



# SUMMARY

Improving Australia's marine science  
**Postgraduate Training System**  
to meet the needs of the **blue economy**



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# Improving Australia's marine science Postgraduate Training System to meet the needs of the 'blue economy'

Prepared by a Working Group of the **National Marine Science Committee**

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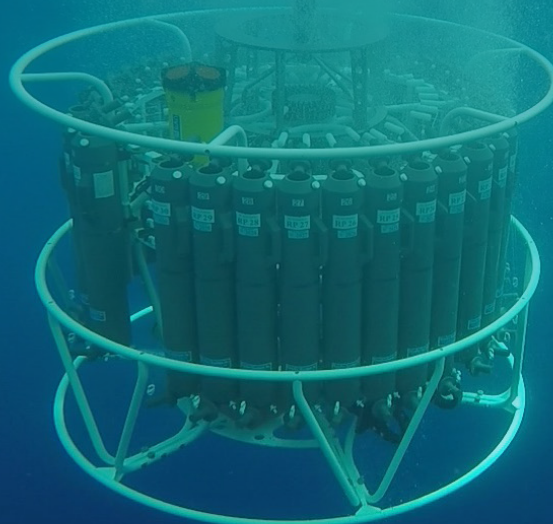
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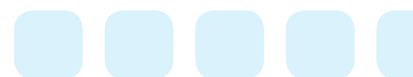
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# Improving Australia’s marine science postgraduate training system to meet the needs of the ‘blue economy’ |

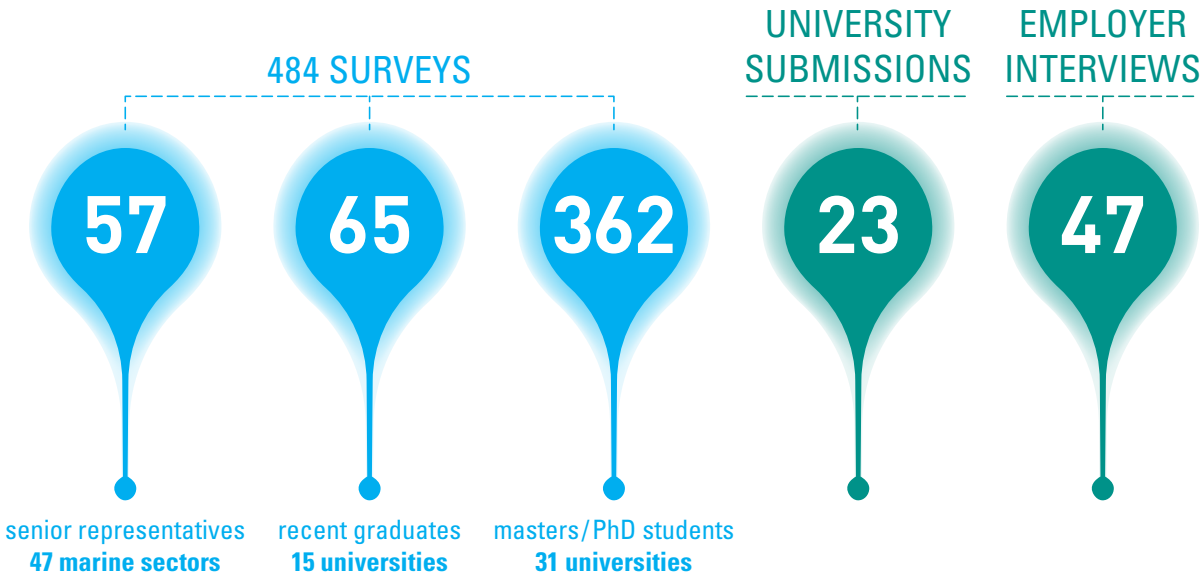
As a maritime nation with the world’s third largest Exclusive Economic Zone, Australia is deeply invested in the ‘blue economy’. The World Bank defines the blue economy as ‘the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, while preserving the health of ocean ecosystems’.

Australia’s marine industries had 393,000 employees in 2015–2016. Two thousand people worked in ocean science, with 50% of them engaged in research.

The science required to develop Australia’s blue economy is outlined in the *National Marine Science Plan 2015–2025* produced by the National Marine Science Committee (NMSC). The plan calls for a workforce of world-class marine scientists equipped with strong quantitative skills, in tune with industry and government priorities, and working in cross-disciplinary teams.

