# CAREER VIEW

## MARINE BIOLOGY, ECOLOGY AND BIODIVERSITY

**Marine biologists and ecologists are champions of the environment. They take up the challenges posed to plant and animal survival by climate change, global warming, pollution and even tourism. As people move in greater numbers around the planet, biosecurity is a key area for ecologists as countries work to protect indigenous ecosystems from pests. Only a few marine biologists swim with humpback whales and even fewer ecologists incubate the eggs of tuatara. But there are many other fascinating life forms to study and discover in the sea and on land. Managing biodiversity in marine and land-based ecosystems is a growing area of work for scientists, and people with specialist skills and knowledge are in high demand worldwide.**

### MARINE BIOLOGY

Marine biology is the study of life in the sea - how different organisms interact with one another and their environment. Marine biologists work to understand, protect and encourage sustainable use of the marine environment. They can now make predictions about how marine ecosystems will cope with changes such as global warming, pollution, pressure from fisheries and damage caused by tourism. In New Zealand waters there may be 100,000 unknown species just waiting to be discovered. Of those we know about, research is continually revealing new ways in which marine species can help humans sustain life.

The work of marine biologists informs medical science and the pharmaceuticals industry. In New Zealand waters the marine sponge *Mycale hentscheli* provides a complex molecule called peloruside. The molecule was isolated by scientists at Victoria University and could have a major role in controlling cancer.

Fisheries research contributes to the development of aquaculture and fisheries management. In New Zealand, mussel and salmon farming are growth industries. Research for fisheries' management involves learning how to manage the stocks of commercially exploitable fish that live around shores or in the deep seas. Surveys are conducted of fish populations at larval, immature and mature stages. Computer models are used to help predict future stocks of fish, and governments use the data to impose fishing controls that can help a species to survive the

pressures of highly efficient modern fishing methods that can threaten species with extinction.

### ECOLOGY AND BIODIVERSITY

The study of how plants, animals, micro-organisms and human beings live in balance with each other is fascinating. People are constantly changing ecological communities through activities such as transport systems, industry, agriculture, building cities and leisure pursuits. To be able to work effectively, ecology and biodiversity specialists study the intricacies of physical and biological

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*Areas covered include how degrees and courses relate to employment opportunities, to life/work planning, graduate destination information and current issues or material relevant to the employment scene. Your comments and suggestions always welcomed.*



TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
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processes; genetics and molecular biology; statistics; plant ecology and conservation; animal ecology and behaviour, and evolution. Ecologists strive to maintain the rich biodiversity of the planet and strike a balance between human development and conservation.

Ecology is about numbers. Ecologists count the numbers of a species in a given area, work out the distribution of populations and compare them. They monitor the effects of changes in populations over time. In the Christmas Islands invasive ants have obliterated land crabs, a keystone species. This has changed the entire forest, allowing a greater abundance of plants to grow that were formerly eaten by the crabs. The studies are also relevant to other islands in the Pacific. Wellington hosts unique centres of native biodiversity including Otari-Wilton's Bush, Kapiti and Matiu/Somes Islands, and Zealandia, the first urban sanctuary of its kind in the world and an example of ecological restoration. Being able to work outdoors attracts many plant and animal lovers to study this branch of science.

## WHERE DO GRADUATES WORK?

Employers across all sectors value the data management, research, analytical, and practical skills that graduates offer. Career options are varied. Conservation, scientific research, resource planning, biodiversity management, weed and pest biology, policy advice and teaching attract ecology and biodiversity majors. Marine biology graduates find opportunities in fisheries research and control, aquaculture and related areas. Employers increasingly prefer to recruit candidates with post-graduate degrees.

