

## House of Representatives Standing Committee on Industry, Science and Innovation

### Review of the research training and research workforce issues in Australian universities

#### Submission from James Cook University

James Cook University makes the following recommendations in addition to strongly supporting the recommendations made by the Australian Council of Deans and Directors of Graduate Studies as listed below.

#### Recommendations made by James Cook University:

*JCU Recommendation 1:*

**That a National Priority Postgraduate Research Scholarship Scheme is introduced to provide attractive and competitive stipends to attract outstanding students:**

- (1) in areas of national significance in which there is an emerging skills gap e.g. Engineering, Earth Sciences, the enabling sciences, Quantitative Marine Science, Indigenous Health.**
- (2) from minority groups which are under-represented in research training e.g. Indigenous Australians.**

*JCU Recommendation 2:*

**That the Australian government work with the States to ensure that all international research students enrolled at Australian universities do not have to pay fees for their children attending government schools in order to increase Australia's competitiveness as international research training destination.**

*JCU Recommendation 3:*

**That all collaborative research centres receiving funding from the Australian government (CRCs, ARC Centres of Excellence, CERFs etc) be required to dedicate a specified percentage (e.g. 10%) of their funding to research training in order to increase the opportunities for research students to be trained in Mode II research environments.**

*JCU Recommendation 4:*

**That the number of ARC postdoctoral fellowships be doubled to address the burgeoning academic and research skills shortage in Australia, and the increased challenge of universities attracting appropriately qualified staff and that universities be encouraged to co-invest in such fellowships to provide fellows with the opportunities to gain academic teaching experience**

*JCU Recommendation 5:*

**That Research Training Practice is included in the program priorities for research funded by the Australian Teaching and Learning Council.**

**Recommendations made by the Australian Council of Deans and Directors of Graduate Studies (DDOGS) and supported by JCU:**

*DDOGS Recommendation 1:*

**That the number of RTS places available to Australian universities be increased.**

*DDOGS Recommendation 2:*

**That the full cost of each HDR program is funded and the somewhat arbitrary high cost/low cost divide abolished.**

*DDOGS Recommendation 3:*

**That the RTS scheme funding formula be modified to allow the splitting of HDR completions between Australian universities in order to recognise joint provision of PhDs.**

*DDOGS Recommendation 4:*

**That APA stipends be increased by at least 30% per annum, tax free and are appropriately indexed in future.**

*DDOGS Recommendation 5:*

**That the length of APA funding be increased to 3.5 years with a six month optional extension.**

*DDOGS Recommendation 6:*

**That the number of IPRS awards be increased to reflect the growth in the international student cohort and that each award fully fund the fees payable by the student.**

*DDOGS Recommendation 7:*

**That the suite of Endeavour Scholarship Programs be reviewed to improve the accessibility and international competitiveness of the scheme.**

*DDOGS Recommendation 8:*

**That the suite of government funded programs which provide support for industry links for PhD students be reviewed.**

*DDOGS Recommendation 9:*

**That the government support an active research agenda to inform quality improvement in HDR programs and outcomes.**

## **JCU as a research training institution**

James Cook University (JCU) is Australia's national university for the tropics and amongst the top five tropical universities of the world for research in the University's areas of research excellence (viz. ecology/environment, plant and animal science, geosciences, coral reef science and tourism). JCU is ranked in the top 500 universities in the World by The Shanghai Jiao Tong University Academic Ranking of World Universities 2007 and is a member of the consortium of Innovative Research Universities Australia. The University's tropical focus underpins its research mission, which has two complementary themes reflecting the University's tropical and regional location. Thus at JCU research and research training is concentrated on issues of global significance to industries and communities in the tropics. This focus is complemented by a commitment to the delivery of research benefits to the northern Queensland community.

JCU is committed to the principle of concentrating research training in its areas of research strength, but also recognises its regional responsibility to support research training in a range of disciplines. Our regional mandate requires us to meet the education and research needs of northern Queensland, one of Australia's largest regional communities, a process that requires us to attract and retain high quality staff in a wide range of disciplines. A major challenge is to achieve an appropriate balance between research training concentration and diversity.

