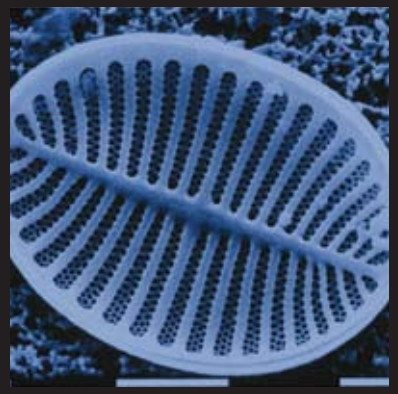
UNIVERSITY OF TASMANIA



UTAS

Research to Reality

2009 EDITION 4

This edition of *Research to Reality* is devoted to research being undertaken in the fields of marine and Antarctic studies and helps describe the area covered by the University's newest institute, the Institute for Marine and Antarctic Studies (IMAS). However, aspects of marine research highlighted in this issue are also undertaken in other entities within the University such as the Centre for Excellence in Ore Deposits (CODES) and the Tasmanian Institute of Agricultural Research.

One of the driving reasons for the creation of IMAS is the recognition that in Tasmania there are more than 700 scientists and associated staff working in the field of marine and Antarctic studies, distributed between UTAS, including the Tasmanian Aquaculture and Fisheries Institute (TAFI), the Institute of Antarctic and Southern Ocean Studies (IASOS), the Australian Maritime College (AMC), marine science researchers within the Schools, CSIRO and the Australian Antarctic Division. While IMAS comprises the UTAS components, physical co-location with the Antarctic Climate and Ecosystems Cooperative Research Centre, the Integrated Marine Observing System and the Tasmanian Partnership for Advanced Computing will encourage the development of new research linkages and collaborations and provide greater opportunities for our graduate students. Our success in obtaining Commonwealth funding for a new building for IMAS, hopefully to be built on Princes Wharf on Hobart's historic waterfront, juxtaposed with CSIRO Marine and Atmospheric Research and large enough to house most of the IMAS family, will ensure the highest visibility for an area of research in which IMAS and Tasmania excel. A feature of the development will be the opportunity for the public to understand more about Tasmania's relationship with its surrounding waters, and further afield with Antarctica. IMAS will operate in three locations – Hobart's waterfront, the Marine Research Laboratories at Taroona and at the AMC. I predict that IMAS and its collaborators will quickly become a formidable force in temperate, cool and cold water marine science, and that IMAS and its collaborators will be leaders in Antarctic and high-latitude Earth-systems science.

A fundamental partner in IMAS is the Tasmanian Government. Through the Tasmanian Government's joint venture agreement with UTAS since 1998, TAFI has become a highly effective and respected instrument for the development and sustainable management of Tasmania's living marine resources and undertakes relevant research and development in these fields for national and international clients. The University recognises the role the State Government has played in TAFI and acknowledges its continuing support of IMAS. While the nature of the partnership may be changing the mutual respect in which the University and the State Government hold each other is undiminished and the University looks forward to building on its already strong relationship with government and the State's fishing and aquaculture industries. The proposed co-location of many elements of IMAS will encourage opportunities for further development of the partnership and add further value to the State Government's support.

Jo Laybourn-Parry

Jo Laybourn-Parry
Pro Vice-Chancellor
for Research

UTAS IMAS INSTITUTE FOR MARINE AND ANTARCTIC STUDIES AMC AUSTRALIAN MARITIME COLLEGE SUPPORTED BY Tasmania Australian Government Department of the Environment, Water, Heritage and the Arts Australian Antarctic Division ace CRC IMOS Integrated Marine Observing System CSIRO

IMAS interim director Professor Michael Stoddart, IMAS chairman Professor Rob Clark, Pro Vice-Chancellor for Research Jo Laybourn-Parry and Tasmanian Government Minister for Primary Industries and Water, David Llewellyn.

Something fishy in the water

TAFI is a joint venture between the University of Tasmania and the Department of Primary Industries, Parks, Water and Environment and has been awarded an $80,000 Tasmanian Community Fund grant to implement REDMAP.

Professional and recreational fishers along with the general public are playing a significant role in collecting data on fish species, including helping scientific research through keeping tabs on the distribution and volume of the range of fish found in Tasmanian waters.

The 'citizen scientists' are from Tasmania's relatively large commercial fishing community, recreational fishers, as well as the broader community who use the waters for yachting and scuba diving.

The research is being managed through the Coastal Climate Change Range Expansion Database and Mapping Project, or REDMAP, which comes under the umbrella of the Tasmanian Aquaculture and Fisheries Institute.

The project aims to interpret the impact of climate change on the waters of Tasmania through invaluable input from people with a history of observations and working knowledge of their particular patch of water.

REDMAP is delivered through an interactive website that allows the fishing industry and the general public to report sightings of marine species that may well be on the move due to warming waters along the Tasmanian coastline.