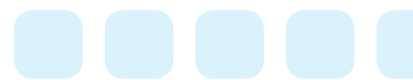
In 2019, the NMSC led a subsequent study to assess the capacity of Australia’s university postgraduate training to cultivate this essential workforce. The views of students, graduates, universities and employers were examined in the context of national and international postgraduate training to articulate a blueprint for building the driving force of Australia’s blue economy. This summary presents the study’s key findings.

## Who participated in the study?



“Almost three quarters of students and graduates surveyed wanted to work in industry.”

## Do students have time to develop industry-focussed skills? |



The climate for postgraduate training has changed significantly since the *National Marine Science Plan* was launched in 2015, with a greater proportion of students planning non-academic careers. Almost three quarters of students and graduates surveyed wanted to work in industry.

The basic structure of higher education in Australia has not changed during this period. Qualification requirements are regulated by the Australian Qualifications Framework (see: <https://www.aqf.edu.au/>). By international standards, Australia's tertiary education system is compressed. For example, Australian bachelor and PhD programs each typically take three years, while four years are allocated in the United States and China. Producing multiple peer-reviewed publications and achieving research of an international-standard is a significant challenge in a three-year timeframe. The curriculum leaves little room for additional coursework, skills training and internships tailored to industry.

The Australian PhD is designed to produce internationally competitive research professionals. Research higher degrees are awarded for an

externally-examined thesis and increasingly, doctoral students are expected to publish their findings during or soon after candidature. This approach is important for the international standing of the degree and the university and vital for candidates who seek academic careers. While four-year PhD stipend scholarships and industry-funded scholarships are on the rise, timely completions are internationally-recognised as an index of degree quality. In addition, research higher degree completions influence each university's share of government research funding.

Given the entrenched duration and structure of Australian postgraduate degree programs, both universities and students have to meet the demands of the blue economy within these time constraints.



Image: Thomas Moore, MNF/CSIRO

# Does graduate training meet the future needs of industry employers? |

Employers had difficulty finding graduates with expertise in social science, quantitative fisheries science, water quality, engineering and mathematics. One third of employers anticipated changes in the disciplinary knowledge needs of their organisation in the next decade.

They foresaw a greater emphasis on specialist skills including information technology, computing, analytics, statistics and modelling, artificial intelligence and machine learning, social science, genetics, law and engineering. One employer identified 'a legacy mismatch between training and industry demand'.

The *National Marine Science Plan 2015–2025* suggests that some of this mismatch could be addressed through advanced coursework. Australian universities offer a wide range of coursework masters degrees and world-class research expertise in disciplines sought by marine sector employers. Much of this teaching and research is not explicitly linked to the blue economy at present.

Some universities offer coursework degrees relevant to the blue economy in areas such as climate change, maritime engineering, maritime policy

and marine and coastal science. At least one such degree is offered across institutions. The Sydney Institute of Marine Science partnership between four Sydney-based universities offers a joint coursework Master of Marine Science and Management.

Institutions could jointly develop additional short courses and coursework programs relevant to the blue economy and deliver them via online education or block mode delivery. This approach would benefit from the economies of scale and overcome the geographic dispersion of both students, and teachers of specialist subjects. Few joint research degrees are likely to be offered across Australian universities though, despite the growth of joint PhDs between an Australian and an international university. This is because the development and delivery of such joint PhDs incurs considerable operational and financial disincentives.