JCU currently has an enrolment of 768 research students, 30 % of whom are international students. Research students represent 5.5% of JCU's total student enrolments.

JCU provides direct funding to Faculties and Schools for research training based on research performance. In addition, JCU has invested in the following central structures and resources to ensure that research training is of high quality across the University:

- A Graduate Research School which ensures that the policies and procedures for admission, monitoring of progress, and examination are consistent across all faculties.
- A centrally administered system of milestones including a formal Confirmation of Candidature, an Annual Report and a Pre-Completion Seminar.
- A centralised competitive system for awarding government and university stipend scholarships based on the academic and research record of the prospective students and the research and research training record of the supervisory team.
- A Research Skills Program of free seminars and workshops.
- An International Bridging Program that provides mandatory specialist support to international students.
- Supervisor registration and training.
- A policy on the minimum standard of resources, facilities and other support to be provided for various categories of research student.
- A Graduate Student Centre on the Cairns Campus.
- A scheme of competitive grants for research students.
- A competitive International Travel Award Scheme.
- Fee Subsidy Scholarships for International Students who win competitive stipend scholarships.

JCU has made these investments in research training at a level which far exceeds the income we receive from the Research Training Scheme (RTS) and international research student fees in recognition of the importance of research training to our national and knowledge economies. We are keenly conscious of the contributions made by higher degree by research students to innovation, new knowledge and Australia's productivity and competitiveness.

## **Research Training Contributions to the Global Knowledge Economy**

JCU recognises that to participate strongly in the global knowledge economy, Australia needs to develop outstanding innovation and knowledge workers, both within and beyond the academy. Research training programs not only create the next generation of researchers and knowledge workers but also significantly contribute to the national research effort. If Australia is to be competitive in an increasingly global market for research talent, there are a number of problems with our current system of research training that need urgent attention as outlined below in the context of the terms of reference of this review.

## The Research Training Scheme

JCU responded positively to the introduction of the RTS in 2000 and many of the central programs summarised above were introduced in response to the scheme. As funding within JCU broadly reflects the RTS funding drivers, there is close alignment between research training and areas of research competitiveness, encouraging nodes of research and research training excellence. Inclusion of international student completions in the funding formula has enabled JCU to capitalise on its tropical location and invest in international students who are attracted to JCU because of the university's research reputation and the opportunity to study problems of relevance to their home countries in Asia and the Pacific.

However, JCU is concerned that the total pool of the RTS funding has not kept pace proportionately to the increase in enrolments and completions across Australia. We are also concerned that Australia lags other OECD countries in terms of the numbers of PhDs per head of population. In 2001, there were 5.9 doctoral holders in Australia per thousand people aged 25-64 which is below the corresponding numbers for Canada (6.5), Germany (15.4), Switzerland (23.0) and the USA (8.4)<sup>1</sup>. The data from the 2006 Australian census indicate that the proportion of doctoral holders has risen slightly to 6.8 per thousand people aged 25-64, a proportion which is still below the earlier figures for most of our competitors (who have presumably also improved). The proportion of doctoral holders is much lower for the North, Far North, North Western and Mackay Statistical Divisions in Queensland where the rate per thousand is 3.5, confirming the importance of JCU's need to invest in doctoral education as part of its responsibility to its region.

JCU is also concerned that RTS funding falls well short of the full cost per student of delivering HDR programs, both at the high band and the low band levels. For example, the RTS return for high band students is approximately \$28,000 per EFTSL. If the student is on a university scholarship and undertaking a project in a laboratory based science their stipend and project costs alone are at least \$32,000 per year. Costs of university staff time and infrastructure are additional to this investment. In addition, many students have unpaid external supervisors on their supervisory committee, a hidden and unmet cost of delivery. Thus it is virtually impossible to train a research student in the sciences without external funding for the research project. The challenge of meeting such costs is illustrated by the national success rate in the ARC Discovery Scheme, which is only ~20%. Thus even very good researchers sometimes miss out on expected funding forcing the university to meet the shortfall in the project costs of their research students (who cannot put their career on hold waiting for the next funding round). The challenge for universities in funding the costs of research students in emerging areas is even greater because the RTS Scheme effectively pays the university in arrears after a student graduates.

