A healthy coral reef. Tourism, food and coastal protection are examples of services provided by this coastal ecosystem.

Photo: P. Mumby
Selayar. The CCRES pilot site in Indonesia.
Photo: A. Hooten
LEADERSHIP MESSAGE

Our project development objective (PDO) is to design and support the uptake of innovative models for valuing mangrove, seagrass and coral reef ecosystem services with the potential to enhance the sustainability of marine-based enterprise and marine spatial planning in select coastal communities.

The project aims to help communities capture more of the benefits from healthy ecosystems and promote conservation, by demonstrating the links between ecosystem health, local benefit capture and community welfare.

In working towards achievement of this objective, 2016 has been our busiest year to date. We have consolidated the design work of the past three years, and are now preparing the pathway for the uptake of CCRES outputs by coastal managers, policy officers and decision makers in the Philippines, Indonesia and within the East Asia-Pacific region more broadly.

With up to 17 tools, models and information products in the final stages of development, the task is now to integrate these tools or models into a package aimed at assisting end-users to manage the challenges facing them.

We started the year with a Stakeholders Forum in Manila, bringing together over 130 interested stakeholders and project members to view the proposed tools and models, and to ascertain how these could be used in their day-to-day roles. The feedback we received has been essential in planning the final stages of tool development — that is, what these tools and models should look like to ensure maximum uptake and usage.

From here the teams continued to refine the tools and models, working in both El Nido (Philippines) and Selayar (Indonesia) to develop and test them in pilot sites to ensure usability, applicability, accessibility and transferability of the end product. Some of the highlights have included the uptake of a policy tool aimed at identifying appropriate reserve coverage to rebuild fisheries. The tool, developed by Peter Mumby and Nils Krueck, is developing policy goals for the area set aside for no-take reserves as part of a strategy to protect marine biodiversity and rebuild reef fisheries in Indonesia. This knowledge and information has been transferred to MMAF spatial planners, COREMAP CTI project staff and WWF through workshops and seminars.

At both the El Nido and Selayar pilot sites, the systems analysis team is in the final stages of developing the simulation models and reconciling data requirements based on the dynamic hypothesis developed as part of the focus group discussion outcomes. All five teams have successfully developed models around the identified socio-economic problem.
Work is proceeding rapidly on the business development models which will enable existing business and non-business professionals to better evaluate a range of business tools, and to assess how changes to existing businesses and/or investments in new business concepts in a given industry can better align local economic activity with long-term marine ecosystem health and value.

Excitement is also building for the Project’s Eco-Biz Challenge led by Damian Hine, with support from Andy Harvey and Mariglo Laririt in El Nido and Anya Phelan in Selayar. The challenge is designed to identify local entrepreneurs and develop a deeper understanding of enterprise-level solutions to environmental issues which are possible at both pilot sites.

Throughout the year project members have been involved in not only the design activities but have been instrumental in building a large base from which to launch these tools in mid-2017. We have brokered relationships and partnerships both locally, nationally and regionally and set in place a broad framework for the dissemination and delivery of the tools. We have delivered 14 information sharing and dissemination campaigns and built on our knowledge platform through our communications team. Examples of how we are building the knowledge base and broadening the networks aware of the work include Jim Sanchirico and Ted Gilliland presenting at a World Bank webinar on A New Tool for Simulating the Impacts of Fisheries Policies in Developing Countries: The Bio-LEWIE Model.

The Bio-LEWIE model they are developing can be used to show the impacts of policies such as the promotion of alternative livelihoods (e.g. tourism) and the creation of new Marine Protected Areas (MPAs). Our CCRES researchers from the University of the Philippines Marine Science Institute (UPMSI), Cornell University and UQ also shared their work at the International Coral Reef Symposium (ICRS 2016) in Hawaii, USA.

Our year ended with the CCRES project’s Mid-Term Review. The review’s objective was to assess project performance; likelihood of achieving the PDO by project closure; and implementation progress, sustainability, efficiency and effectiveness. The review has highlighted expectations for the next 18 months and its recommendations will guide the development of the Tools Implementation Plan aimed at ensuring maximum engagement with end-users and stakeholders, and uptake of our tools. It is truly a sign of success when someone sees the value in years of hard work and utilises the end product in their work to achieve better outcomes for marine and coastal ecosystems. It is our ambition to ensure this happens over the next 18 months.

