NCCARF
National
Climate Change Adaptation
Research Facility
Adaptation Research Network
MARINE BIODIVERSITY AND RESOURCES

marine adaptation bulletin

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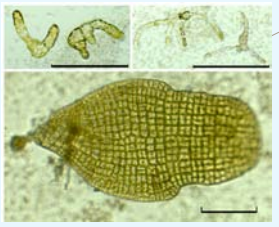

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Climate Adaptation
Knowledge Exchange

At a glance

The Adaptation Research Network for Marine Biodiversity and Resources will foster an inclusive, collaborative and interdisciplinary research environment that generates outputs relevant for policy-makers and managers to develop appropriate climate change adaptation responses.

INVESTMENT
Australian Government Department of Climate Change through the National Climate Change Adaptation Research Facility (NCCARF) hosted by Griffith University

FRAMEWORK
Five interconnecting themes (integration, biodiversity & resources, communities, markets, policy)

HOST INSTITUTION
University of Tasmania

CONVENOR
Associate Professor Neil Holbrook

TIMEFRAME
2009-2012

IN THIS ISSUE

Convenor's Spot

It's been a very difficult 2010/11 summer. With storms and tropical cyclones causing severe flooding, loss of lives and properties across Australia's eastern and southern states, and bushfires destroying homes in southwest Western Australia, this summer has in some way touched all Australians. Numerous stories and images have been broadcasted on live-to-air TV around the nation, including the passage of tropical cyclone Yasi – category 5, the torrent through Toowoomba and the Lockyer Valley, and the devastating and extensive flooding across Queensland, and parts of New South Wales, Victoria, South Australia and Tasmania.

Climatically, the large and significant La Niña event (and concomitant warmer Australian region tropical waters) that has been running its course over the past six months or so was expected to produce higher rainfall and more storms than usual during this summer period. The devastation that the severe weather brought, however, was largely unexpected. So, how good were our seasonal climate forecasts and weather warning systems? Can our ever-improving weather/climate forecasts be used more effectively to better inform climate risk management and the implementation of short to longer term adaptive strategies? How has the marine environment been affected? These are just some of the questions that will be valuable to tease out.

Finally, the six million dollar question(s) - were the weather extremes experienced across Australia during the 2010/11 summer unprecedented, and are we seeing the effects of climate change? Thorny questions that always trigger debate in the media – nevertheless, the climate prognosis is that we should expect increases in extremes. In the fullness of time, the events of this summer will be analysed and re-analysed by many people – including the (re-)insurance industry. We need to learn from the events of 2010/11. One of the big challenges is how we can best utilise our knowledge of climate risk in developing adaptation strategies (improving adaptive capacity) to future climate extremes

Neil Holbrook

Census of Marine Life 2010

Professor Nic Bax, Chair Australian National Committee for the Census of Marine Life

The Census of Marine Life (CoML) was released at the Royal Institute in London in October 2010 after 10 years of research and exploration by 2700 scientists from 80 nations and the discovery of 6000 potentially new species. The public release was followed by the inaugural two-day J. Frederick Grassle Symposium at the Royal Society where the highlights from the many projects and national committees were presented, concluding with the work of several artists that have been inspired by the Census. The majority of Census products and results are available at http://www.coml.org/ including the Census song and music video.

Australia was well represented in the Census – Dr Ian Poiner, (Director of the Australian Institute of Marine Science) chaired the International Scientific Committee. Australian scientists had leadership roles in censuses of Coral Reef Ecosystems (CReefs), the Census of Antarctic Marine Life (CAML), History of Marine Animal Populations (HMAP), Barcode of Life (BCOL), Tagging of Pacific Pelagics (TOPP), and the Oceanographic Biogeographic Information System (OBIS). Over 160 Australian marine scientists were involved with the Census over the 10 years, with prominent contributions to additional censuses including Seamounts (CenSEAM), continental margins (CoMarge), and synthesis projects.