Thus JCU agrees with the DDOGS that a significant increase in RTS funding is required to address this significant funding shortfall. The current system of partial RTS funding with subsidy coming from undergraduate and graduate coursework activities is not sustainable. Funding for research training should meet real costs and be internationally competitive.

Thus JCU strongly supports the DDOGS Recommendations 1 and 2.

*DDOGS Recommendation 1:*

**That the number of RTS places available to Australian universities be increased.**

*DDOGS Recommendation 2:*

**That the full cost of each HDR program is funded and the somewhat arbitrary high cost/low cost divide abolished.**

PhD mobility between institutions, nationally and internationally improves the breadth and quality of research training and the possibilities for employment and collaboration after completion. This issue is of particular importance for remote institutions such as JCU with a regional mandate to meet the education and research needs of northern Queensland. Our research students need to be able to interact with the wider community of Australian scholars particularly in disciplines outside our areas

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<sup>1</sup> Auriol,L. (2007) Labour Market characteristics and international mobility of doctoral holders: results for seven countries, DSTI/DOC(2007)2,OECD

of research focus which we need to support to fulfil JCU's regional mandate. Conversely, research students from other Australian Universities often want to conduct their fieldwork from JCU to take advantage of our unparalleled access to environments of international significance such as the Great Barrier Reef and the Wet Tropics Rainforests. Joint PhD programs are gaining profile and relevance internationally and JCU has students enrolled in conjoint PhD degrees with institutions in several countries. However, nationally the RTS does not credit completion to more than one university. There is therefore a strong disincentive to cross institutional co-supervision, a hindrance to national mobility and broadening of the Australian PhD experience. JCU has raised this issue with officers from the Australian Government Department of Education, Employment and Workplace Relations on several occasions. These officers have invariably given in principle agreement to the concept of shared completions but seem unable to effect the required operational changes to their computer systems.

Thus JCU strongly supports the DDOGS Recommendation 3.

***DDOGS Recommendation 3:***

**That the RTS scheme funding formula be modified to allow the splitting of HDR completions between pairs of Australian universities in order to recognise joint provision of PhDs.**

## Scholarships

JCU considers that current Australian HDR scholarships are inadequate both in value and duration. At around \$20,000 per annum tax free, the value of PhD stipends paid under the scheme is insufficient to meet the living expenses of students, let alone to be attractive to outstanding students in an era of high employment, particularly in disciplines such as engineering and earth sciences, that are central to the present resources boom in Queensland and Western Australia. Ryland, 2008<sup>2</sup> reports that sixty-six percent of research students he surveyed worked at least two hours a week whilst studying, including fifty-eight percent of students who were on scholarships. The Council for Australian Postgraduate Associations (CAPA) has reported that the stipend rate for APAs will slip below the poverty line by the end of 2008<sup>3</sup>. A significant increase is required as well as an indexation process to maintain parity for the future.

Thus JCU strongly endorses the DDOGS Recommendation 4:

***DDOGS Recommendation 4:***

**That APA stipends are increased by at least 30% per annum, tax free and are appropriately indexed in future.**

Australia is not keeping pace with other OECD countries in regard to research training output. The Group of Eight reports that Australia is producing only 2.3 doctorates per 100 university graduates compared with 3.9 in Canada, 10.1 in Switzerland and 11.2 in Germany. The Go8 reports that there has been a 29% decline in HDR domestic commencements since 1995 - from 8298 to 5885 in 2006, with particular shortfalls in students commencing PhDs in earth sciences, environmental studies, mining-related engineering, accounting, banking and finance<sup>4</sup>, all areas of high relevance to the resources boom.

As well as the inadequate levels of support available for candidates, the current Australian employment market and availability of high salaries for commencing graduates, exacerbates the challenges in attracting quality candidates. In Australia, employment in scientific and engineering professions is growing more than twice as fast as the workforce as a whole<sup>5</sup>. In Queensland, employment in these professions is at 1.3 times the national rate and the percentage of domestic science and engineering graduates is falling.