## PUBLIC SECTOR

Examples of key employers in the public sector include:

***Department of Conservation (DOC).*** Employment options in DOC for graduates with marine biology, ecology and diversity degrees include ranger, science adviser and technical adviser. Rangers work out in the field at different levels across the biodiversity spectrum with a community and practical skills focus. Some ranger positions have a specialist emphasis, as in marine work. Science advisers do scientific work across the spectrum with specialisations in many areas for example marine biology, plant ecology, freshwater, pest management and other areas. Technical advisers provide practical technical advice across the range of biodiversity. Advisers work both in national office and

out in the regions. A postgraduate degree at Master's or PhD level is preferred for science adviser roles. DOC recruits people who are great problem-solvers and passionate about the Department's work. Good interpersonal skills and awareness of self and others are essential.

***National Institute of Water and Atmospheric Research (NIWA) and Ministry for Primary Industries (MPI).*** Work options in research include: mathematical modelling of fish stocks and marine ecosystems to determine the status of marine species and the sustainability of existing fishing practices; the effects of fishing on bycatch species and the aquatic environment; the impact of the environment (e.g. climate, pollution) on marine sustainability; characterisation of and analysis of factors affecting marine biodiversity; statistical analyses of fisheries and marine data to examine trends in marine species and their ecosystems; laboratory work examining the biological attributes of marine organisms (e.g. trophic relationships, spawning dynamics) and fieldwork sampling marine systems from shore or from research vessels. Other roles include designing and overseeing research programmes for marine systems, developing and implementing fisheries management plans, developing marine policy, contributing to science and/or policy-based international forums, and

monitoring compliance with fishing regulations.

*"We look for highly-motivated graduates with relevant course work and experience for the positions we have available"*, says the Chief Scientist at MPI. Officials say that their biggest problem is finding graduates with strong quantitative skills that are essential for all disciplines within marine biology. There is a world-wide shortage of people with both biology and mathematics/statistics training and marine biology graduates who have both sets of skills have a huge advantage over those who don't. These skills are needed to design field sampling programmes, analyse biological and physical data from marine systems, analyse commercial and recreational fishing data, develop mathematical models of marine systems and the species within them, and to investigate hypotheses about the structure and function of marine ecosystems. Graduates need strong writing and speaking skills and must be able to work both independently and as part of a team.

***Environmental Protection Authority (EPA)*** aims to protect the environment, people and communities by preventing or managing the harmful effects of hazardous substances and new organisms. Roles relevant to marine biology, ecology and biodiversity graduates include: advisors who deal with enquiries; researching applications for import or use; proposing risk management control options and overseeing compliance management; policy analysts who provide scientific and technical operational policy advice, legislative advice, coordination, monitoring and evaluation; applications administrators who manage paper flows and administrative support for applications. Additional subjects useful for work with EPA include eco-toxicology, plant ecology and entomology, among others. EPA looks for organisational, interpersonal skills and clear thinking ability when recruiting graduates. For senior advisory positions, experience in a regulatory environment and/or a relevant industry or science-based organisation is required. Policy analysts need experience in government process and sustainability.

***Plant and Food Research*** employs around 600 scientists in fruit and environmental research throughout New Zealand, Australia and the USA. The company offers summer studentships during which undergraduates gain hands-on experience; postgraduate students are also hosted.

***Landcare Research.*** Manaaki Whenua - Landcare Research is New Zealand's leading environmental research organisation. Positions within Landcare Research include: Molecular Ecology Technician, Scientist or Postdoctoral Researcher, Programme Leader, Plant Molecular Systematist, Science Liaison Coordinator, Field Worker, Sustainable Business Manager, Animal Facility Technician, Sustainability Analyst, Researcher/Team Leader, Environmental Analyst, Ecological Economist, Mycorrhizal Ecologist, Environmental Analyst/Modeller, Field Technician, Urban Development/GIS Position, Invertebrate Ecologist, Wildlife Ecologist, Environmental Scientist, Insect Ecologist/Weed Biocontrol Scientist, Reproductive Biologist, Biometrician, Plant Pathologist, Soil Water Researcher and Biodiversity Science Manager.

***Te Papa Tongarewa, Museum of New Zealand*** employs a Natural Environment team to maintain and develop the Museum's Natural History Collections. The collections are used for research, teaching, museum exhibitions and public education programmes. Positions within the Natural Environment team are highly sought after. Graduates could apply for collection information officer roles, collection technician and eventually collection manager. With experience graduates may progress to roles such as researcher or curator.