Photo: CoML

Dr Alan Butler (CSIRO retired fellow) and co-authors produced the Census of Australia's marine biodiversity, concluding that we had 33,000 databased species, a further 17,000 collected and awaiting names, and potentially 250,000 species in all (minus microbes). This national total was the highest reported by any Census National/Regional group – a reflection of Australia's mega-diverse status and our history of productive taxonomists (Butler et al., 2010. PLoS ONE doi:10.1371/journal.pone.0011831). While Census scientists were unable to provide a precise estimate of global marine biodiversity, it is clear that is well over a previous estimate of 1 million and could be as high as 10 or 30 million species (not including microbes).

The Census has left an enduring legacy with OBIS which brought together more than 800 datasets and nearly 30 million records and is now maintained under UNESCO's Intergovernmental Oceanographic Commission. Census findings were reported in more than 2,600 papers, 34 books and 40 reports most of which are freely accessible online.

Beyond the products, the Census has also developed a community of scientists – it was one of the largest scientific collaborations of all time – with a desire to continue working together with increasing levels of standardisation to provide enduring global monitoring of marine plant and animal life. This will have increasing significance as shared data sets for climate change and species adaptation inform interdisciplinary research and society's future options.

While the Census and its principal sponsorship by the Sloan Foundation ended with the Census release, many of the Census communities are planning to continue in new forms. The Ocean Tracking Network has formed to build on several CoML animal tagging projects. The Global Oceans Biodiversity Initiative (www.gobi.org) is using Census results and expertise to further their objective of identifying Ecologically and Biologically Significant Areas (EBSA) on the High Seas, supporting the work of the Convention on Biological Diversity (CBD). Six Census projects have combined to form an international deep sea collaboration (INDEEP) that had its first meeting in New Orleans in December. The HMAP project spawned an entire new field of study that integrates expertise in the social and natural sciences and humanities. The CReefs project is funded for another year (BHP Billiton is the Australian sponsor) and is planning a new project focused on the development of "life gauges" initially focused on the continued development of Autonomous Reef Monitoring Structures (ARMS), next generation sequencing with novel bioinformatics, and passive acoustic sensors.

The Australian National Committee and its parent committee Oceans Policy Science Advisory Group (OPSAG) will be asking Australian marine scientists how Australia should respond to a second Census of Marine Life, at a proposed special session at the Australian Marine Sciences Association (AMSA) conference (Fremantle, July 2011). Results from this will feed into an international discussion at the 2nd World Marine Biodiversity Conference (Aberdeen, September 2011 see <http://www.marine-biodiversity.org/>).

The Census of Marine Life led to an unprecedented international collaboration among marine scientists. It is the kind of international initiative that will be required as scientists develop the technology and capacity to monitor the global biological marine environment at a similar level to that already achieved for the global physical marine environment.

Fisher Knowledge Contributing to Better Science

Trixi Madon, CEO, Commonwealth Fisheries Association

The recent Census of Marine Life reflects a tremendous scientific effort, the future benefits of which cannot be understated. The link between scientists to science is clear. What is less well widely known is the role of the fishing industry in contributing to science through funding, practical support and their knowledge of the marine environment in which they operate.

Photo: Austral Fisheries

Globally, there is increasing understanding, and study of, the repository of knowledge that fishers hold. Local ecological knowledge held by people engaged directly with their ecosystems, including commercial fishing, is recognised as a valuable asset for understanding environmental change, as well as for ecosystem management and conservation. Scientists do acknowledge the value of this information but also recognise that it is not necessarily in a form they can easily use.

The fishing industry works closely with scientists and science organisations to identify changes in ocean life and oceanographic conditions that may be indicators of climate change. Some of the many programs Commonwealth fishers are involved with include:

- a multi-year, multi-agency and industry program to develop underwater cameras for attachment to fishing gear to investigate seabed organisms, the impacts of fishing on those benthic organisms, and to identify different marine habitats or ecosystems;
- collection of meteorological data on ocean state, currents, wind speed and general weather conditions for use in weather forecasting;
- collection of acoustic data for scientific analysis of micronekton layers (small fish) at depths across ocean systems; and
- detailed catch and bycatch observations and records provided for analysis of changes in the spatial distribution of species.

Industry provides significant funding of science including programs such as ocean temperature and current predictive modelling, and satellite-based sea-state anomalies to detect ocean currents and temperature fronts. Various benefits have been derived from such programs, including improved ability to detect water temperature changes and fish habitat movements. There are clearly positive mutual benefits for industry generated information. This is often provided at industry's cost to relevant organisations, for example, for weather forecasting which in turn improves the accuracy of the forecasts and predictions for the industry.