<sup>2</sup> Ryland, K. 2008. *Further analysis of the result of the ARC Linkage project: Reconceptualising the Australian doctoral experience*, In Zammit, F: Personal Communication.

<sup>3</sup> CAPA Media Release: APAs to Break Poverty Line. April 30 2008.

<sup>4</sup> Go8 Backgrounder – Researcher Supply and Demand - no 3, November 2007.

<sup>5</sup> Professor Peter Andrews, Queensland Chief Scientist webpage <http://www.dtrdi.qld.gov.au/dsdweb/v3/>

Queensland Chief Scientist Peter Andrews estimated a short-fall of 75,000 PhDs in the enabling sciences by 2010 a few years ago<sup>6</sup>. His web page states that world-wide demand for people with science, engineering and technology (SET) skills has grown substantially and he notes that the United States has already called for an additional 2.2 million scientists and engineers and the European Union has projected the need for an additional 700,000, despite the fact that the proportion of PhD-qualified engineers and scientists in the EU is already much higher than in Australia. e.g. in the EU 14% of new doctorates graduated in engineering in 2004<sup>7</sup>.

Undergraduate enrolments in enabling disciplines (especially science) have been steadily declining for a number of years, creating a supply problem for research candidature. JCU believes that further incentives are required to attract outstanding research students, in particular (1) in areas of national significance in which there is an emerging skills gap (e.g. Engineering, Earth Sciences, the enabling sciences, Quantitative Marine Science, and Indigenous Health), and (2) from minority groups who are underrepresented in research training (e.g. Indigenous Australians who can attract high salaries external to the academy and typically have family commitments at a younger age than the wider community).

Our experience suggests that potential students in these categories will require a stipend which is significantly above the APA rate recommended by the DDOGS (see DDOGS Recommendation 4 above). We therefore recommend that a National Priority Postgraduate Research Scholarship Scheme be introduced to provide attractive and competitive stipends to attract outstanding students in areas of national significance and from minority groups. We suggest that the operational arrangements for such a scheme be developed after wide consultation to ensure that it is attractive to the target groups.

*JCU Recommendation 1:*

**That a National Priority Postgraduate Research Scholarship Scheme be introduced to provide attractive and competitive stipends to attract outstanding students:**

- (1) in areas of national significance in which there is an emerging skills gap e.g. Engineering, Earth Sciences, the enabling sciences, Quantitative Marine Science, Indigenous Health.**
- (2) from minority groups which are under-represented in research training e.g. Indigenous Australians.**

The current average completion time for an Australian PhD is over 3.5 years and scholarship funding is not aligned with the RTS scheme. JCU shares the view of the DDOGS and the Council of Australian Postgraduate Associations that stipend funding should cover the full candidature time supported by the RTS. At three years, with a possible extension of six months, the duration of the APAs is generally considered too short to allow for a reasonable completion time, particularly if coursework and enrichment (breadth) components are included as expected in modern PhDs and encouraged by the RTS.

Western et al.'s study<sup>8</sup> reported that research graduates felt able to work at the frontiers of their disciplines and were able to contribute to scholarship and research but were less convinced that they had acquired the team based and other generic skills relevant to their careers during their research training. JCU provides these skills through its Research Skills Program but a worryingly high proportion of talented hard-working students fail to complete their PhD in the period for which they have stipend scholarship support. Too many such students are forced to seek employment before completing their thesis, a practice which invariably delays and sometimes prevents successful completion of their PhD.

Thus JCU endorses the DDOGS Recommendation 5.

*DDOGS Recommendation 5:*

**That the length of APA funding be increased to 3.5 years with a six month optional extension.**

<sup>6</sup> Professor Peter Andrews, Queensland Chief Scientist webpage <http://www.dtrdi.qld.gov.au/dsdweb/v3/>

<sup>7</sup> Meri, T. Statistics in Focus. Science and Technology. Eurostat 131/2007

<sup>8</sup> Western et al. , (2007) Survey of Graduate's Employment Outcomes - 5 to 7 Years Out. University of Queensland.