2016 has been a busy but productive year and we look forward to working with our team, partners and end-users of the tools over the coming 12 months to ensure we achieve the uptake which is core to our PDO.

Melanie King
Professor Peter Mumby
Mark Paterson
Professor Damian Hine
Dr Carl Smith
2016 HIGHLIGHTS

JANUARY
Investigating what motivates fishers
A research team led by Masters student Lisda Haryani from Hasanuddin University (UNHAS), Makassar, Indonesia, explored the situation of six local villages at Selayar, Indonesia, using participatory interviews with coral reef fishers, village staff and local businessmen, to gain an understanding of the pressures felt by reef fishers and their willingness to shift their fishing ground.

Mapping dynamics in coastal communities
The systems analysis team based at the Center for Coastal and Marine Resources Studies at Bogor Agricultural University (IPB), Indonesia, undertook the second round of focus group discussions in Selayar to validate and refine the results received from their previous visits. Simulation models are now being developed, validated and tested.

Welcoming new partner for business development
In January, CCRES welcomed the Economic Research Center (P2E) at the Indonesian Institute of Sciences (LIPI) as the new partner working with Prof Damian Hine at The University of Queensland (UQ), Australia. Led by Dr Agus Eko Nugroho, the P2E team will enrich the expertise and innovation for the business development activities in Indonesia.

FEBRUARY
Involving stakeholders in product development
More than 130 people attended the inaugural CCRES Stakeholder Forum in Manila, the Philippines. The forum was aimed at seeking input, advice and guidance on the suite of tools being developed under the project. Feedback from participants was valuable and will be incorporated into the development and validation of the tools.

Analysing the value-added sector
Researchers from UQ and Cornell University, USA, completed a site visit as part of the analysis of the value-added sector at El Nido, the Philippines. Rice, coconut and cashews were among the industries reviewed.

MARCH
Engaging with regional partners and stakeholders
CCRES participated in the PEMSEA-convened regional workshop on developing State of the Oceans & Coasts (SOC) reports for its member countries, and the East Asian Seas region as a whole. The subsequent report will focus on the blue economy, highlighting ocean economy, ecosystem services, losses from unsustainable activities, opportunities for innovative and sustainable investments, and supporting governance mechanisms.

MAY
Advisory Board & Technical Steering Committee
The CCRES Advisory Board meeting was held in Jakarta, Indonesia, with the design and testing of CCRES tools as a clear priority. During this time, the Technical Steering Committee visited the Indonesian pilot site of Selayar to explore the environmental and technical challenges at the site, and to see the progress of CCRES work undertaken there.

Collecting additional data at El Nido
El Nido field sites were revisited for additional measurements on crevice abundance, reef fish, coral recruits, turf and macroalgae. These data will be incorporated into models and analysed for various uses in CCRES.

Understanding the fisheries and agricultural sectors
Researchers from De La Salle University (DLSU), Manila, the Philippines, completed site visits and meetings with business-related enterprises in the fisheries and agricultural sectors in El Nido. The findings are being incorporated into the business development work and business competition being undertaken in El Nido.
Getting business activity underway at Selayar
Researchers from UQ and LIPI initiated the business activity in Indonesia by conducting their first scoping visit in Selayar. Results from the visit have been catalogued in a report with outcomes to be incorporated into the next stages.

Joining global stakeholders to talk SDGs
CCRES participated in the 8th GEF International Waters Conference held in Sri Lanka. The meeting, with its theme *Scaling-Up GEF IW Investments from Source to Sea and Beyond in the Context of Achieving the UN Sustainable Development Goals*, prioritised “learning tracks [on] catalyzing transformation and scaling up investments; strengthening governance processes to sustain project interventions; and data to policy” (http://iwlearn.net/events/IWC8).

JUNE
Coming together for business development
A business roundtable was held in Manila, bringing together participants from industry, NGOs, donor organisations, regional organisations and research institutions. The discussion focused on developing commonalities including identifying business opportunities, challenges and emerging opportunities around new business investment, barriers and catalysts for business scaling and replication, and building entrepreneurial infrastructure and support.