Fisher knowledge of the marine environment in which they operate can lead to improved overall understanding of that environment as well as adaptation strategies within it. Important information about historical observed marine changes can be added to existing data sets. For example, an individual fisher's knowledge (and interest) can play a key role in bringing new information to the attention of scientists as occurred for spawning aggregations of coral trout. The importance of such aggregations is now recognised and has been incorporated into adaptive fisheries management.

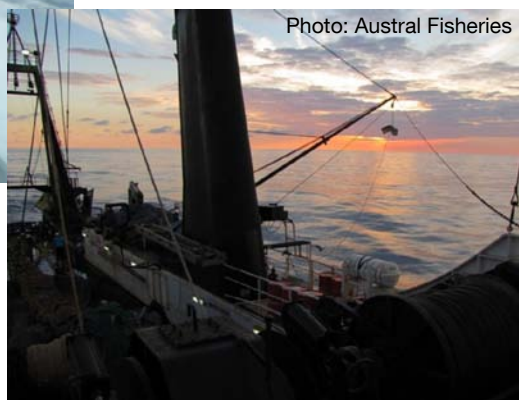


Photo: Austral Fisheries

Many marine and natural resource planning processes now take advantage of mechanisms applied to capture local knowledge to complement scientific knowledge. A recent Victorian government initiative – the draft Aboriginal Fishing Strategy - calls for the incorporation of Aboriginal customary fishing into fisheries policy and management plans.

Two recent research studies in southeast Australia have highlighted the contribution commercial fishers can make to better science, which can lead to better policy and management outcomes for not only fisheries but also other marine life.

A 2010 study of the influence of environmental factors on recruitment and availability of fish stocks in southeast Australia included examination of the efficacy of industry-based environmental data collection capabilities. The dynamics of fish stocks are significantly influenced by environmental and oceanographic factors. Experienced fishers have a wealth of information that can be quantitatively incorporated into data collection. This study concluded that the collection of environmental data by industry can be successful, and

recognised the potential of longer term collection of fine-scale data from individual vessels.

Regional and local data collected by fishers regarding climatic changes may be valuable in ensuring the sustainable management of Australia's marine resources into the future.

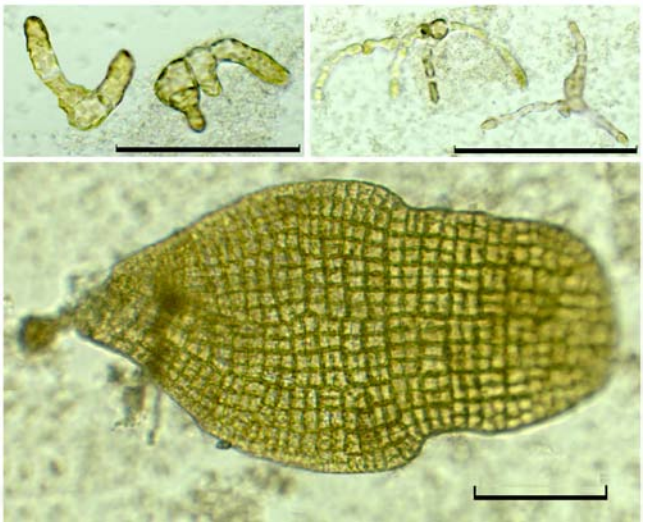
An earlier 2006 study on integrating fishing industry knowledge of fishing grounds with scientific data on seabed habitats for informed spatial management and ESD resulted in the mapping of seabed habitats across an area of 141,000 km^2 in depths from ~50m to 1,300m. The successful collaboration between scientists and fishers achieved an integrated map considered superior to either industry or science data in isolation, as it combines complementary detail from both sectors.

Continuing further collaborations between scientists, fishers and policy makers based on mutual recognition of respective knowledge and skill bases is expected to further benefit the marine environment.