## Attracting and supporting high quality international research students

As the DDOGS point out, in addition to increasing the total doctoral quantum and introducing specific measures to address the decrease in Australian students, we also need to ensure that we attract, enrol and maintain a strong international cohort of research students. Australia is in a global market for research talent and we need to be able to attract the brightest and best to our shores to do PhDs.

To increase the pool of potential new researchers and their contributions to new knowledge, Australia has a great opportunity to improve the intake of high quality international HDR students. Optimising and promoting the benefits of a single, national higher education system with consequent quality control and uniformity as well as areas of expertise and research excellence, Australia is well placed to attract the best and brightest from overseas. The demand for available places is strong. For example at JCU, the ratio of international applicants to research scholarships is about three times that for domestic students. However, we are competing against well funded scholarships at international universities and hampered by inadequate and under funded international scholarship schemes. The Australian situation contrasts with recent initiatives by our international competitors such as Canada and New Zealand placing Australian universities at a significant disadvantage.

In order to attract high quality international candidates we need to improve the International Postgraduate Research Scholarships (IPRS) which purport to pay the tuition fees of our best international students, but in reality leave a shortfall to be picked up by the host university. Thus IPRS have declined in value when we should be increasing them in number and value to be internationally competitive.

Additionally, the suite of international postgraduate scholarships offered under the Endeavour program is complex and poorly targeted. The scheme needs to be reviewed, rationalised and simplified to provide a core set of high quality, internationally competitive scholarships that fully-fund living and training costs. Similar concerns are held about the AUSAID suite of scholarships. Accordingly, JCU strongly supports the following DDOGS recommendations.

*DDOGS Recommendation 6:*

**That the number of IPRS awards be increased to reflect the growth in the international student cohort and that each award fully funds the fees payable by the student.**

*DDOGS Recommendation 7:*

**That the suite of Endeavour Scholarship Programs be reviewed with the aim of improving the accessibility and international competitiveness of the scheme.**

Other barriers to increasing Australia's intake of high quality international students include the fees at government schools for the dependent children of overseas students. In Queensland, these fees range from \$8000 in prep to \$8800 per year in year 12. Such fees are clearly prohibitive for an international student on a stipend scholarship of \$20000 per year. In order to increase the international competitiveness of Australia as a research training destination, JCU recommends that the Australian government work with the States to ensure that international research students are exempt from school fees for their dependant children attending government schools.

*JCU Recommendation 2:*

**That the Australian government work with the States to ensure that international research students are exempt from school fees for their dependant children attending government schools, in order to increase Australia's competitiveness as international research training destination.**

## Industry training schemes

The processes of research and research training have been radically transformed. The old paradigm of discovery was characterized by the hegemony of disciplinary research and driven by the autonomy of researchers and their host universities. This practice is being superseded – but not

replaced – by a new paradigm of knowledge production known as Mode 11 research<sup>9</sup>. Mode 11 research is done by teams of researchers who often have contractual links with and obligations to stakeholders external to the university who are underwriting the research. JCU believes that if Australian Research and Innovation are to be internationally competitive, Australia must give high priority to training research students in a Mode 11 Environment. Research students need to be vital members of Mode II research teams.

As explained above, JCU is committed to supporting research and research training that serves the needs of regional industries and communities and, more broadly, addresses issues of global significance to the tropics. These goals are achieved in part through collaboration with other institutions and industry in a Mode II environment..

From JCU's perspective, the most successful vehicle for such collaboration has been via the CRC program. On a per capita basis, JCU's involvement in the Cooperative Research Centres (CRC) program has been one of the highest amongst the Australian universities. Our approach to membership of the CRC program has been strategic, based on synergy with areas of research strength and alignment with our research mission. The fact that the University's research is undertaken by researchers located in the region in close partnership with local stakeholders adds an additional dimension to the University's research profile and ensures that the research address questions of regional relevance.