The REDMAP website incorporates an interactive, extensive marine species database aimed at linking fishing, science and education.

It will rely on the knowledge and experience of local fishers and divers to create a network of observations from around the State that help identify how the waters are changing, in particular the marine species that are caught or seen.

TAFI marine biologist and REDMAP designer Dr Gretta Pecl said the project aims to engage and inform both the fishing industry and the community.

"Ocean warming will have profound implications for marine ecosystems, and the economic and social systems that depend on them," she said.

"Recent research and anecdotal evidence has indicated particular marine species are shifting their ranges further south along the Tasmanian coast, with some species being 'newcomers' to our waters from Victoria and New South Wales," she said.

"While there may be many reasons for habitat shifts, it is suspected that the effects of climate change, in particular rising sea temperatures, are creating the greatest impact."

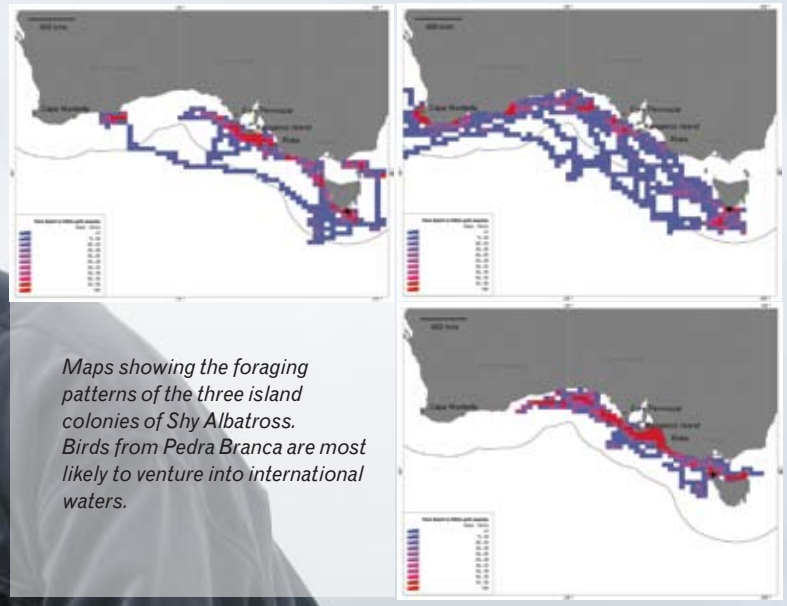
As well as being available to the public, the information on the REDMAP website will be available as an educational resource. Primary and high school teachers will be able to download fact sheets and lesson plans on climate change and the marine environment, ecological changes occurring in Tasmanian waters and information on local research projects into the impacts of climate change.

For more information see www.redmap.org.au

TAFI researcher Dr John Keane doing a spot of fishing with REDMAP developers Rebecca Brown and Dr Gretta Pecl.

Albatross youth stray into foreign waters

Funding for satellite tracking of Shy Albatross has come from the Australian Government's Department of Environment, Water, Heritage and the Arts and through funds raised by the Big Bird Race, organised by Ladbrokes. Operational and logistic support comes from the Tasmanian Government.



Maps showing the foraging patterns of the three island colonies of Shy Albatross. Birds from Pedra Branca are most likely to venture into international waters.

The reason why almost half the Shy Albatross juveniles do not survive long enough to breed is being revealed by tracking of the young birds' teenage escapades.

Research at UTAS has revealed that Shy Albatross (*Thalassarch cauta*), which are listed as vulnerable and only breed on three islands off the coast of Tasmania, fly halfway around the world during the first four years of their lives before returning to their natal colony (birthplace) to breed.

The young birds, which are foraging much further than their elders, are at more risk of being caught in hooks and the lines of fishing vessels operating in international waters.

Rachael Alderman is analysing satellite tracking from 48 fledglings as part of her UTAS-CSIRO joint PhD program in quantitative marine science (QMS). The joint QMS program was established to help fill the international shortage of marine scientists with highly developed quantitative skills.

"While adult breeding-age albatross have a 96% survival rate from year to year, less than half of the fledglings will survive the three to four years at sea to return to their colony to breed," Ms Alderman said.

This study has provided evidence that most of the juvenile mortality occurs soon after fledging.

"Being able to successfully locate and catch food soon after leaving the nest is likely to be vital for the fledglings' survival and this can be influenced by how quickly naive birds learn to forage, as well as the availability of prey such as small pelagic fish and squid," Ms Alderman said.

It is estimated that there are up to 16,000 pairs of Shy Albatross that live on the three rocky islands off the coast of Tasmania – Albatross Island off the north-west coast and two remote islands off southern Tasmania, the Mewstone and Pedra Branca.

One of the most surprising discoveries from Ms Alderman's research is that fledglings from each of the three islands have unique foraging regions, which puts some colonies more at risk than those that do not venture as far from Australia's coastline.