Network Supported Research Complete

Christopher Mabin started his honours in the early stages of 2010 at the Australian Maritime College

Marine habitat forming species are under threat from changing oceanographic conditions due to climate change. Kelp – "forests of the sea" – are foundation species and support diverse reef ecosystems via the provision of food and habitat. Kelp dominate temperate subtidal rocky reefs worldwide and are a key contributor to the high levels of marine biodiversity and endemism for which southeastern Australia is renowned, supporting lucrative fisheries and tourism industries. Ocean-atmospheric models demonstrate clear links between increased atmospheric CO_2 and a strengthening of the East Australian Current (EAC), forcing warmer, nutrient-poor waters further south for longer time periods, leading to conditions that may harm the long-term viability of kelp populations in southeast Australia. This study aimed to examine the effects of EAC-related changes in temperature and nutrients on the ubiquitous temperate Australian kelp, *Ecklonia radiata*. Field studies compared differences in surface seawater temperature, kelp morphology and reproduction across sites in NSW and Tasmania, while a laboratory experiment tested the combined effects of increased temperature and reduced nutrients on the development of microscopic stages (pictured). *Ecklonia radiata* size and the amount of reproductive tissue was generally significantly greater in the cooler waters of Tasmania compared to NSW. Importantly, one morphological trait (lamina length) was a strong predictor of *E. radiata* reproduction, highlighting the way in which climate driven changes to morphology will also impact reproduction. In the laboratory, temperature had a significant effect on *E. radiata* development with microscopic stages growing fastest between 16-22°C and no emergence of juvenile kelp above 22°C. Surprisingly, the microscopic-stage development of *E. radiata* was unaffected between high and low nutrient concentrations. Given forecasted increases in ocean temperature of between 2-3ºC in southeastern Australia by 2100, these findings suggest that *E. radiata* morphology, reproduction and development will be affected by future climate-induced EAC shifts. In particular, this study provided a snapshot of the future health and viability of southeast Australia's marine ecosystems under a southward extending EAC whilst providing information for future marine resource management.



This study sheds some light on the future health and viability of southeast Australia's kelp populations and highlights the importance of developing climate change adaptation strategies for industries likely to be affected by shifts in the EAC. Further investigations to explicate the impacts of predicted oceanographic scenarios on kelp populations are necessary to augment climate change risk reduction strategies and to reduce uncertainty among industries that rely on kelp-based ecosystems.

Coastal Zone Asia - Pacific Conference Report

Stewart Frusher (Tasmanian Aquaculture and Fisheries Institute) and Sarah Jennings (School of Economics, UTAS)

The combined Coastal Zone Asia-Pacific Conference and World Small Scale Fisheries Congress (CZAP/WSFC) was held in Bangkok from the 17th to 22nd October 2010. The Marine Biodiversity and Resources Network (MBRN) hosted a special session at the conference where Network members detailed the Network's role and approach to co-ordinating climate change adaptation research in Australia.

CZAP has been a forum for the exchange of insights and ideas on addressing issues facing coastal areas in the Asia Pacific region for nearly a decade. This region has a history of diverse interests in a dynamic environment, often dealing with a complex plurality of rules and customs. Like most regions throughout the world, the use of coastal regions is expected to intensify as populations increase and this will lead to intensified competition, conflicts and environmental impacts. Climate change will add an additional layer of complexity that is expected to escalate the need for an increased understanding of vulnerability and resilience in these complex social-ecological systems.

Bangkok 2010 marked the inaugural WSFC which was motivated by the need for increased recognition of small scale fisheries in global production and employment, and the significant role that these fisheries provide in rural livelihoods, food security and cultural identity. Predicting the impacts of climate change, and identifying the options for future management of impacted systems, will be essential if the human and ecological services they provide are to be maintained, and if small scale fisheries are to be part of the solution for poverty alleviation and food security issues in developing countries.

The importance of climate change in the context of coastal zone management and small scale fisheries provided a high level of interest in the frameworks being developed within the MBRN. Of specific interest was the inter-disciplinary approach that integrates the communities (social), markets (economic), biodiversity and resources, and policy themes in the Network. Understanding the vulnerabilities, resilience and adaptability of social-ecological systems to climate and non-climate drivers of change was a recurring theme throughout the week.