Presenting at our first World Bank webinar
A webinar titled *A New Tool for Simulating the Impacts of Fisheries Policies in Developing Countries: The Bio-LEWIE Model* was presented by Prof Jim Sanchirico and Ted Gilliland from the University of California, Davis (UC Davis), USA. The Bio-economic Local Economy-Wide Impact Evaluation (Bio-LEWIE) model can be used to show the impacts of policies such as the promotion of alternative livelihoods (e.g. tourism) and the creation of new Marine Protected Areas (MPAs).

Showcasing our science to the world
CCRES researchers from the University of the Philippines Marine Science Institute (UPMSI), Cornell University and UQ shared their work at the International Coral Reef Symposium (ICRS 2016) in Hawaii, USA. CCRES Chief Scientist Prof Peter Mumby gave a plenary.

JULY
Gathering data for a hydrodynamic model
Leilani Solera and a team of researchers from UPMSI travelled to El Nido to measure ocean currents. The trip was the last in a series of field surveys aimed at examining how tide and monsoon regimes can change the magnitude and direction of currents in Bacuit Bay. Data from this work will inform the development of the connectivity model, which will be integrated into the Fish SPACE model.

AUGUST
Examining watersheds, plumes, sedimentation
Researchers Bayosa Aya Carino-Valdez from UPMSI, Dr Rene N. Rollon from the Institute of Environmental Science and Meteorology (UP), and Engr Bryan Hernandez from the College of Engineering (UP) travelled to El Nido in August. Their mission was to examine four major watersheds and their coastal areas, and to establish sites at two rivers for longer term measurement of discharge. The team visited watersheds in Barangays Barotuan, Bucana, New Ibajay, Pasadena and Manlag observing their size, surrounding land use, and other distinct conditions. The data collected at those locations is meant to calibrate watershed and plume models which can provide information on sedimentation for the Fish SPACE model, as well as the other CCRES tools.

Building capacity for data collection
UC Davis researchers conducted survey training and capacity-building workshops for over 40 researchers and professors at UNHAS as part of the Bio-LEWIE activity in Selayar. Here, they detailed their methods to create and collect data on the ground.
SEPTEMBER
Developing skills in planning, MPA design
The combined expertise of UQ, the University of Melbourne, Australia, and WWF Indonesia came together to train 30 participants in basic and advanced Marine Protected Area (MPA) design methods at a marine spatial planning workshop at Denpasar, Indonesia.

Scoping behaviour change research activities
Two research teams, comprising psychologists, social scientists and marine ecologists, began fieldwork with a scoping mission to Selayar. The researchers are exploring how CCRES can empower local communities to change the way they interact with the environment in order to improve their health and wellbeing, and sustain their coastal ecosystems.

Kicking off Bio-LEWIE at Selayar
Household surveys at Selayar for the Bio-LEWIE model also commenced. Data was collected from 487 households from 12 of the 52 villages in the six sub-districts of Selayar Island, and from 256 businesses in Benteng.

NOVEMBER
Joining PEMSEA to catalyze the blue economy
CCRES attended PEMSEA’s Regional Workshop on Catalyzing Blue Economy Investment in East Asia held in Xiamen, China. The workshop provided an excellent opportunity to present blue economy investments in East Asia, discuss the barriers and solutions towards establishing a pipeline of blue economy investments, and to connect with finance and investment experts.

Developing an eco-challenge for business
The Business Development team visited El Nido to develop the forthcoming Eco-Biz Challenge with local stakeholders. The visit was a success with a lot of enthusiasm and commitment from local organisations to support the challenge.

Identifying sustainable household behaviour
As part of developing a pilot intervention for promoting positive environmental behaviours among parents and children (households), members of the behaviour change team from UQ, Currie Communications and IPB ran nine focus groups with men, women and young adults in three villages at Selayar. The data collected from more than 100 villagers will be analysed to identify a candidate behaviour for promotion during May 2017.

Limestone cliffs are home to balinsasayaw (swiftlets) nests, a major income source in El Nido.
Photo: A. Hooten
TOOLS UNDER DEVELOPMENT

The CCRES project is developing innovative tools that demonstrate the link between healthy coral reef, seagrass and mangrove ecosystems, and community welfare. These tools will assist coastal managers and planners to strengthen implementation of ecosystem management plans.

During the past year, and as part of the Mid-Year Review process, CCRES has refined its suite of tools.