Of the three populations, Albatross Island shows the most restricted foraging range and the highest survival rate, with juveniles from this population foraging mainly in Bass Strait and the nearby highly productive shelf waters off the coast of South Australia.

Birds from the two southern populations, Pedra Branca and the Mewstone, also forage in the waters off South Australia. However, they have further to travel to get to these productive waters and, as a result, they appear to have lower chances of surviving through the first few weeks post fledging than do Albatross Island birds.

The juveniles from these two islands are also more likely to venture into international waters.

"One individual from the Mewstone was tracked flying west across the Indian Ocean to forage in waters off South Africa – travelling 10,000 kilometres in less than one month. Band return information suggests this is relatively common behaviour."

Ms Alderman said rates of seabird bycatch in South African waters are alarmingly high. Identifying new albatross foraging ranges will help educate international fishing vessels to introduce measures to reduce the risk of hooking albatross.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1. *Rachael Alderman undertaking research on Albatross Island.*
2. *Albatross Island, off the north-west coast of Tasmania is home to 6,000 Shy Albatross pairs.*
3. *Pedra Branca – a remote rock in the Southern Ocean that is home to a declining colony of 200 pairs of Albatross.*
4. *The Mewstone in remote waters off southern Tasmania.*

Surviving *the winter darkness* in Antarctica

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Life in Antarctica is likely to change dramatically in the next 100 years, with the microscopic plants that support the ecosystem struggling to survive the predicted warmer water temperatures in winter.

Climate change is predicted to cause oceans surrounding Antarctica to heat up, including in winter.

When sunlight hours fall dramatically during the long, dark polar winter, many microscopic plants, which rely on photosynthesis to survive, slow down their metabolism and remain in suspended animation.

It is not until day length increases that they can resume photosynthesising and therefore producing energy to allow growth and reproduction.

It is the cold sea temperatures in winter that help the microscopic plants reduce their metabolism, but if sea temperatures rise in winter these plants are unable to slow down their metabolism.

Researchers at the Institute of Antarctic and Southern Ocean Studies are investigating what will happen to the microscopic plants that form the basis of the Antarctic food chain if sea temperatures rise.

Chief investigator of the polar study Professor Andrew McMinn said there was evidence that these microscopic plants do not survive winter if the water is warmer.

"Life on the planet won't stop, it will recover, but how this will happen is what we're trying to figure out," Prof. McMinn said.

"We're talking about the microscopic plants that underpin everything in this ecosystem. If there are no plants, then there are no krill, finfish, whales, seals or penguins."

Sea temperatures in Antarctica remain at -2°C throughout most of the year, which is cool enough for the organisms to survive the winter on the accumulated energy reserves that they obtained from the sunlight of the warmer seasons.

"If the waters become warmer during the dark winter, the plants will use their energy reserves more quickly and will not survive as well to produce the large phytoplankton blooms that feed the returning animals," Prof. McMinn.

As part of the study, the researchers have incubated some of these microscopic plants in the dark at an Antarctic temperature of -2°C and they survived. Those incubated in the dark at temperatures of only a few degrees higher did not.

"My initial response to the research is that while these plants like the warming waters in the light, in the dark they use their energy stores too fast. If the water gets much warmer, it is unlikely that these plants would survive," Prof. McMinn said.

While Prof. McMinn is studying the microscopic plants in the ocean surrounding Antarctica, another UTAS research team is investigating single-celled organisms that inhabit the lakes on the Antarctic continent and have developed some fascinating adaptations to dark polar winters.

A vast ice cap covers 98 per cent of Antarctica, but the limited ice-free areas carry an amazing array of lakes that range from freshwater to lakes that are as salty as the Dead Sea.

These lakes are dominated by single-celled microscopic organisms (Protozoa, algae and bacteria). There are no or few zooplankton and no fish. The big question is how is carbon, the basic building block of life, cycled in these lakes and how does life survive in cold and winter darkness?

Surprisingly life continues to function in the cold, dark waters throughout winter. This is because the Antarctic summer is very short, so the lake community has to hit the deck running at the start of summer.