## Disciplines valued by employers, in order of priority

environmental science and management

marine biology

mathematics, statistics and modelling

marine and microbial ecology

cross-disciplinary studies

marine engineering

oceanography

fisheries

computer science

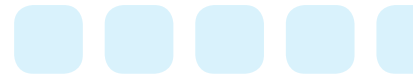
social science

## Disciplines prioritised by the environmental consulting sector and publically funded research agencies

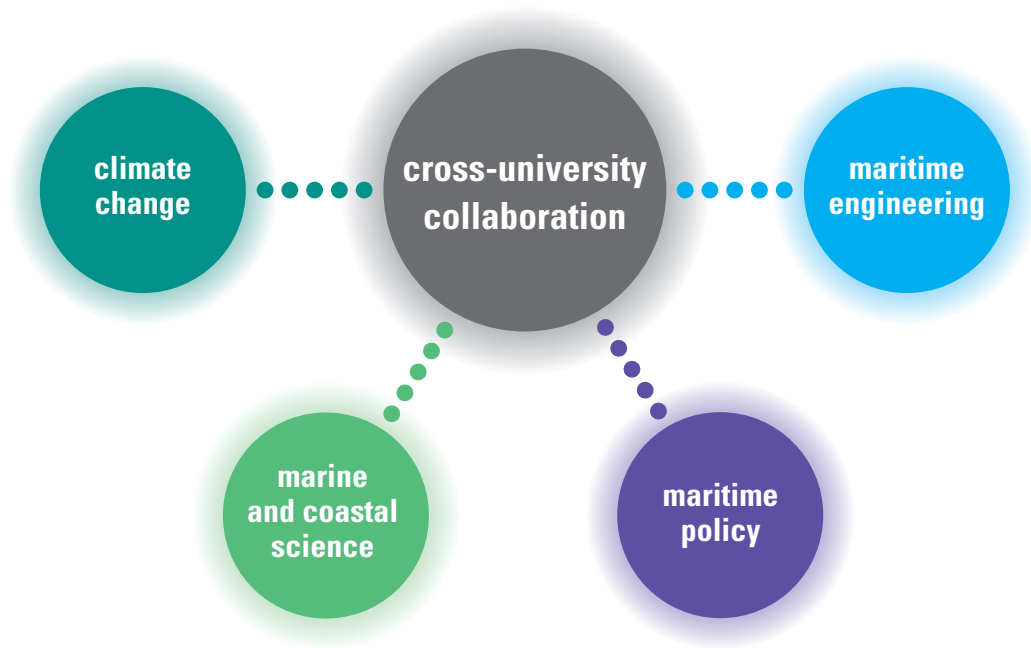
mathematics

statistics

modelling



## University partnerships can provide coursework degrees relevant to the blue economy



Some universities allow research higher degree students to enrol in a limited number of coursework postgraduate subjects to broaden their skills base with no additional fees. Taking advantage of this option, however, appears largely at the discretion of individual students guided by their supervisors. The University of Tasmania Quantitative Marine Science program is an exemplar for other degrees requiring in-depth expertise in more than one discipline.

Both breadth and depth of expertise are important to satisfy employers who expect their staff to be nimble and adaptable. Students who can demonstrate mastery of more than one discipline are likely to have an employment advantage.

Despite this need, the study found little evidence of explicit efforts to attract students – whose first degree is engineering, mathematics, social science and law – in a marine-sector career. This gap needs to be addressed using several different approaches and their success evaluated against appropriate baselines. The full report makes recommendations to fill this gap.



*Australian universities offer a wide range of coursework masters degrees and world-class research expertise in disciplines sought by marine sector employers.*

## Adding quantitative skills |

Some universities endeavour to boost the quantitative skills of marine scientists through short courses and advanced coursework, rather than by attracting students with advanced quantitative skills to practise marine science.