## LOCAL GOVERNMENT

***Regional Councils.*** Areas of interest include biosecurity, control of regional plant and animal pests, flood control and mitigation of erosion, civil defence (e.g. natural disasters, marine oil spill). Ecology and biodiversity graduates may work in environmental monitoring and resource consent assessments, applying the Resource Management Act 1991, and in environmental management. Depending on skills and experience, graduates may move into positions such as policy development or environmental science. Roles in resource management require a tertiary qualification in physical sciences (water resources,

ecology, environmental engineering) and preferably a postgraduate qualification in one of these. Successful candidates must be able to work in a team and with the public, prioritise and complete work to deadlines, have strong oral and written communication skills, and keep up to date with expertise in their fields. Self-reliance, flexibility, commitment and enthusiasm are also important.

***City Councils*** have a wide range of operations. City Council roles relevant to ecology and biodiversity graduates are found in areas such as Open Space and Recreation Planning, and Parks and Gardens. Role titles include: planner – ecology and biodiversity; community biodiversity coordinator; park ranger (for city council reserves, including coastal); pest officer (weed and animal pest control); gardeners (e.g.Botanic Gardens). There may be short-term contracts doing field or ecological surveys for areas of ecological significance. Commitment, competence and confidence are sought after when hiring new employees, as well as people who model integrity and respect in their jobs and take pride in delivering exceptional customer service.

## PRIVATE SECTOR

A sample of commercially run organisations:

***Cawthron Institute*** is a unique science and research facility, established in New Zealand in 1919. The Institute provides research-based advice, products and analytical services that support the development of New Zealand's seafood industry and sustainable management of the coastal and freshwater environment. The Institute employs many scientists with doctorates and master's degrees.

***New Zealand King Salmon Co Ltd*** employs staff at head office in Nelson, and in research and farming in their regional aquaculture facilities. The range of positions include: site supervisors, sea farm managers, fish health technicians and fish health manager. Key skills and attributes sought include: a positive attitude, an ability to get on with people, previous history of management or supervision, and technical skills that include an understanding of fish biology, experience working on a fish farm and understanding of fish farming processes.

***United Fisheries*** employs people with a science background as account managers selling their organic fertilisers to the rural sector – strong communication and relationship skills are required as well as sales skills.

## EDUCATION

***Universities:*** Universities are excellent places to work for graduates who enjoy transmitting knowledge and skills at an academic level and who wish to continue research. Graduates considering an academic career require a PhD and a record of publication to be competitive for junior positions. Other tertiary organisations and colleges may also have openings in suitable areas for graduates from marine biology, ecology and biodiversity programmes.

***Other educational institutions:*** Teaching is a viable career option for marine, ecology and biodiversity graduates as biology and general science including ecological studies are taught in secondary schools. Teacher training is required.

## SKILLS

Undergraduate and graduate degrees in marine biology, ecology and biodiversity provide excellent grounding for successful and varied careers. A graduate skill set includes:

- **Creative thinking.** The design of research questions and new methods of approach develops innovative thinking. Students build experience through extensive fieldwork, laboratory experiments and project implementation.

- **Quantitative.** Statistical analysis is an extremely important part of advanced marine and ecological

work. Students taking statistics in their first and second years are equipped with the necessary statistical techniques employers require.

• **Analytical.** Using analytical skills students sift data, evaluate concrete and conceptual information and draw appropriate conclusions. These skills are useful in research, policy, and business roles at all levels of responsibility.

• **Observational.** During field work in a range of settings students hone their ability to observe and gather relevant data, using evidence to support deductions and experimental hypotheses.

• **Scientific methodology.** Scientists have to be systematic in setting up experiments and recording them accurately. Degree studies teach respect for scientific method and the need for accurate data as well as the ability to analyse it.

• **Planning/organisation.** Planning and implementing field trips, laboratory experiments, working in teams, using equipment, and learning scientific methodology gives students practical experience in managing and completing projects.