The early CRCs were required to dedicate 10% of their budget to research training. This requirement led to the CRCs investing in stipend scholarships and scholarship top ups, student research projects and cohort support. This investment produced significant and cost-effective returns for Australia. For example, the 188 research students supported by CRC Reef Research produced 32% of the CRC Reef publications and 43% of the refereed journal articles on 9%of the total CRC Reef Research budget (see Box below<sup>10</sup>)

#### **CRC Reef Research**

A group of highly motivated and productive research students has been a cornerstone of CRC Reef success. 188 students (105 PhD, 31 Masters, 52 honours) were supported by the Centre. CRC Reef students were recruited across a wide range of disciplines including marine biology, earth sciences, oceanography, anthropology and archaeology, social sciences and economics, resource management, spatial analysis, environmental studies and engineering. Highlights have included:

- CRC Reef students produced 32% of the CRC Reef publications and 43% of the refereed journal articles on 9%of the total CRCReef Research budget.
- Students supported with dedicated staff resources and skills training in a wide range of technical and personal skills to enhance their capacity to apply their knowledge in new employment.
- Co-supervision with government management and research agencies was provided for many students and was of significant advantage to students.
- Involvement of many students in national and international collaborative projects.
- Student organization of and participation in four large research workshops with key stakeholder groups.

CRC investment in research training declined with removal of the requirement for investment of 10% of the budget in research training and the phasing-out of public good CRCs in recent years . The Commonwealth Environment Research Facilities (CERF) program does not have the same incentives or imperatives to invest in research training. The APA (Industry) program enables research students to links to industry but lacks the potential for the cohort development and support afforded to CRC candidates and is less attractive to high quality candidates.

<sup>9</sup> Gibbons, MC, Limoges, C, Nowotny, H, Schwartzman, S, Scott, P, & Trow, M. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. Sage Publications Inc. London 192pp.

<sup>10</sup> Woodley S., T. Harvey, A. Jones and D. McB. Williams. 2006. *World Heritage Research: Making a Difference - CRC Reef: Research, Education and Capacity Building 1999-2006* CRC Reef Research Centre Townsville

The recently-introduced Commercialization Training Scheme (CTS) takes a different approach. In contrast to the ‘immersion training’ offered by CRCs, which provided extended opportunity for research students to work with stakeholders, the CTS offers interdisciplinary skills training via a Postgraduate Certificate in Commercialization that is typically undertaken at the completion of the PhD. Pearson and Brew<sup>11</sup> warn of the dangers inherent in approaches such as this which ‘bolt-on’ graduate attribute development to research education. Cryer<sup>12</sup> suggests that these skills need to be embedded within students’ research degree programs so that they are ‘part of the students’ everyday thinking, help develop proficiency, facilitate transferability, and develop the habit of lifelong learning’.

The CTS program presents additional challenges to remote universities such as JCU. We do not have the numbers to provide a dedicated Postgraduate Certificate in Research Commercialisation and so encourage our research students who are interested in commercialisation to enrol externally in appropriate courses offered by capital city universities. Thus in contrast to the CRCs, the CTS fails to provide the opportunity for research students to work with regional industry stakeholders for extended periods.

The anecdotal evidence suggests that the success of Australian programs designed to encourage students to work with industry is mixed. Thus JCU endorses the DDOGS recommendation that a comprehensive review should be conducted of the mechanisms for enhancing industry links with PhD programs.

***DDOGS Recommendation 8:***

**That the suite of government funded programs which provide support for industry links for PhD students be reviewed.**

In addition JCU makes a further recommendation:

***JCU Recommendation 3:***

**That all collaborative research centres that receive funding from the Australian government (CRCs, ARC Centres of Excellence, CERFs etc) be required to dedicate a specified percentage (suggest 10%) of their funding to research training in order to increase the opportunities for research students to be trained in Mode II research environments.**

## **Challenges in training, recruiting and retaining high quality researchers (graduates and staff)**

### *Academic workforce and Australia’s research capacity.*

As pointed out in the DDOGS submission, Graeme Hugo’s work<sup>13</sup> on the staff needs for Australian universities stresses the looming problem of Australia’s declining academic workforce and notes that two thirds of Australia’s academic staff are over 40 years of age and that universities are likely to lose between a fifth and a third of their staff in the next decade or so. The long “lead times” to attract and train doctoral candidates, coupled with the increasing diversity of employment outcomes for PhD graduates suggest an impending supply crisis in the academic workforce. This shortfall is likely to be particularly challenging for regional universities. The Go8 has estimated that Australia needs to graduate at least 800 more PhDs per annum simply to maintain the number of PhD graduates within our academic workforce, before allowing for the projected (and economically imperative) growth in higher education enrolments.