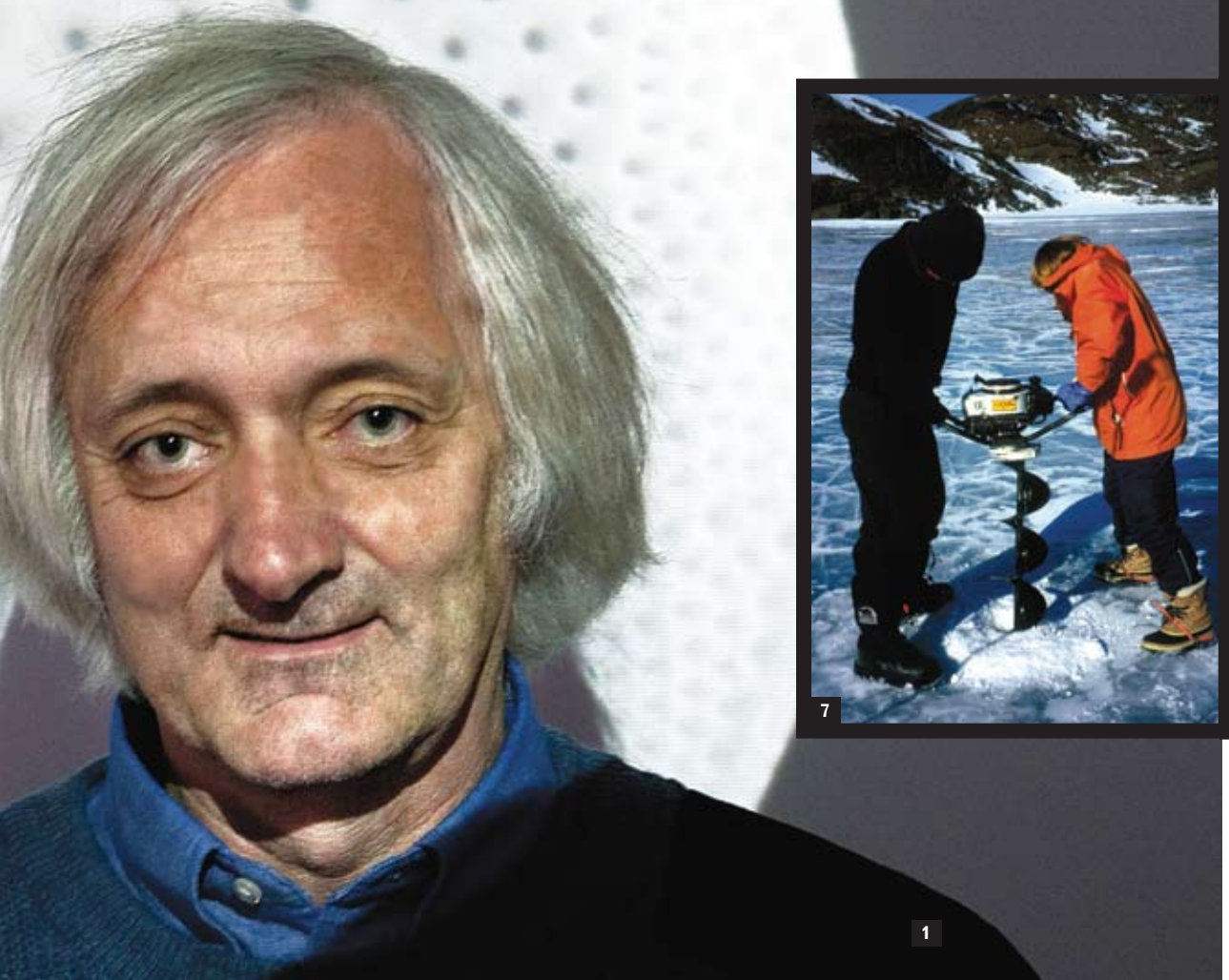
Chief investigator UTAS Pro Vice-Chancellor (Research) Professor Jo Laybourn-Parry and members of her team have worked on saline and freshwater lakes in the Vestfold Hills in Australian Antarctic Territory and the McMurdo Dry Valleys with the US Antarctic program for many years.

They have found that nutritional versatility is a major key to survival, with many of the phytoplankton using both plant and animal-like methods to supply nutrition.

The lake phytoplankton are often dominated by a few phytoflagellate species, of which Cryptophytes are especially common. Phytoplankton are the single-celled equivalent of trees and grass on land, creating new living material by photosynthesis.

Cryptophytes not only carry out photosynthesis but can also survive by eating bacteria when there is insufficient light to undertake photosynthesis. So they have both animal-like and plant-like nutrition and can survive winter darkness in an active form by exploiting bacteria as an energy source.

This phenomenon is called mixotrophy or mixed nutrition, and while it is seen elsewhere in the world's oceans and lakes, it is a particularly important survival mechanism in Antarctic systems.



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1: Professor Andrew McMinn is examining how climate change could impact on the survival of microscopic plants in the oceans surrounding Antarctica.

2: Although just single-celled organisms, some phytoplankton have a complex structure.

3: Climate change will have significant impacts on Antarctic plants and animal caused by both melting ice and warming sea temperatures.

4: Lake Druzhby (foreground) and Crooked Lake in Vestfold Hills in Australian Antarctic Territory.

6: Professor Jo Laybourn-Parry takes a break from drilling sea ice near a penguin rookery in the Vestfold Hills of Antarctica.

7: Professor Jo Laybourn-Parry and helper drilling the ice of an Antarctic lake, prior to sampling the water below.

The project studying the adaptations of phytoplankton in Antarctic lakes in Professor Jo Laybourn-Parry's project is funded by the British Natural Environment Research Council, the United States National Science Foundation and the Department of Environment, Water, Heritage and the Arts.