• **Communication and interpersonal.** Being able to communicate scientific findings in a clear, concise way to clients with a non-science background is crucial. Students develop skills in verbal and written communication through report writing, discussion and making presentations. They learn how to work effectively in groups in formal and informal settings such as field trips and interview situations.

• **Leadership.** Projects require leadership. Students have the opportunity to take an active lead in many different stages of scientific enquiry, such as formulating hypotheses, designing questions, implementation of research, analysis of data and presentation of findings.

## JOB TITLES

Many of the following are general and will often be prefixed or suffixed with the specific area of expertise required: science officer • aquaculture technician • marine biologist • ecologist • data analyst • laboratory technician • research assistant • research scientist • policy analyst/advisor • diver • data analyst • field officer • fisheries/fish health technician • planner • land management officer • resource officer • volunteer coordinator • ranger • biosecurity officer • pest control officer • sea farm managers • science writer/ editor • environmental education officer • technical adviser-risk analysis • weed control officer/ecologist • lecturer • teacher.

# GRADUATE PROFILES

### *Catherine Duthie*

*Adviser, Biosecurity Risk Analysis - Plants and Pathways Team*
*Ministry for Primary Industries*

I came to university late in life after a career as a chef, and in my first semester studied a diverse range of topics as I wasn't sure what I was most interested in. The biology courses had me hooked from the beginning. I was most interested in the natural environment so I completed a Bachelor of Science (BSc) in Ecology and Evolution. I then went on to do an Honours degree studying the potential of weta to act as seed dispersers of native plants. My PhD research saw me spending my summers in Nelson Lakes National Park studying interactions between native ants and invasive wasps. This opportunity to translate ecological theory to real environments was one of the most exciting aspects of my studies.

I started searching for work as soon as my dissertation was submitted for marking. I was limited as I needed to stay in Wellington until my son had finished school so the public sector offered the best opportunity for employment. I was fortunate that my current position was advertised at just the right time. Until joining the Ministry for Primary Industries, I was unaware of the diverse and interesting opportunities in the public sector for someone with my degree. I now work for MPI as a biosecurity risk advisor. I assess the likelihoods of invasive insects arriving in New Zealand and the economic and environmental impacts should they establish. The skills I gained from my degree have been invaluable in this job, I have to read scientific literature from all over the world on a diverse range of topics and synthesize all this information to give practical advice on pests of concern to New Zealand. I feel my work has direct benefit to the environment and it almost feels like an extension of my studies as I am constantly learning. The opportunity to communicate with researchers in New Zealand and worldwide and attend international scientific conferences in order to stay current is an essential and exciting part of the job. My advice to students contemplating a degree in Ecology and Evolution is to get involved with projects that fascinate you. There are a variety of community and volunteer projects as well as opportunities to assist graduate researchers that will let you hone your skills, gain some real world experience and make those all important contacts.

## *Olivier Bittar*

*Commercial diver*
*Self-employed*

I'm writing this on an oil rig support vessel in the Philippines, looking back on a career lifestyle that has brought some exhilarating moments, such as diving into a bait ball surrounded by yellowfin tuna, sharks and dolphins. That was recreational spearfishing but when I related the experience in a spearfishing magazine I used my marine biology background to add detail about the unique life history and physiology of that species of fish. When I first enrolled at Victoria University I was keen on becoming a civil engineer so I enrolled in science and mathematics subjects. Then during the following summer holidays I went spear fishing for the first time around the Alderman Islands, Coromandel. The experience blew my mind. Through diving I discovered a world below the surface of the sea full of life and amazing diversity. This inspired me to change my BSc major to Marine Biology. The physics and calculus papers I had already gained are not part of the usual marine biology requirements but they were relatively easy to cross credit. The concepts I had learned in calculus stood me in good stead when it came to understanding the statistical applications needed in marine science. I think mathematical skills and knowledge are crucial for success in the field, which involves a great deal of data analysis. For me nothing beats working outside in the fresh air or under the water so I particularly enjoyed the fieldwork during my degree at Victoria. I gained skills in analytical and critical thinking, problem solving, processes of discovery, and how to develop ideas. When I did an Honours degree at the University of Queensland, I learned how to run my own project, and developed scientific report writing skills.

