in the International Advisory Board, Initiative for Studying and Implementing Systems (Canada)
- UOO0510 AI Tony Dowell appointment to the 2010 Panel of the International Classification of Disease Revision (ICD11) World Health Organisation.
- VUW0903 PI Tim Naish's appointment as a Lead Author to the IPCC 5th Assessment Report
- UOC0812 PI Philip McCann appointment as a Special Adviser to Johannes Hahn, the European Commissioner for Regional Policy

In addition, Marsden researchers report that they were appointed to editorial positions on a total of 26 international journals over 2010-2011.

RESEARCH QUALITY

The quality of Marsden-funded research is ensured by rigorous selection procedures, including peer review of all proposals that proceed to the second stage of the evaluation process. The following figures show that projects receiving funding are typically judged as being excellent–outstanding by their, predominantly, international reviewers.

2009 Round:



2010: round:

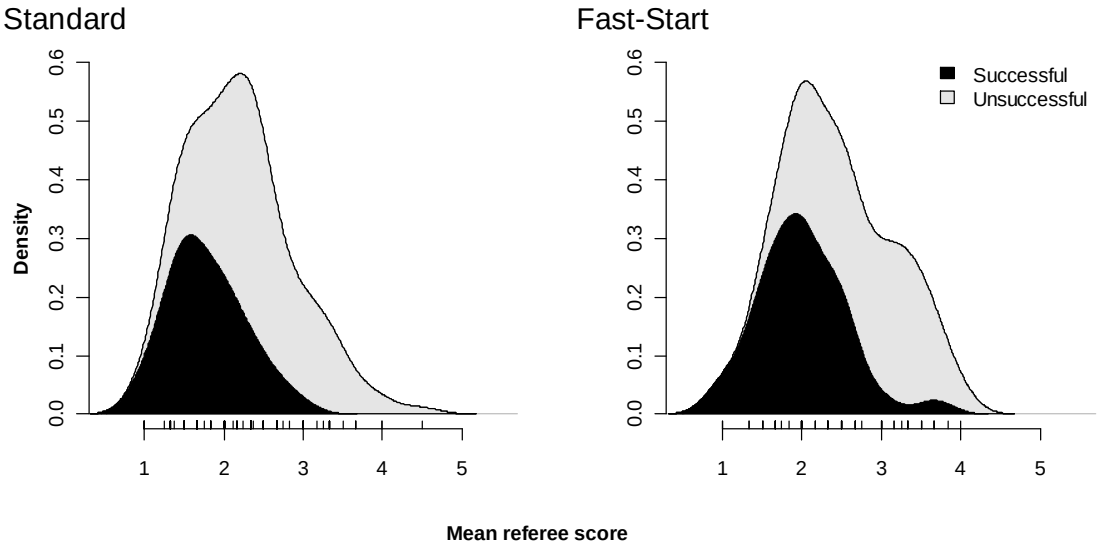


Figure A2.7. The estimated distributions of the average referee score received for both funded and unfunded proposals to the 2009 and 2010 funding rounds[8].

[8] Scores equate to: 1 = "Outstanding – among the top 5% of proposals worldwide"; 2 = "Excellent – among the top 10% of proposals worldwide"; 3 = "well above average, top 20%"; 4 = "above average"; and 5 = "average or below average".

Referee scores for both standard and Fast-Start applications range between one and five. Mean referee scores for each round typically reveal three three populations of proposal-type with means centred on: "Excellent" to "Outstanding"; "Well above average"–"Excellent"; and, "Above average" to "Well above average". The vast majority of successful Standard and Fast-Start proposals come from this highest ranked, "Excellent" to "Outstanding", population. As can be seen from these charts, there are many proposals judged as excellent–outstanding but which are unsuccessful due to funding limitation.

Measures of research excellence for contracts active in the 2009-10 years are as follows:

Papers reported as attributable to Marsden contracts over 2009-2010 continue to be published in the world's most prestigious journals. Table A2.7 lists examples of Marsden-supported research appearing within the top-100 journals (as ranked by their 2010 Journal Impact Factor).