Professor Andrew McMinn's saltwater research is funded with $85,000 annually by an ARC Discovery grant.

Understanding how oceans function through state-of-the-art technology

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Australia has one of the largest marine jurisdictions on Earth – more than 70 per cent of our territory is marine.

The University of Tasmania is leading a national marine observing system, the Integrated Marine Observing System (IMOS), which uses state-of-the-art remote sensing technologies and data services that will answer major questions relating to climate change.

IMOS data are open to all researchers around the world with access provided over the internet through the Ocean Portal.

IMOS is funded ($102 million) through the Australian Government National Collaborative Research Infrastructure Strategy and the Super Science Marine and Climate Change Initiative and involves 10 Australian agencies and several co-investors.

The major ocean currents on Australia's eastern, western, northern and southern boundaries – the best known being the East Australia Current and the Leeuwin Current – affect regional climatic conditions and help sustain marine ecosystems.

Recent research has identified long-term changes in both currents and these are impacting on the biodiversity and functioning of coastal marine ecosystems. Long-term, sustained observations are crucial to the management and sustainability of our marine biodiversity, particularly within the context of climate change.

This article highlights just some of the technology employed by the IMOS program, for example Argo floats that, among other parameters, track salinity changes. Salinity is an indication of the global hydrological or water cycle, because the salinity of the ocean is a consequence of the difference between rainfall and evaporation at the sea surface.

Acoustic fish tagging is another aspect of the IMOS program. This technology allows tagged fish to be tracked remotely over large distances through a network of receivers placed on the sea floor for long periods. The data collected are important in managing and sustaining fisheries.

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An autonomous underwater vehicle (AUV) is employed by IMOS to map the sea bed and provide vital data for evaluating the biodiversity of off-shore bed habitats and their 'health'. This technology has shown that the invasive black sea urchins that destroyed Tasmania's seaweed and kelp forests have not spread to the environmentally valuable sponge beds located in deeper water off the State's coast.

For more information on IMOS see the website at www.imos.org.au

IMOS
Integrated **Marine Observing** System

1. *Dr Helen Phillips, of the UTAS Centre for Marine Science, with some Southern Ocean floats that are ready to be released to sea.*
2. *Argo floats about to be released into the Southern Ocean by Professor Nathan Bindoff, of the Institute of Antarctic and Southern Ocean Studies, and Dr Helen Phillips, of UTAS Centre for Marine Science.*
3. *Jan Seiler, Dr Vanessa Lucieer and Dr Neville Barrett, of the Tasmanian Aquaculture and Fisheries Institute, have used autonomous underwater vehicles to map the ocean floor habitats off the coast of Freycinet, Tasman Peninsula and Bruny Island in Tasmania.*
4. *Southern Ocean Time Series observations (SOTS) moored instruments have been deployed for observations of physical, biological and chemical properties in the sub-Antarctic zone southwest of Tasmania.*
5. *Facilities and monitoring equipment used in Australian waters to gather research data are made available to Australian scientists via IMOS.*
6. *Autonomous underwater vehicle being deployed in the sea off the coast of Tasmania.*
7. *Stereo photographic image of 'white' lobster in deep reef habitat (80m) off the coast of Bruny Island.*
8. *Tasmanian Aquaculture and Fisheries Institute researcher Dr Jayson Semmens, who is involved with the Acoustic Tagging and Monitoring System. Dr Semmens is pictured with a banded morwong involved in the tagging program.*

Neptunian eruptions

Above: Dr Sharon Allen (left) and Professor Jocelyn McPhie with volcanic pumice formed in submarine volcanoes, which they have classified and named 'Neptunian eruptions'.

Middle: Remotely operated vehicle, called Hyperdolphin, picking up a 40cm chunk of pumice from a giant pumice clast at 876m water depth in the Izu-Bonin Arc, south of Japan.

Bottom: Submarine pumice deposits on Milos (Greece).

Two University of Tasmania researchers have defined a new kind of explosive eruption from volcanoes under the ocean.

Dr Sharon Allen and Professor Jocelyn McPhie of the UTAS School of Earth Sciences and Centre of Excellence in Ore Deposits (CODES) coined the term 'Neptunian' for a particular eruption type shown only by seafloor volcanoes.

The work of Dr Allen and Prof. McPhie has made a significant contribution to our understanding of underwater volcanoes. Neptunian eruptions are one of the most common types of volcanic eruptions on Earth, but also one of the most poorly understood.

Three-quarters of all volcanic eruptions occur under the ocean and the many metal-rich ore deposits, including those mined at Rosebery, Hellyer and Mt Lyell in western Tasmania, originally formed in and near volcanoes on the seafloor.

The Southern Ocean also has a series of underwater volcanoes, including one that erupted in 1962 and caused fragments of pumice up to one metre in diameter to wash up on the south-west coast of Tasmania.