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<sup>11</sup> Pearson, M., & Brew, A. (2002). Research training and supervision development. *Studies in Higher Education*, 27(2), 135-150

<sup>12</sup> Cryer, P. (1998). Transferable skills, marketability and lifelong learning: The particular case of postgraduate research students. *Studies in Higher Education*, 23(2), 207-216.

<sup>13</sup> Hugo – Workshop on PhDs in the Humanities, Arts and Social Sciences, Sydney, March 2008.

### *International competition*

The DDOGS also point out that this challenge is compounded by the recent unprecedented internationalisation of the academic labour market and the resultant fierce competition for “star researchers” and high quality research students is fiercely competitive. It has never been easier for highly skilled Australians to move to positions in foreign countries, especially other OECD nations. Strategies are clearly needed to retain our best students and researchers as well as attract international researchers and research students to Australia.

### *Disincentives to choosing a research career*

A young researcher’s enthusiasm for a research career is too frequently moderated by pragmatic issues including pay and job security. Early career research positions are typically funded by project funds (“soft money”). This disincentive is significant for the average PhD graduate who is in his or her mid 30’s – with associated financial and family commitments. Current measures of research performance and excellence are dependant on continuity of service and research output. This is especially difficult for women, , particularly in lab and field based sciences, who wish to interrupt their career for family reasons.

### *Post-doctoral fellowships*

Post-doctoral fellowships are the most common form of apprenticeship into a university research career but they are in short supply and funded for only three years. The success rate for ARC Discovery Postdoctoral Fellowships starting in 2008 was only 17.8%. The lack of availability and guaranteed tenure is a major deterrent for applicants and also result in some post-doctoral fellows spending much of the last year unproductively looking for a new job rather than writing up their research.

The ARC offers a four-year '75% research and 25% teaching' option to provide a development opportunity for aspiring academics. Under this option, a fellow may spend 25% of her/his time on activities other than the proposed research project, such as teaching. The usual ARC Discovery Postdoctoral Fellowships is a three-year full-time research position; this option extends the fellowship to four years and provides an excellent foundation for an academic career. In view of the burgeoning crisis in the Australian academic workforce, JCU recommends that the number of ARC postdoctoral fellowships be doubled and that universities be encouraged to co-invest in such fellowships to provide fellows with the opportunities to gain academic teaching experience.

#### *JCU Recommendation 4:*

**That the number of ARC postdoctoral fellowships be doubled to address the burgeoning academic and research skills shortage in Australia, and the increased challenge of universities attracting appropriately qualified staff and that universities be encouraged to co-invest in such fellowships to provide fellows with opportunities to gain academic teaching experience.**

## **Other challenges in research training**

### *Informing/enabling improvement*

JCU consistently strives to improve the quality of our PhD programs through evidence-based practice informed by research. This effort is hampered by a lack of consistent and accessible data on the outcomes of research training practice in Australia. We strongly endorse the DDOGS recommendation:

#### *DDOGS Recommendation 9:*

**That the government supports an active research agenda to inform quality improvement in HDR programs and outcomes.**

In addition, JCU recommends that research to improve the quality of research training be include as a priority area for funding by the Australian Teaching and Learning Council.

#### *JCU Recommendation 5:*

**That Research Training Practice be included in the program priorities for research funded by the Australian Teaching and Learning Council.**

## Tropical science, knowledge and innovation (SKI)

Australia is the only developed country with a significant tropical landmass. As a result, Australia historically has played a leading role in research on issues of importance to the world's tropics. Consistent with this role, JCU's research vision is to focus its research effort on issues of importance to the tropics with the goal of consolidating the University's standing as one of the world's leading tropical research universities. This vision is driven by the University's unique tropical location, particularly its close proximity to the World Heritage-listed Great Barrier Reef and Wet Tropics rainforest, its links with rural, remote and Indigenous communities, and its strengths in research fields relevant to the tropics.