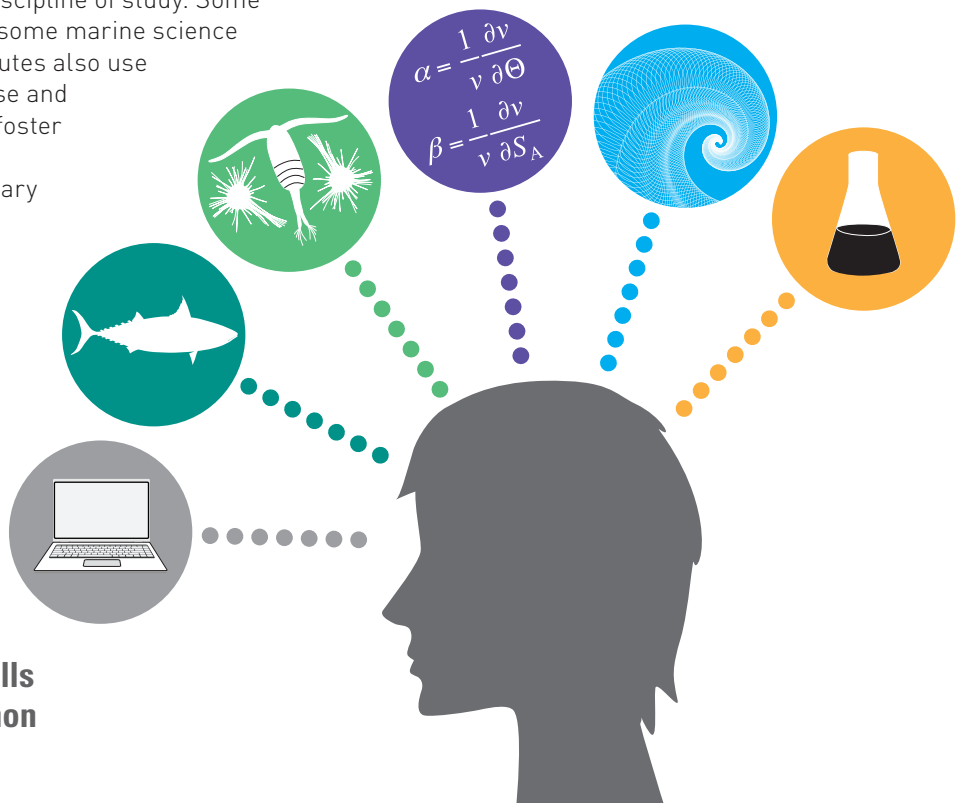
The latter approach will require explicit initiatives at the high school and undergraduate level that encourage the take-up advanced mathematics along with subjects relevant to marine science. The Bachelor of Science (Advanced) at James Cook University, an elite program for high-achieving students, follows this approach. This degree lets students select the major/s they feel passionate about (such as marine biology), while simultaneously developing the analytical and modelling skills that are in high demand.



*... the drivers and opportunities for postgraduate coursework and research training are becoming more cross-disciplinary and problem focussed.*

## Cross-disciplinary training |

As the links between universities and industry strengthen, the drivers and opportunities for postgraduate coursework and research training are becoming more cross-disciplinary and problem focussed. Students identified 'cross-disciplinary' as their third most common discipline of study. Some universities and especially some marine science research centres and institutes also use group projects, short-course and workshop opportunities to foster cross-disciplinary skills. A deterrent to cross-disciplinary research higher degree projects is a shortage of appropriate examiners. A socio-ecological approach to environmental problems is becoming more accepted, however, and cross-disciplinary PhDs are expected to be much more common (and accepted) in future.



**Cross-disciplinary skills are becoming a common focus of coursework and training**



## Skills needed for employment |

Employers prioritised the transferable skills of problem solving, time management, written and oral communication, adaptability, flexibility and teamwork. More than one third felt that new challenges in the next decade would require quantitative skills to work with big data, artificial intelligence, and machine learning. Also important would be the ability to tackle large, complex projects as part of cross-disciplinary teams.

Universities suggested that formal and informal training – including workshops, seminars, coursework and informal support – could help students develop the transferable skills sought by employers and/or required to complete postgraduate degrees. Such training could augment skills in communication, and quantitative and statistical skills. Networking, teamwork, project management, business-oriented thinking and leadership, however, mostly were considered part of research degrees. Universities should encourage students to engage with industries and other stakeholders by participating in competitions and social media, and writing for a general audience.

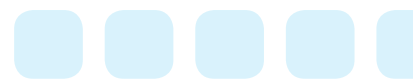
Some universities are collaborating in skills development. The e-Grad school developed by the universities of the Australian Technology Network is a successful national example. Western Australian universities collaborate to train PhD students for jobs outside academia after submitting their thesis for examination.

This takes place through iPREP WA, a program to help participants recognise the problem-solving and critical thinking skills developed during their PhD, and build confidence and experience to seek employment outside academia. iPREP participants work in cross-disciplinary teams on problems defined by industry, learning to network and deliver business and personal 'pitches'. The experience sharpens their teamwork, communication, personal branding and knowledge of the job market.

Much of the skills training of research higher degree students occurs early in candidature when their career plans are undeveloped (or unrealistic). These skills may be difficult to identify and market to employers. Universities use e-portfolios and/or other audit tools, graduate certificates, micro-credentials and Australian Higher Education Graduation Statements to record and recognise the skills development that occurs during postgraduate training. Some universities train students to explain and promote their skills to prospective employers and to understand their capabilities.