Of the 15 holders of the prestigious James Cook Research Fellowship over 2009–2010, 14 have been principal investigators on Marsden contracts.

Numerous prizes and awards to Marsden researchers, a selection of which are listed in Table A2.8.

Table A2.7: A selection of papers of note, published in 2009 and 2010:

- Beaumont, H.J.E., Gallie, J., Kost, C., Ferguson, G.C. & Rainey, P.B. Experimental evolution of bet hedging. Nature 462, 90-93 (2009). [UOA310]
- Currie, T.E., Greenhill, S.J., Gray, R.D., Hasegawa, T. & Mace, R. Rise and fall of political complexity in island South-East Asia and the Pacific. Nature 467, 801-804 (2010). [UOA0709]
- Naish, T. et al. Obliquity-paced Pliocene West Antarctic ice sheet oscillations. Nature 458, 322-328 (2009). [GNS0401]
- Zapka, M. et al. Visual but not trigeminal mediation of magnetic compass information in a migratory bird. Nature 461, 1274-1277 (2009). [UOA128]
- Gray, R.D., Drummond, A.J. & Greenhill, S.J. Language Phylogenies Reveal Expansion Pulses and Pauses in Pacific Settlement. Science 323, 479-483 (2009). [UOA0709]
- Paulot, F. et al. Unexpected Epoxide Formation in the Gas-Phase Photooxidation of Isoprene. Science 325, 730-733 (2009). [UOO0706]
- Schaefer, J.M. et al. High-Frequency Holocene Glacier Fluctuations in New Zealand Differ from the Northern Signature. Science 324, 622-625 (2009). [VUW0611]
- Tylianakis, J.M. ECOLOGY: Warming Up Food Webs. Science 323, 1300-1301 (2009). [UOC0705]
- Collins, L.J. & Penny, D. The RNA infrastructure: dark matter of the eukaryotic cell? Trends in Genetics 25, 120-128 (2009). [MAU303]
- Jeyifous, O. et al. SAP97 and CASK mediate sorting of NMDA receptors through a previously unknown secretory pathway. Nature Neuroscience 12, 1011-1019 (2009). [UOA0512]
- Browning, B.L. & Yu, Z. Simultaneous Genotype Calling and Haplotype Phasing Improves Genotype Accuracy and Reduces False-Positive Associations for Genome-wide Association Studies. The American Journal of Human Genetics 85, 847-861 (2009). [UOA0803]
- Browning, S.R. & Browning, B.L. High-Resolution Detection of Identity by Descent in Unrelated Individuals. The American Journal of Human Genetics 86, 526-539 (2010). [UOA0715]
- Cary, S.C., McDonald, I.R., Barrett, J.E. & Cowan, D.A. On the rocks: the microbiology of Antarctic Dry Valley soils. Nature Reviews Microbiology 8, 129-138 (2010). [UOW0802]
- Baddeley, D. et al. Optical single-channel resolution imaging of the ryanodine receptor distribution in rat cardiac myocytes. Proceedings of the National Academy of Sciences 106, 22275-22280 (2009). [UOA0806]

- Bunce, M. et al. The evolutionary history of the extinct ratite moa and New Zealand Neogene paleogeography. Proceedings of the National Academy of Sciences 106, 20646-20651 (2009). [PAL0601]

- Cross, F.R., Jackson, R.R. & Pollard, S.D. How blood-derived odor influences mate-choice decisions by a mosquito-eating predator. Proceedings of the National Academy of Sciences 106, 19416-19419 (2009). [UOC0507]

- Fong, S.W. et al. TGF-β2 alters the characteristics of the neuromuscular junction by regulating presynaptic quantal size. Proceedings of the National Academy of Sciences 107, 13515-13519 (2010). [UOO0607]