The importance of further developing approaches that effectively integrate disciplinary expertise with stakeholder participation was also a central issue. Many of the participatory approaches described during the week have synergies with the evolving MBRN's methodology and CZAP/WSFC provided a forum for participants to gain insights into the approach and for Network representatives to learn about other related initiatives. Formal and informal interactions at the conference/congress highlighted the global challenge to develop adaptation solutions for the marine environment at the local, national and international scales, and the importance of collaboration and information exchange in meeting this challenge. There was considerable interest by delegates, representing more than 40 nationalities, in the experience that has been gained by the MBRN in facilitating marine adaptation to climate change in Australia.

Additional information is at <http://www.cdc.fish.ku.ac.th/czap2010>.

Climate Change and the Little Penguin: Impacts and Adaptation Options

Lynda E Chambers (Centre for Australian Weather and Climate Research, Bureau of Meteorology) and Peter Dann (Research Department, Phillip Island Nature Park)

Long-term data sets (since 1968) on breeding success and survival, as well as shorter datasets on foraging and breeding distributions (since 1984), have been used to assess observed and projected impacts of climate change on Little Penguins on Phillip Island, Australia. Anticipated impacts include: a small loss of breeding habitat due to sea-level rise and associated erosion along creeklines; increased fire risk; increased burrow temperatures and heat-related mortality; altered breeding timing, success and survival associated with increased ocean temperatures and reduced marine productivity. However, a number of adaptation options exist to reduce climatic impacts and increase penguin resilience including: increasing appropriate ground vegetation within breeding habitats to better insulate burrows; placing a high priority on fire response planning and training; and encouraging colonisation of other suitable breeding areas through active management, in particular eradicating foxes, improving penguin access and optimizing vegetation type and cover for breeding penguins. Continued monitoring of penguin populations will enable judgments to be made on the effectiveness of management actions and inform further adaptation responses.

Photo: Lynda Chambers

International Perspective: Adapting to Climate Change in Coastal North America: Synthesis and Sharing

Jennifer Hoffman (Senior Scientist/Director of Projects, EcoAdapt) and Alex Score (Scientist, EcoAdapt)

As the effects of climate change on marine ecosystems become more pronounced, and as human awareness of these effects grows, more and more people are wondering how best to tackle this problem. Over many years of working to adapt natural resource conservation and management to climate change, we and other adaptation colleagues have encountered people feeling stymied by too little information and guidance, too much information and guidance, or simply by the magnitude of the problem itself. How best could we help these people move beyond their sense of paralysis, and help to develop climate change adaptation into a coherent field of practice?

An obvious place to start was to create a broad synthesis of the state of adaptation, including not just what people were doing but how it was that they had made the move from awareness to action. With funding from the Gordon and Betty Moore Foundation, we undertook a survey of climate adaptation efforts in coastal North America, with a focus on activities related to natural resource management and conservation. We used a number of approaches to identify possible adaptation case studies, including telephone and web-based surveys, literature searches, web searches, presentations, workshops, informal networking at a range of meetings, requests to funders for examples from within their funding portfolio, and networking with organisations and initiatives focused on coastal climate adaptation. We have contacted over 1000 individuals and organisations to date, and have close to 200 case studies completed or in preparation. These range from small community-based efforts to transnational programs, from policy to resource management to capacity building to development. Some are complete, while others are in their early stages.

To facilitate sharing our case studies and other adaptation information, we partnered with Island Press to develop the Climate Adaptation Knowledge Exchange (CAKE), a free online resource where users can access case studies, tools, and a range of other adaptation-related resources. Much of the information is georeferenced, meaning users can search by map, text, or a combination thereof, and we are building connectivity among elements within CAKE. For instance, a user might link from a particular case study to related case studies or supporting documents in the virtual library, or to directory entries for people or organisations involved with the case study.