Tropical Australia accounts for 46% of the nation's landmass and despite its low and dispersed population base, is the source of >30% of the nation's exports, particularly from mining, oil and gas. In order to remain competitive, these industries require a highly trained workforce including PhD-qualified Engineers and Earth Scientists. There are worryingly few doctoral candidates in these areas at present; scholarship stipends are far too low to attract them as pointed out above.

The tropics present unique research challenges and opportunities for Australia. JCU's focus on tropical science, knowledge and innovation (tropical SKI) is increasingly important in an Australian context given a growing worldwide demand for goods and services in a range of research fields relevant to the tropics. The tropics account for approximately half of the world's population and one-third of its landmass. Although some of the world's poorest nations are in the tropics, many tropical countries are developing rapidly. Increases in the standard of living and the emergence of a strong middle class are leading to rapidly changing expectations regarding lifestyle and healthcare. These changes coupled with increasing international aid have created a large and growing demand for goods and services in a range of research fields relevant to the tropics. JCU as Australia's leading tropical research university is in an especially strong position to capitalise on these trends and to play a significant role in training future research leaders for the global tropics.

The Australian tropics present a range of research challenges of national and global significance. These challenges focus on issues as diverse as biodiversity, sustainable tropical ecosystems, climate change, tropical agriculture, healthcare in rural and remote communities, tropical health and medicine, mineral resources and cultural diversity. In addition, tropical Australia offers research training opportunities of unparalleled relevance to other countries in the tropics, including developing countries in the Asia-Pacific region, Africa and the Americas.

Critical to enhancing Australia's capacity on tropical science, knowledge and innovation (SKI) is a current lack of critical mass in many fields. The 1993 Australian Science, Technology and Engineering Council (ASTEC) *Review of Research and Technology in Tropical Australia*, for example, commented on the "lack of research groups of sufficient size and multi-disciplinary nature to obtain optimal value from R&D in the tropics". Many organisations in tropical Australia have significant capacity in tropical SKI but inter-institutional collaboration has been difficult given the geographic spread of facilities and researchers across the region. Although some progress was made in the 1990s, the *Tropical Futures Forum* in 2004 reached a conclusion similar to the ASTEC report and endorsed a tri-partite agreement between Queensland, Western Australia and Northern Territory as a vehicle to achieve change. The Queensland Government's recent review of *Opportunities in tropical science, knowledge and innovation for Queensland* (2006) and the Smart State Council, chaired by the Premier, has endorsed a number of recommendations to expand Queensland's capacity in tropical science, knowledge and innovation.

In recent years, JCU's approach to this challenge has been to partner with other research organisations in the region with the goal of co-locating key research staff and infrastructure. Recent infrastructure developments have the potential to achieve this goal leading to increased collaboration and associated critical mass in research fields relevant to tropical SKI. These developments include:

- the *Australian Tropical Forest Institute* on JCU's Cairns campus which bring together researchers from JCU, CSIRO and Queensland Department of Primary Industries and Fisheries (QDPI&F) to create Australia's largest grouping of researchers focusing on the sustainable management of tropical landscapes.

- *Australian Tropical Herbarium* based in the Australian Tropical Forest Institute building in Cairns which brings together the tropical plant collections of CSIRO, the Queensland Herbarium and JCU to create Australia's largest collection of tropical plant species supported by molecular systematics and other research facilities.
- *Australian Tropical Science and Innovation Precinct* due for completion on JCU's Townsville campus in 2009, which will house CSIRO researchers currently based at the Davies Laboratory in Townsville together with researchers from the joint venture between the Australian Institute of Marine Science and JCU, ARC Centre of Excellence on Coral Reef Studies, Australian Centre for Tropical Freshwater Research, Marine and Tropical Science Research Facility and Qld Department of Primary Industries and Fisheries thereby expanding – on a significant scale – collaboration between these institutions.

These developments offer substantial national and international opportunities for research training in areas of great relevance to Australia and its region. These opportunities can only be realised by substantially increased investment in RTS places, scholarships and Post-Doctoral Fellowships as outlined in the JCU and DDOGS recommendations above.

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