- Fraser, C.I., Nikula, R., Spencer, H.G. & Waters, J.M. From the Cover: Kelp genes reveal effects of subantarctic sea ice during the Last Glacial Maximum. Proceedings of the National Academy of Sciences 106, 3249-3253 (2009). [UOO0709]

- Heyers, D., Zapka, M., Hoffmeister, M., Wild, J.M. & Mouritsen, H. Magnetic field changes activate the trigeminal brainstem complex in a migratory bird. Proceedings of the National Academy of Sciences 107, 9394-9399 (2010). [UOA128]

- Kang, H.J., Paterson, N.G., Gaspar, A.H., Ton-That, H. & Baker, E.N. The Corynebacterium diphtheriae shaft pilin SpaA is built of tandem Ig-like modules with stabilizing isopeptide and disulfide bonds. Proceedings of the National Academy of Sciences 106, 16967-16971 (2009). [UOA0812]

- McWethy, D.B. et al. From the Cover: Rapid landscape transformation in South Island, New Zealand, following initial Polynesian settlement. Proceedings of the National Academy of Sciences 107, 21343-21348 (2010). [LCR0501]

- Nesse, R.M. et al. Colloquium Paper: Making evolutionary biology a basic science for medicine. Proceedings of the National Academy of Sciences 107, 1800-1807 (2009). [UOA0606]

- Vergoz, V. et al. Peripheral modulation of worker bee responses to queen mandibular pheromone. Proceedings of the National Academy of Sciences 106, 20930-20935 (2009). [UOO0615]

- Wang, P.-Y. et al. Müllerian inhibiting substance contributes to sex-linked biases in the brain and behavior. Proceedings of the National Academy of Sciences 106, 7203-7208 (2009). [UOO0607]

- Table A2.8. A selection of the awards and prizes recorded for the contracts reviewed in 2006/07 through 2008/09

Researcher	Contract	Distinction awarded
Dr H Tregidga	AUT0901	AUT Vice Chancellor's Emerging Researcher Excellence Award
Dr AR Pitman	CRO0601	2010 Chairman's Award, New Zealand Institute for Plant and Food Research
Professor JL Tallon	IRL0501	Prime Minister's Science Prize
Professor JL Tallon	IRL0601	Companion of the New Zealand Order of Merit
Associate Professor RD Tilley	IRL0602	Easterfield Medal from the New Zealand Institute of Chemistry
Professor SC Hendy	IRL0602	New Zealand Association of Scientists Research Medal
Professor SC Hendy	IRL0802	Massey University Distinguished Young Alumnae Award
Dr GVM Williams	IRL0901	Hector Medal
Dr JM Wilmshurst	LCR0501	Landcare Research 2009 Science Excellence Award
Dr MS McGlone	LCR0501	Fellow of the Royal Society of New Zealand
Dr TR Buckley	LCR0502	New Zealand Association of Scientists Research Medal
Professor PB Rainey	MAU0513	Fellow of the Royal Society of New Zealand
Professor PB Rainey	MAU0513	James Cook Research Fellowship
Professor PB Rainey	MAU0513	Fellow of the Royal Society of New Zealand
Professor PA Schwerdtfeger	MAU0606	2009 Massey University College of Science Research Award
Dr E Sattlegger	MAU0607	Massey University Women's Award
Professor DB Scott	MAU0701	Fellow of the Royal Society of New Zealand
Professor PA Schwerdtfeger	MAU0703	2010 Fukui Medal
Professor PA Schwerdtfeger	MAU0703	2010 Humboldt Research Prize
Dr VV Filichev	MAU0704	Massey University Early Research Career Medal 2008
Professor PJ Lockhart	MAU0709	James Cook Fellowship
Professor GJ Martin	MAU0711	Hector Medal 2008
Dr WM Patrick	MAU0801	NZBIO Young Biotechnologist of the Year
Dr S Lippert	MAU0804	Emerging Researcher of the Year Award
Professor PH Gander	MAU0805	Fellow of the Royal Society of New Zealand
Dr TL Signal	MAU0805	Massey University Research Medal - Early Career
Professor VV Flambaum	MAU0806	2009 Boas Medal
Professor VV Flambaum	MAU0806	2009 Lyle medal
Professor VV Flambaum	MAU0806	Fellow of the American Physical Society 2010
Dr WM Patrick	MAU0902	Massey University Research Medal - Early Career
Associate Professor SR Marsland	MAU0908	NZMS Early Career Award for Mathematical Sciences
Professor U Zuelicke	MAU0910	Fellow of the New Zealand Institute of Physics
Associate Professor AJ Drummond	UOA0502	Hamilton Memorial Prize 2007