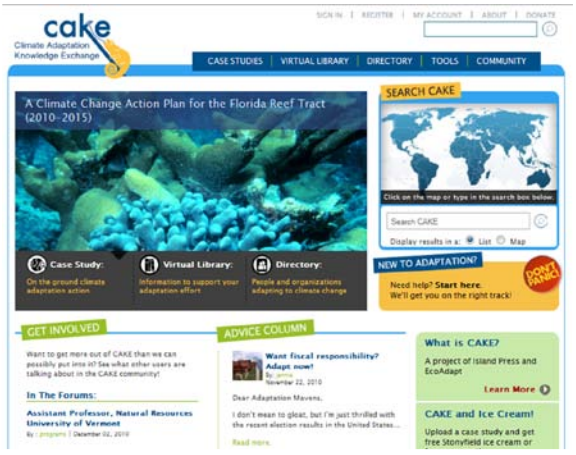
An example of the sort of case study generated by our survey and found on CAKE is the development of the Climate Change Action Plan for the Florida Reef Tract. The Florida reef system is the third largest in the world, with a rich diversity of organisms and reef types. As with many reefs globally, pollution, habitat degradation, and overharvest have been major drivers of decline, with climate change effects such as increasing water temperature and decreasing pH now exacerbating and compounding those stressors. While a variety of management actions were in place, there was no plan to holistically address and manage the ecological and economic stressors associated with climate change. Furthermore, distrust among various stakeholder groups—the fishing community, recreational users, conservation practitioners, and governmental agencies—was high. Through the concerted effort of a number of individuals and organisations, distrust was overcome sufficiently to get people to the table. In 2004 the Florida Reef Resilience Program (FRRP) was formalised, bringing together diverse interests, expertise, and management authorities. The FRRP evolved organically across disciplines, user groups, and resource management entities that leveraged resources and focused efforts on the emergent challenges. A steering committee representing federal and state agencies, fishing, diving, science, management, and environmental community spearheaded the development of a holistic five year plan, the Climate Change Action Plan for the Florida Reef System 2010-2015.

An emerging theme from this survey and case studies is the importance of building the reality of climate change and its effects into a range of planning, policy, and management efforts. Examples include incorporating climate change data and models into fisheries management, environmental impact assessments, species recovery plans, and watershed management plans. Actual adaptation action appears most likely and most sustainable when it is built into existing processes; this also increases the likelihood that existing protections will remain effective in the face of climate change. While much of the academically-driven adaptation literature addresses the question “What are all the changes that are going to happen as a result of climate change and how can we respond?”, it is just as important to ask “What do I do and how should I adjust that for the reality of climate change?”. The range of answers we’ve heard is amazing.

For more information visit:

www.cakex.org

www.ecoadapt.org



Between Science and History: History of Marine Animal Populations

Joseph Christensen, Postdoctoral Associate Lecturer, Murdoch University

The International Year of Biodiversity 2010 has seen the culmination of the Census of Marine Life (CoML), a decade-long research initiative devoted to assessing the diversity, distribution, and abundance of marine life in the world's seas. Some 2,700 scientists from across the globe have been involved in CoML, the most comprehensive inventory of global marine life to ever be compiled. Now totalling over 28 million records, CoML has established a baseline that can be used to forecast, measure, and understand changes in the global marine environment, as well as to inform the management and conservation of marine resources.

One of CoML's lesser-known components is HMAP, or the History of Marine Animal Populations, which looks at the past history of marine life - how and why diversity, distribution and abundance have changed over a long-term period. In addressing these questions, HMAP has become a bridge between science and history, and fostered significant advances in understanding the historic impact of humans on marine environments, and the influences of climate change and the natural environment on society over time. More than 100 researchers have contributed to HMAP since the year 2000, making the program the world's largest initiative in marine environmental history.

Photo by Malcolm Tull in Tanjung Luar, Lombok, 2005

In Australia, HMAP research has taken place in two sub-projects, South-East Australia and Asia. The South-East Australian component has been led by Dr Neil Klaer of the CSIRO. Using old logbooks up to the 1950s from the South-East Australian steam trawl industry, Dr Klaer has shown that the population size for commercially caught fish dropped by 75% between 1915 and 1961. Steam trawlers fished the sea so heavily that, in the space of decades, a fundamental change in population size and composition occurred. This information about historical population size has been used to inform current fisheries policy, helping to ensure that with adaptive management fishing today is kept at a more sustainable level.