After graduating I worked in marine tourism on the Great Barrier Reef then as an observer coordinator for the Fishing and Fisheries Research Centre at James Cook University in Townsville. I've always loved being in the water and my next career move took me into commercial diving. The money is good, the work is tough and physical and I've travelled a lot. But you really have to network to keep getting contracts. I now have many commercial diving certifications and have worked on the scientific and commercial sides of big construction projects such as the Gorgon project at Barrow Island and the desalination plant in Sydney. I've even done preparation work in the Sydney aquarium for the transfer of Dugongs into a new tank, so the work I've done has been very varied. I'm now thinking about my next career move and plan to bring together my passion for the marine environment with years of practical experience working on large-scale construction projects.

## *Flavio Mayorga*

*Technical adviser, Marine Species and Threats*
*Department of Conservation (DOC)*

Over a decade has passed since a dream started to form in my head when I was visiting the Galapagos Islands. This marvellous biodiversity hot spot, swarming with land and marine life is part of Ecuador, my country of birth. It was then that I realized what my I wanted to do for a career. Thanks to the support of my family I travelled to New Zealand and completed my tertiary education in Marine Biology. Right from the start life here has given me a taste of what the submerged environment looks like. The undergraduate part of my studies had broadened my view and knowledge of natural resources and the biological world. I developed my critical thinking skills and increased my knowledge of the underwater world through field trips, which showed me the beauty and complexity of the marine world from up close. A sombre facet was to learn in detail how resources are being depleted all over the world with little consideration for life; with this came the realisation of the need to preserve it. My Master's in Marine Conservation at Victoria University has been a launching platform from which to consider how I may work in a practical way within the field of marine environment. When I completed my studies I obtained temporary work at the Department of Conservation, which has allowed me to see how conservation works from the political point of view, thus complementing my academic study. I used my academic skills to contribute to the data management of New Zealand marine mammals' databases and was part of a team that works towards maintaining the health of these species. At DOC I saw the passion that conservationists put into their work for the environment and this has further increased my determination to help preserve the oceans. I would recommend this course to those who have passion for

the ocean and have its survival at heart. An increasing global awareness of the need to preserve the precious resources of our world would generate further jobs and opportunities in this field.

### *Jessie Prebble*

*PhD student*
*Formerly Laboratory technician*
*Te Papa Tongarewa Museum of New Zealand*

After completing an undergraduate degree with majors in Ecology and Botany, followed by the almost compulsory working-in-a-café-in-England stint, I came home to Wellington, bored and ready for the next challenge. The challenge was a Master's at Victoria University majoring in Ecology and Biodiversity. I researched native New Zealand harebells (genus *Wahlenbergia*), looking at how the different species in New Zealand are related to each other and to their overseas relatives. I love getting out in the hills, I'm passionate about conservation, I'm fascinated by evolution and intrigued by the obscure – so studying tiny rare plants that no one has heard of was the obvious choice for me. The bit I enjoyed most about my Master's was the field work. It turns out if you choose the right project it is possible to have a legitimate reason for spending the summer tramping in out of the way sub-alpine meadows around New Zealand and Australia. After finishing my Master's I worked for several years before deciding to come back to study - and I got some pretty cool jobs. I worked as a research assistant for a lecturer at Victoria University, I worked for the Department of Conservation monitoring Titipounamu (Rifleman) bird populations in the Tararua Ranges north of Wellington, and I worked as a lab technician for the botany researchers at the Museum of New Zealand Te Papa Tongarewa. All three jobs I got because of the skills I learnt and the connections I made doing my Master's project. I am currently back doing a PhD in botany, studying native forget-me-nots (genus *Myosotis*) – an even smaller and less well known plant. This one grows on the sub-Antarctic islands so guess where I'm off to this summer? If you're interested in post-grad study in ecology and biodiversity I would suggest talking to several academics about possible projects and thinking about what practical skills you would like to learn from the course. Doing a project that combines field and lab work components has been beneficial for me in finding work, as has the encouragement of really supportive supervisors.