Despite their prevalence, Neptunian eruptions and the submarine volcanoes that produce them are poorly understood as they are almost impossible to observe and sample, being located in water 200m to 1300m deep.

Dr Allen and Prof. McPhie's work has for the first time unearthed the unique explosive behaviour of Neptunian eruptions by studying pumice-rich deposits that are now uplifted and exposed on volcanic islands in Greece.

"There is a particular sequence of events that occurs during eruptions from submarine volcanoes that makes them unique," Dr Allen said.

"While land-based volcanoes release hot gas and ash into huge buoyant plumes up to 20 kilometres above the volcano, submarine eruptions produce gas-driven columns of hot pumice that become rapidly water-logged and collapse just one kilometre above the vent, producing fountains of pumice and ash.

"The ocean water also helps to buffer the explosion and prevents the fracturing of pumice, resulting in giant pumice clasts greater than one metre across that sink to the ocean floor."

Prof. McPhie said there were vast areas of the modern seafloor covered by these pumice-rich Neptunian deposits.

"Neptunian eruptions reflect the critical influence of confining pressure and the higher heat capacity, density and viscosity of water compared to volcanic eruptions that occur in air," Prof. McPhie said.

Research on Neptunian eruptions was funded by part of a $460,000 Australian Research Council grant awarded to Dr Sharon Allen.

CODES is an ARC Centre of Excellence in ore deposit research working in close association with industry. Although CODES is not part of the Institute for Marine and Antarctic Studies, CODES' expertise in submarine geology provides potential ongoing collaboration between the two groups.

Assoc. Prof. Nowak's work is funded by Tasmanian Salmon Growers Association, Fisheries Research & Development Corporation, Aquafin CRC and Seafood CRC.

Stepping up salmon's fight against gill disease

A Tasmanian-based research team is now the recognised global leader in the fight against one of aquaculture's threats – amoebic gill disease (AGD).

AGD is caused by the presence of marine amoeba *Neoparamoeba perurans* on the gills of salmon. It is the reaction of salmon to the amoeba that causes changes in gill structure and affects the fish. If untreated, the fish will die.

Headed by Associate Professor Barbara Nowak of the Australian Maritime College's National Centre for Marine Conservation and Resource Sustainability, the team is now focusing on vaccine development in collaborative research with CSIRO and funded by the Seafood CRC.

It follows the breakthrough in 2007 when PhD student Neil Young discovered the amoeba causing AGD.

"Two new PhD students will start working on AGD next year, one on new approaches to vaccine development and the other on AGD epidemiology," Assoc. Prof. Nowak said.

The vaccine development will be funded by the Seafood CRC while the AGD epidemiology will be funded by the Chilean Government.

Aside from working with Tasmania's $300 million per annum salmon industry, the 15-member team's expertise has spread worldwide and its published research is known by anyone who is interested in AGD.

"We are now recognised as leaders in AGD and get a lot of enquiries to help with diagnostics, control and treatment," Assoc. Prof. Nowak said.

"I have current collaborations with researchers in other countries – we work on AGD in the USA, Chile, France and Japan. I have been invited to speak to the Chilean salmon industry and salmon industries from Scotland, Norway and Ireland. We have established diagnostic services in Ireland and Chile."

Aquaculture is one of the fastest growing primary industry sectors in Australia and continues to be an important part of Australian fisheries production. Over the past decade aquaculture production has more than doubled from 29,300 tonnes to 62,500 tonnes, with the most valuable aquaculture species being farmed salmonids (salmon and trout).

Associate Professor Barbara Nowak is leading the fight against amoebic gill disease in salmon.

Southern Ocean detective

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UTAS Antarctic wildlife biologist Andrea Walters is a whisker away from solving a Southern Ocean mystery. What do seals eat?

Seals spend several months at a time at sea hunting for food – but what type of food they consume while in the Southern Ocean remains largely a mystery.

Ms Walters will analyse the chemicals in the whiskers of seals to determine what they have been eating.

Ms Walters, who is conducting her PhD within the School of Zoology's Antarctic Wildlife Research Unit, is part of a team studying temperate species, including other top predators within the Southern Ocean and Antarctic ecosystem such as elephant seals, Antarctic fur seals, penguins and other seabirds.

In collaboration with John van den-Hoff of the Australian Antarctic Division, Ms Walters is analysing the chemicals in the whiskers of 11 elephant seal pups to build a time-line of their diet – months after the meal was eaten.

Seal whiskers act as a chemical time series, with the history of the seal's diet being integrated into the whiskers as they grow.

Analysis of the stomach contents of southern elephant seals regularly found a significant amount of squid beaks – which led to the assumption that elephant seals were primarily feeding on squid. Not true, according to Ms Walters, whose results have found that small luminescent mesopelagic fish (lantern fish), in addition to squid, may

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also be an important part of the elephant seal pup diet.