The second HMAP sub-project to be based in Australia is HMAP Asia, which is directed by Professor Malcolm Tull and centered in the Asia Research Centre at Murdoch University. One of the last HMAP sub-projects to commence, HMAP Asia has grown to encompass 12 separate historical case studies from across the Indo-Pacific region - including the history of shark fishing in Indonesia, shrimp farming in Bangladesh, the growth of fish curing yards in India, indigenous whaling in the Philippines, the expansion of industrial tuna fishing in the Indian, Pacific and Southern Oceans in the twentieth century, the commercial turtle fishery of North-West Australia, and the history of recreational fishing in Western Australia. The case-studies are being assembled into a book due for publication in 2012.

HMAP Asia researchers encountered several obstacles as the project developed. Research has been hampered by the fact that source materials are written in a number of languages, that archives are spread across many different countries, and the simple fact that, for many of the region's fisheries, historical records barely exist at all. Building a team to overcome these obstacles has been one of the principal challenges confronting the project. To this end, the early addition to the project of Griffith University's Associate Professor John Butcher, author of *The Closing of the Frontier: A History of the Marine Fisheries of Southeast Asia c.1850-2000* (2004), was instrumental in contributing to the development of HMAP Asia.

A second challenge relates to outreach - drawing out the policy implications of the case studies and encouraging adaptive management. For many of commercial fisheries in South and South-East Asia, unsustainable harvests and poor management threaten the livelihood of thousands of fishers, and the food security of many more. Yet the project's examples from the turtle fishery of North-West Australia and the Shark Bay recreational snapper fishery demonstrate that scientists, managers and stakeholders can work together to monitor populations threatened by climate change impacts and human intervention and to restore those populations from the brink of collapse. In bridging the gap between science and history, HMAP Asia is shedding new insights into the past, present, and future state of marine life in the Indo-Pacific region.

For more information, visit the CoML website (www.coml.org/) or the HMAP website (www.hmapcoml.org/).

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Fisheries and Aquaculture Climate Change South East Australia Program

The South East Australia Program (SEAP) is one of the three regional programs intrinsic to the National Climate Change Action Plan for Fisheries and Aquaculture.

Dallas D'Silva is the Program Coordinator for SEAP, which is supported by co-investment from the Victorian Government Department of Primary Industries, the Fisheries Research and Development Corporation, the Australian Government Department of Agriculture, Fisheries and Forestry and CSIRO. In-kind support is also provided from State Government fisheries departments of Tasmania, New South Wales and South Australia.

Biophysical risk assessments have been developed by SEAP partners. Draft reports were due on 31 December 2010.

Results from the risk assessment process will be used to inform the development of future management and adaptation projects. For further information contact Dallas D'Silva, SEAP Coordinator on: (03) 9658 4363.

World Conference on Marine Biodiversity 2011

The World Conference on Marine Biodiversity 2011 will be held in Aberdeen, Scotland from 26-30 September 2011.

The conference will bring together scientists, practitioners and the public to discuss and advance our understanding of the issues surrounding biodiversity in the marine environment.

Keynote speakers at the conference will be Jean-Michel Cousteau, Jacqueline McGlade, Phil Bourne and Richard Brock.

For more information visit: http://www.marine-biodiversity.org

WORLD CONFERENCE ON MARINE BIODIVERSITY 2011

Contact us

Adaptation Research Network for
Marine Biodiversity & Resources
School of Geography and Environmental Studies
University of Tasmania, Private Bag 76
Hobart, TAS 7001 Australia
Phone: 03 6226 2134
Fax: 03 6226 7628
E-mail: arnmbr@arnmbr.org
Website: http://www.nccarf.edu.au/marine/

THEMES

Integration
Associate Professor Neil Holbrook
Neil.Holbrook@utas.edu.au

Biodiversity & Resources
Dr Alistair Hobday
Alistair.Hobday@csiro.au

Communities
Professor Tim Smith
Tim.Smith@usc.edu.au

Markets
Dr Sarah Jennings
Sarah.Jennings@utas.edu.au

Policy
Associate Professor Marcus Haward
Marcus.Haward@utas.edu.au

If you would like to submit an article to the MAB, please send correspondence to: arnmbr@arnmbr.org

This issue of the Marine Adaptation Bulletin has been compiled by Anna Lucas and Clare Brooker.

MAB Editors: Neil Holbrook and Anna Lucas

Marine Adaptation Network Partners:

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