Researcher	Contract	Distinction awarded
Dr ME Hauber	UOA0503	2007 Early Career Research Excellence Award
Professor PJ Donaldson	UOA0504	Physiological Society of New Zealand Triennial Medal for Excellence in Physiological Research
Professor MA Brimble	UOA0508	L'Oreal-UNESCO Women in Science Asia-Pacific Laureate in Materials Science 2007
Professor MA Brimble	UOA0508	World Class New Zealand Award, in Research, Science, Technology & Academia 2008
Dr NI Lewis	UOA0601	Appointment to He Waka Tangata
Associate Professor KA Campbell	UOA0604	Hochstetter Lecturer 2009
Professor MA Brimble	UOA0705	Royal Society of Chemistry UK Natural Products Chemistry Award 2010
Professor RD Gray	UOA0709	Fellow of the Royal Society of New Zealand
Professor NH Perry	UOA0807	Fellow of the Royal Society of New Zealand
Dr S Guindon	UOA0808	Early Career Research Award
Associate Professor AJ Drummond	UOA0809	Rutherford Discovery Fellowship
Professor EN Baker	UOA0812	Leach Medal 35th Lorne Conference on Protein Structure and Function
Dr A Nies	UOA0817	Fellow of the Royal Society of NZ 2010
Dr A Nies	UOA0817	Research Award of the New Zealand Mathematical Society 2009
Dr AJR Hickey	UOA0820	University of Auckland Early Career Excellence Award
Professor W Gao	UOA0923	Distinguished Materials Scientist China
Professor MM Roche	UOA0924	Distinguished New Zealand Geographer Medal
Professor GJ Irwin	UOA313	Fellow of the New Zealand Academy of the Humanities 2009
Professor DS Bridges	UOC0502	College of Engineering Research Award 2009
Professor JW Cole	UOC0508	IAEM Academic Recognition Award 2008
Professor MH Turnbull	UOC0601	Roger Slack Medal 2009
Professor MA Steel	UOC0603	College of Engineering Research Award 2008.
Professor MA Steel	UOC0603	James Cook Fellowship 2010-2011
Professor RJ Reeves	UOC0604	T.K. Sidey Medal 2007
Professor A Cockburn	UOC0707	2009 Chris Wallace Award for Outstanding Computer Science Research Contribution 2005-2007
Dr JM Tylianakis	UOC0802	Rutherford Discovery Fellowship
Dr R Menon	UOC0806	ICO Prize 2009
Professor P McCann	UOC0812	ERSA 50th Anniversary Award for outstanding research at the European Regional Science Association Congress 2010
Professor CA Semple	UOC0906	New Zealand Mathematical Society Research Award 2010
Dr BC McNeill	UOC0914	College of Education Emerging Researcher of the Year 2010
Professor J Bercovitch	UOC308	University of Canterbury Research Medal 2006
Dr SM Hughes	UOO0412	Illumina Emerging Researcher Award, Queenstown Molecular Biology Meeting 2009
Professor GW Tannock	UOO0617	Otago School of Medical Sciences Distinguished Researcher 2009
Professor AE Herbison	UOO0703	Liley Medal