Lantern fish possess light-emitting organs over their body, which Ms Walters suspects helps the elephant seal pups to catch them. "The pups are still developing their hunting skills and the luminescent fish probably make easy prey," she said.

Elephant seal pups in the research project were also tagged to record their journeys in the Southern Ocean. "By marrying the tracking and isotope data together, we have been able to look at the diet of these pups in a spatial context, including relating diet to location," Ms Walters said. "The whisker analysis also helps determine what level in the food chain, or trophic level, the seal pups are feeding at. This information is important as it will help us to better understand the role of this important consumer of marine resources within different food webs of the Southern Ocean and therefore help with future resource management."

The Antarctic Wildlife Research Unit team, which is part of the School of Zoology, is making a significant contribution to the knowledge of the complex ecosystems and climate change impacts in the Southern Ocean, sub-Antarctic islands and Antarctica.

Professor Mark Hindell (Antarctic Wildlife Research Unit director) is examining the biology of marine mammals and seabirds, particularly with respect to Antarctic and sub-Antarctic ecosystems. Dr Mary-Anne Lea (research associate) is studying the interaction between the movements and diving of marine predators, their prey and climatic variability, while Dr Susan Gallon (postdoctoral researcher, Australian Endeavour Fellowship) is investigating the swimming behaviour and foraging success of seals from the Southern Ocean.

Eight PhD and honours students are also doing vital research into the amazing animals that inhabit temperate zones.

Seals are a popular topic, with Virginia Andrews-Goff (PhD student) studying the winter foraging range of Weddell seals in the sea ice zone of eastern Antarctica. Michele Thums (PhD student) is analysing foraging strategies of the southern elephant seals, while Malcolm O'Toole (honours student) is mapping elephant seal foraging behaviour. Mike Sumner (PhD student) is using statistical methods for estimating movement from archival and satellite tags.

Seabirds are also an important part of the marine ecosystem and Julia Sommerfeld (PhD student) is measuring breeding success, survivorship, foraging strategies and diet of masked boobies, while Caitlin Vertigan (PhD student) is measuring various life history traits of two sympatric seabirds (animals that occupy the same breeding location but exhibit differing life histories). Tim Reid (PhD student) is looking at the foraging ecology of flesh-footed shearwaters breeding on Lord Howe Island, while Ben Arthur (honours student) is investigating the use of habitat and food resources by two species of beach-nesting shorebird that are declining in number Australia-wide.

Funding for Andrea Walter's project has been provided by a Department of Environment, Water, Heritage and the Arts ACAMMS grant of $17,500; a Sea World Research and Rescue Foundation Inc grant of $17,000; and a $14,500 Winifred Violet Scott Charitable Trust grant.

1. *The A-Team (from left) Tim Reid, Julia Somerfield, Andrea Walters, Susan Gallon, Mary-Anne Lea, Virginia Andrews-Goff, Ben Arthur and Malcolm O'Toole.*
2. *Dr Susan Gallon spending some quality time with an elephant seal bull.*
3. *PhD student Michele Thums is analysing foraging strategies of the southern elephant seals by using electronic data loggers to track their movement and diving behaviour.*
4. *Elephant seal pups on Macquarie Island. John van den-Hoff collected two whiskers from each pup for the study. Picture by John van den-Hoff*
5. *Caitlin Vertigan is measuring life history traits of little penguins on Wedge Island.*
6. *Honours student Ben Arthur on Wedge Island measuring and weighing shearwaters.*

Future of oceans governance in polar regions

Threats to polar environments from human and environmental changes are increasing the challenges in Antarctic and Arctic oceans governance.

This mounting pressure, caused by climate change and technological developments, has led to a major review by an international research team, incorporating the UTAS School of Government and the Institute of Antarctic and Southern Ocean Studies (IASOS).

The global research network is examining the legal and policy issues facing Australia and Canada in their respective polar regions, with a comparative analysis on sovereignty and security.

Chief project investigator Associate Professor Marcus Haward said while the current legal regimes governing the Antarctic and Arctic differ, there was room for considerable analysis and comparison of the formal and legally binding approach of the Antarctic Treaty, as opposed to the informal, cooperative regional approach taken by the Arctic Council.

"The Arctic ocean has increased pressure from climate change and from offshore oil and gas development," Assoc. Prof. Haward said.

"With this is the likelihood of increased shipping along the Arctic coast of Russia, while in the Antarctic marine biological prospecting and increased ship-borne tourism highlight important management issues."

Research into these challenges will contribute to improved responses to polar resource management, shipping standards and environmental management.

Working in collaboration with the University of Melbourne, ANU, UNSW, Dalhousie University and the University of Calgary in Canada, this work builds on a 15-year research relationship established within the framework of the Australian-Canadian Oceans Research Network (ACORN).

Together, they have shaped and influenced policy and framework into oceans governance, including the Australian Oceans Policy (1998) and the Canada Oceans Act 1997. It was in the late 90s that ACORN broadened its research agenda to include both the natural and social sciences for investigating theoretical approaches to oceans governance.