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<td><strong>Tool #11</strong></td>
<td>SESAMME is a mapping tool, available as an iPad app, which enables researchers and stakeholders to build interactive pictures of socio-ecological systems. It is designed to capture information about system components (resources, activities, pressures, decisions) from local communities and help them visualise how these components interact. CCRES is using SESAMME to understand specific socio-ecological problems of fish catch decline, mangrove loss, water pollution and food insecurity in the East Asia-Pacific region.</td>
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<td><strong>Tool #12</strong></td>
<td>Simulation models quantify interactions between socio-economic systems and ecosystems. They can be used to explain to decision-makers how the interactions within systems affect system behaviour. They can also be used by decision-makers to run scenarios and explain how these affect the trajectory and behaviour of the system over time.</td>
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<td><strong>Tool #13</strong></td>
<td>A simulation and storytelling tool that helps managers to understand and visualise the dynamics of socio-ecological problems and assess the influence of alternative scenarios on system trajectories over time.</td>
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<td><strong>BUSINESS DEVELOPMENT</strong></td>
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<td><strong>Tool #14</strong></td>
<td>Enabling business and non-business professionals to better evaluate value chains, pricing, competitive dynamics, and profitability; and to assess how changes to existing businesses and/or investments in new business concepts in a given industry or sector can better align local economic activity with long-term marine ecosystem health and value.</td>
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<td><strong>Tool #15</strong></td>
<td>A framework to improve commercial outcomes for ideas. It includes the Eco-Biz Challenge — a competition designed to identify local entrepreneurs and develop a deeper understanding of enterprise-level solutions to environmental issues which are possible at both pilot sites.</td>
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<td><strong>PEOPLE &amp; ENGAGEMENT</strong></td>
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<td><strong>Tool #16</strong></td>
<td>This tool is a community-based behaviour change guide, comprising a training course and workbook, for use by practitioners who seek to foster sustainable behaviours in parents and children living in coastal households in Indonesia.</td>
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<td><strong>Tool #17</strong></td>
<td>This is a diagnostic and planning toolkit, consisting of a set of linked frameworks, principles and strategies, designed to assist governments, communities and NGOs to foster sustainable marine resource use and livelihoods, across multiple levels of formal and customary governance.</td>
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Bontolebang village, Selayar, the site of our pilot intervention for promoting positive environmental behaviours.
Photo: M. Paterson
SCIENCE & DISCOVERY

QUANTIFYING THE VALUE AND MARKET POTENTIAL OF CORAL REEF AND MANGROVE ECOSYSTEM SERVICES

VALUING CORAL REEF FISHERIES PRODUCTIVITY, IN RELATION TO HABITAT QUALITY

Knowing how many fishers can fish from a particular reef and understanding the specific impact of changes in habitat quality would be very useful information for people managing coastal environments across the East Asia-Pacific.

The aim of the food web modelling framework is to develop a model that can estimate a reef’s productivity; that is, how many fish it can support based on its structure and health. This will assist marine spatial planners and coastal resource managers from government and community agencies to estimate the value of coral reef fisheries and their potential to change over time, given different habitat impacts.

The framework and model is now complete for both El Nido (the Philippines) and Selayar (Indonesia) and will potentially inform the answers to questions such as:

- How much fish production may be lost if XYZ happens?
- How much production can we gain from different management strategies?
- Where should we fish? Where should we protect?
- How much fishing/how many fishers can a particular reef support?
- How might catches (size and type) change over time and in different locations?

Results from the modelling are showing that some habitats support biomass but relatively little productivity. Analyses have shown that intermediate complexity reefs may provide the best fishing grounds and the healthiest, most complex reefs may be most suited to protection.

In the Indonesian pilot site of Selayar, data is showing that benthic turf productivity appears to be largely driven by exposure. It has also been noted that variation among sites can also drive significant changes to productivity estimates.

To finalise the testing and validation of the framework, end-users will be engaged in early 2017 to review and test it.

A first draft of the user-friendly look-up table tool for the food web model is available. This table as well as a Bayesian Belief Network (BBN) decision-support tool will enable end-users to predict fish biomass and fisheries productivity based on basic and easily measurable information on local coral reefs, including refuges, algal production, invertebrate abundance and likely fishing pressure (see Figure 1). Even if information is scarce or not available for any given location, the BBN will use data collected through CCRES to make quantitative estimates of the most likely outcome.