Researcher	Contract	Distinction awarded
Dr AC Wanhalla	UOO0705	Rowheath Trust Award
Dr AC Wanhalla	UOO0705	Carl Smith Medal
Dr AC Wanhalla	UOO0705	University of Otago Early Career Award for Distinction in Research 2009
Professor HG Kjaergaard	UOO0706	New Zealand Institute of Chemistry Maurice Wilkins Centre Prize for Excellence in Chemical Research 2008
Dr JR Lane	UOO0706	University of Waikato Young Staff Research Award 2010
Professor RK Walter	UOO0711	Percy Smith Medal
Associate Professor CA Poole	UOO0712	James CookFellowship 2011-2013
Dr JA Horsfield	UOO0713	Dunedin School of Medicine Research Development Strategy Award
Professor WP Tate	UOO0714	Rutherford Medal
Dr RA Zajac	UOO0715	Association for Psychological Science "International Rising Star"
Professor WC Abraham	UOO0802	University of Otago Distinguished Research Medal
Associate Professor CL Day	UOO0810	Otago Schoool of Medical Sciences Distinguished Researcher Award 2010
Professor SA Brooker	UOO0813	New Zealand Institute of Chemistry Maurice Wilkins Centre Prize for Excellence in Chemical Research 2009
Professor H Moller	UOO0820	Conservation in Action Award 2009
Professor SP Robertson	UOO0901	Liley Medal
Associate Professor JNJ Reynolds	UOO0904	Rutherford Discovery Fellowship
Dr M Berney	UOO0909	Swiss Society of Microbiology Encouragement Award 2010
Dr SC Marshall	UOO0921	University of Otago Early Career Research Award
Associate Professor RJ Krauzlis	UOW0603	Salk Institute Innovation Award
Associate Professor RJ Krauzlis	UOW0603	McKnight Technological Innovation Award
Professor IH Witten	UOW0604	World Class NZ Award in Research, Science, Technology and Academia
Professor GP Whittle	VUW0502	VUW Research Excellence Award
Professor M Visser	VUW0606	Fellow of the American Physical Society 2009
Dr EC Le Ru	VUW0607	Rutherford Discovery Fellowship
Associate Professor KM McGrath	VUW0608	New Zealand Association of Scientists Research Medal 2007
Professor PT Callaghan	VUW0608	James Cook Fellowship
Professor PT Callaghan	VUW0608	KEA/NZTE World Class New Zealander Award 2007
Professor PT Callaghan	VUW0608	Blake Medal 2007
Professor PT Callaghan	VUW0608	Knight Grand Companion, NZ Order of Merit 2009
Professor K Sterelny	VUW0701	Jean Nicod Prize for Cognitive Science
Dr T Bridgman	VUW0708	Early Career Research Award 2008
Professor RG Downey	VUW0710	Fellow of the Association for Computing Machinery
Professor RG Downey	VUW0710	VUW Award for Research Excellence

Researcher	Contract	Distinction awarded
Dr N Greenberg	VUW0711	Hamilton Prize
Professor TA Stern	VUW0713	James Cook Fellowship 2010-12
Associate Professor PJ Lester	VUW0718	Fulbright Senior Scholar Award.
Associate Professor PJ Lester	VUW0718	Victoria University Research Excellence Award.
Professor KP McNatty	VUW0801	Pickering Medal 2009
Professor KP McNatty	VUW0801	Shorland Medal
Dr MP Gerrie	VUW0802	Winner of "Science in Our Society" category at 2009 MacDiarmid Young Scientists of the Year Awards
Professor S Schenk	VUW0803	James Cook Fellowship
Associate Professor M Zhang	VUW0806	Senior Member of IEEE
Professor RS Hill	VUW0812	Research Excellence Award
Professor CJN Wilson	VUW0813	Hutton Medal
Professor TR Naish	VUW0903	New Zealand Antarctic Medal 2010
Professor TR Naish	VUW0903	Appointed Lead author to IPCC 5th Assessment Report
Dr SD Behrendt	VUW0910	Victoria University Research Excellence Award 2010
Dr N Greenberg	VUW0912	Rutherford Discovery Fellowship