Image: April Abbott



Most graduates considered their skills in research, oral communication, and leadership had been relatively well-developed through training. Less developed were their business acumen and experience in working in diverse teams. Improvements in problem solving, project management, technical and time management skills varied. This may reflect institutional and individual differences in training opportunities and uptake.

Personal attributes prioritised most frequently by employers were a positive attitude, honesty, initiative, dependability, and adaptability. Only about one sixth of employers anticipated that the personal attributes sought by their organisation would change in the next 10 years. Employers reported difficulties finding graduates with personal qualities such as empathy and emotional intelligence. Given that some employers now use psychometric testing to differentiate between short-listed job applicants, students need to be made more aware of the importance of personal attributes in the selection process.

Some universities mentioned the need for training to highlight the importance of personal attributes sought by employers and/or foster their development.

Others felt these attributes were fostered implicitly through training in research integrity (which is compulsory for research students), university research and social culture, industry placements and internships, cross-disciplinary collaborations, and student mentorship programs.

Recent graduates advised students who aspire to a career in Australia's marine sector to network and collaborate across disciplines, and to make time to help others develop teamwork and interpersonal skills.

### **Universities are recognising the need for graduates to develop the personal attributes valued by employers**



*Given that some employers now use psychometric testing to differentiate between short-listed job applicants, students need to be made more aware of the importance of personal attributes in the selection process.*

## Job-readiness |

Most employers considered job-readiness to be important. They defined job readiness as having advanced time management, teamwork and communication skills: in particular, being able to write well.

In considering Masters or PhD graduates, marine sector employers generally emphasised transferable skills as most important, followed by technical knowledge and life experience. Graduates and students can misunderstand the relative importance of transferable skills, technical knowledge and life experience. This suggests that students need advice on how to research the priorities of their target employers.

A key message from graduates to students who aspire to a career in Australia's marine sector was to obtain industry experience through internships or volunteer opportunities.

Most students and graduates had employment experience related to their degree. Many students and graduates reported that one or more components of their postgraduate training involved a non-university supervisor, took place in a non-university setting and/or involved research relevant to or defined by industry. Many universities offer work placements as a way for students to gain experience in the workplace. This tends to be more developed at the undergraduate level than in marine science postgraduate programs, except in aquaculture.

## Strengthening industry–university links |

Prospective employers need to engage more in career development. Several universities have created industry advisory boards and/or provide scholarships to support projects developed with industry.

Marine sector graduates and students reported low participation in internships cadetships, and/or work placements. This is despite most universities being involved in the national APR[tern program and the Western Australian universities offering iPREP WA. This situation was confirmed by APR[tern data. Nearly half the students who had not completed an internship did not plan to undertake one.

The reason for the limited engagement of marine industries in initiatives such as the APR[tern and CSIRO iPhD programs is not known. Sustained,

targeted outreach is needed to engage employers in these fresh initiatives, especially employers without a history of hiring PhD graduates. In 2018, Inge Mewburn (ANU) and her collaborators used machine learning to analyse advertisements for professional jobs in Australia. They found a large 'hidden job market' for PhD graduates in the Australian workforce. Industries traditionally assumed to have low demand for PhD graduates were seeking high-level research skills and capabilities, even though PhD qualifications were not always specified as essential.



*A key message from graduates to students who aspire to a career in Australia's marine sector was to obtain industry experience through internships or volunteer opportunities.*





## Towards the **blue economy** |


Australian universities have significantly improved the capacity of postgraduate training to meet the needs of the marine sector employers since the *National Marine Science Plan 2015–2025* was published. Most of these improvements are generic rather than targeted to the blue economy and have been driven by the needs of the Australian government. The next stage of addressing the training needs of the blue economy will require universities to develop bespoke initiatives based on the many good ideas provided by employers, graduates, students and universities who contributed to this study.

### Related information available on the NMSC website

- Summary: *Into the blue: advice for postgraduate marine science students*
- Summary: *How universities can help drive the blue economy*
- Full report: *Improving Australia's Marine Science Postgraduate Training System to Meet the Needs of the 'blue economy'*

### Contact

National Marine Science Committee | [Marinescience.net.au](http://Marinescience.net.au)



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