This project has received $17,000 from an ARC Linkage International Grant, and a further $11,250 from UTAS and collaborating universities.

Associate Professor Marcus Haward of UTAS School of Government and Dr Julia Jabour of the Institute of Antarctic and Southern Ocean Studies are examining the laws governing Antarctica.

Slimy orange Antarctic marvel

Studies on *Psychroflexus torquis* have been funded through a Department of Environment, Water, Heritage and the Arts grant of $258,570 and a University of Tasmania grant of $25,000.

Above: Sampling sea ice in Antarctica. Photo by Shane Powell.

Left: Professor John Bowman with PhD student Chawalit Kocharunchitt inspecting the growth of bacterial colonies.

Below left: Close-up of Antarctic ice-sheet bacteria, Psychroflexus torquis*, clearly illustrating the slimy carbohydrates that it excretes to help it survive low temperatures.*

Below right: Sea ice at Eliis Fjord in East Antarctica. The visible band of algae indicates the area from which Psychroflexus torquis *was isolated.*

An obscure, single-celled organism, which has some amazing survival adaptations that allows it to live in the coldest place on Earth, could play an important role in food safety and medicine. But the bacteria, *Psychroflexus torquis*, is at risk of disappearing forever if climate change melts the rare pockets of Antarctic ice where it lives.

The Tasmanian Institute of Agricultural Research's Professor John Bowman is determined to discover the slimy orange bacteria's secrets before it disappears from the wild.

P. torquis is an extreme psychrophile, which means it only grows at low temperatures. It is extremely slow growing, replicating itself just once a day, compared with common warm-temperature bacteria which replicate every half hour.

The bacteria is mainly found in perennial sea ice aged up to 10 years and it feeds on the secretions of the algae.

It is its amazing array of adaptations to withstand extreme cold, high salinity and low nutrients that makes it unique in the bacterial world.

Prof. Bowman has sequenced the *P. torquis's* genome and is now studying the species novel cold adaptation and stress protection mechanisms, which have evolved in the Antarctic cryosphere. The bacteria produces massive amounts of slimy exopolysaccharides (complex carbohydrates that it excretes) and anti-freeze proteins, which help it survive in the extreme cold. "We think the exopolysaccharides actually carry the anti-freeze proteins, and together they influence the way ice crystals grow and allow the microbe to grow at temperatures colder than -10 degrees Centigrade.

"The species also appears to possess the ability to store carbon and energy as glycogen and polyphosphate, which may be important when temperature conditions do not allow efficient transport of nutrients or nutrients are not available."

The bacteria has an unusual light active protein that absorbs light and generates energy, called proteorhodopsin, which has been observed in other microbes living in extremely low nutrient environments. Finally, *P. torquis* also forms a series of different polyunsaturated fatty acids, which may have potential nutriceutical (nutrient supplement) benefits for humans.

Prof. Bowman is currently looking at the bacteria's proteins using the state-of-the-art proteomics facility at the UTAS Central Science Laboratory.

The future of marine and Antarctic studies at UTAS

The University of Tasmania has internationally recognised expertise in marine and Antarctic research. This edition of *Research to Reality* highlights some of this world-leading research being undertaken in Tasmania.

The international profile of Antarctic, Southern Ocean and climate change expertise will be enhanced through the establishment of the University of Tasmania's Institute for Marine and Antarctic Studies (IMAS) from 1 January 2010.

IMAS will consolidate the University's expertise from different faculties and research centres in order to generate increased research activity in marine and Antarctic studies and to provide a stronger mechanism for UTAS to engage with state, national and international players in the field.

IMAS will be an internationally recognised research institute with a capability for delivering excellence in both pure and applied research in Antarctic and marine studies.

IMAS will integrate the well-established Institute of Antarctic and Southern Ocean Studies and the Tasmanian Aquaculture and Fisheries Institute, and collaborate with the Tasmanian Government, CSIRO, the Antarctic Climate and Ecosystems Cooperative Research Centre, the Integrated Marine Observing System, the Australian Antarctic Division and industry stakeholders.

The institute will focus on aquaculture, fisheries management, biodiversity, ecosystem management and modelling, plankton research in the Southern Ocean and physical oceanography. One of its main themes will be climate change and its impacts.

The marine industry is of crucial importance to Australia. A recent Australian Institute of Maritime Science index estimated that the annual value of marine science industries is $38 billion and growing. The sector has grown by 42% since 2000-2001. Within the annual index commercial fishing (wild capture) accounted for $1.3 billion and marine aquaculture $666 million.

Working in partnership with the Australian and Tasmanian governments, as well as the Australian Antarctic Division, UTAS and its networks and collaborators already possess the expertise necessary to make IMAS a world-leading institute with a strong and identifiable southerly focus.

www.UTAS.edu.au

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