### *Ashley Coutts*

*Managing Director*
*Biofouling Solutions Ltd, Tasmania*

When I completed my Master's by research at the Australian Maritime College in Tasmania in 1999 there were many other research questions that I wanted to answer. So my PhD studies at the School of Biological Sciences at Victoria University was really an extension of my MSc. The most rewarding aspect of my PhD was the privilege of diving in the Marlborough Sounds on a regular basis. I was investigating a newly invasive species of sea squirt, which had entered New Zealand waters on a barge and posed a threat to the green mussel population. The Cawthron Institute was very interested in my research so my PhD also involved consultancy work for them. Furthermore, I was able to publish all of my data chapters prior to completing my thesis. Skills I gained from my studies included scientific writing, statistics, experimental design and taxonomy. Because I focused all of my post-graduate studies on invasive marine species (IMS) and bio-fouling as a vector for their anthropogenic dispersal, I was one of the few people in the world with intimate experience in this area. Now that scientific research is suggesting that more IMS are being dispersed around the world via vessel bio-fouling rather than ballast water, regulators are now focusing on managing this vector. My cutting-edge research and experiences had naturally led me into this spotlight. After working as a marine pest adviser with the Australian Quarantine and Inspection Service Canberra, and Assistant Manager, Invasive Marine Species Program, Department of Agriculture, Fisheries and Forestry I went into the commercial field and founded what is currently the largest company in the world in its field – to date we employ five highly dedicated staff. To succeed I think you have to be passionate about your chosen area of study otherwise you will not stand out from the crowd. I am certainly no "Rhodes Scholar" but I believe that my passion and motivation far exceeded those around me, and that is why I am where I am today. However, I never compared myself to others. I just focused on my research and most of all I enjoyed every bit of it.

## MARINE BIOLOGY, ECOLOGY AND BIODIVERSITY AT VICTORIA

### Undergraduate study

Students in Ecology & Biodiversity learn about the huge diversity of plants, animals and microorganisms that inhabit the earth and the interactions between them and with their physical environment. The programme builds on a fundamental understanding of the biology of animals, plants and cells, and adds specialist courses in areas such as plant and animal diversity and function, ecological process, community ecology, behaviour and conservation. In Marine Biology, students gain an advanced understanding of the principles of marine biology, through key courses in introductory marine biology, marine ecology and marine animal resources. The programmes also provide courses in evolution, global change biology, and the statistical methods that are required to interpret complex ecological data. A further key component of both Ecology & Biodiversity and Marine Biology programmes are their respective field courses, where students get 'hands on' experience of identifying organisms, measuring ecological patterns, and developing independent research projects.

### Postgraduate study

Victoria offers a range of options for postgraduate study in Ecology & Biodiversity and Marine Biology. Some of these postgraduate degrees are applied in nature such as the Master's programmes in Conservation Biology, Ecological Restoration and Marine Conservation. Other programmes have a research component that requires development of an in-depth theoretical framework, including the Master's and PhD programmes in Ecology & Biodiversity and Marine Biology. These programmes can be field-focussed or laboratory based, allowing students to follow their interests from direct interaction with the marine or terrestrial ecosystems through to a detailed laboratory study.

Underpinning these programmes, the school has a vibrant research activity. In Marine Biology this includes research into rocky shore and rocky reef ecology, coral reef ecology, marine symbiosis, the eco-physiology of Antarctic ice-algae, seaweed genetics, invertebrate population genetics, and marine conservation. In Ecology & Biodiversity, research includes specialisations in areas as diverse as molecular evolution, ant behaviour, plant-fungi interactions, population dynamics and community ecology, black rhinoceros translocation biology, predator-prey relationships, rare species ecology, management of invasive species.

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