The food web model will be communicated using a BBN, which predicts the probability of outcomes.
based on different variables and dependencies. It will show the probability that a reef will have a high, medium or low density of fish based on a set of variables such as refuge density or level of fishing. A user-friendly interface which summarises the results of the model will allow users to play with the values for variables to predict outcomes.

**VULNERABILITY OF REEF VALUE TO NATURAL AND ANTHROPOGENIC STRESS**

The reef vulnerability activity aims to integrate coral reef vulnerability and associated implications for ecosystem services into Marine Spatial Planning (MSP). The work undertaken here supports several management activities:

1. Gauge the response of reefs to various management interventions, helping users to identify where they might obtain the greatest return for effort.

2. Provide realistic future scenarios for reefs that help people maintain realistic expectations for ‘success’ attributable to management.

3. Provide a baseline expectation for reef trajectories that can be compared to reef monitoring data (are the reefs actually responding the way we expect and if not, point out what is surprising).

4. Provide a tool that integrates the impacts of multiple stressors on the reef, based on scientific understanding of the underlying ecology rather than using simple metrics which entail many assumptions.

As part of the activity, a coral reef trajectory model is being developed using coral recovery rates and trajectories observed in Indonesia. It will capture the effects of natural (storms, crown-of-thorns starfish outbreaks) and anthropogenic (thermal stress, water quality impacts, fishing) stressors on future coral trajectories, and help assess the spatial distribution of reef areas most amenable to local management actions.

The research team has already developed a complex spatial model of coral reef ecosystems that was tested and found to capture the dynamics of the Great Barrier Reef accurately (Ortiz et al 2014 Nature Climate Change). The model is currently being extended to factor in eutrophication and fishing effects with anticipated completion in the first half of 2017. The team will then capture the complex behaviour of the model within a Bayesian Belief Network which provides a simple, user-friendly interface. This is anticipated to take place within the first six months of 2017.

**GENERATING ECONOMIC INSIGHTS INTO LOCAL ECONOMIES**

CCRES is exploring models that could help show how tourism affects local fish stocks and economies.

This modeling framework could help policymakers navigate the economic and ecological linkages that determine tourism’s impacts on poverty and the environment in developing countries.

In other work in Indonesia, data collection for the Selayar Bio-LEWIE is now complete. Data was collected by a team of 16 enumerators who were current and former UNHAS students using tablets and Open Data Kit data collection software. Enumerators worked in pairs, with at least one enumerator per group fluent in the local language Bahasa Selayar (continued on page 14).
MEET THE TEAM

DAMIAN HINE

EVERY two or three weeks, you’ll find Associate Professor Damian Hine on Moreton Bay north of Brisbane. A keen sailor, he sees the opportunities that present when wind and water meet. Perhaps that’s why he works at the intersection of innovation and strategy.

Through The University of Queensland Business School, he leads CCRES’ business development project with a focus on enterprise development and innovation.

“What we are seeking to do is build on the problem identification work that has come out of CCRES, and find enterprise solutions that address these problems,” says Prof Hine.

“We are looking at ways to help businesses make a difference in their communities through innovation, and at the same time assist coastal ecosystems.”

Prof Hine has helped build sustainable businesses across a range of sectors, from high-technology biotechnology and pharmaceuticals, telecommunications and mining services, to innovative horticultural firms and industries.

But he is also comfortable working with very small businesses and communities in emerging economies, and it is this which brings his greatest satisfaction.

“Through my work I have helped hundreds of people to bring their business ideas to fruition — in Latin America, Europe, Asia and the Pacific, as well as rural and regional Australia.”

He is hoping to build on that achievement with CCRES, through creation of a business development model and a framework to improve commercial outcomes for ideas.

“Our project offers a unique opportunity to boost sustainable enterprise development and at the same time raise environmental awareness,” says Prof Hine.

“Working closely with the communities of El Nido and Selayar, we aim to identify local entrepreneurs and provide them with business training. Encouraging eco-friendly businesses in this way has the potential to generate new jobs and advance the local economy.

“Particularly in emerging economies, wealth distribution can be achieved by creating successful businesses rather than just relying on policy. This can make a real difference in communities.

And what turns a creative idea into a successful business?

“It’s about empowering people on the ground, boosting their capabilities, and giving them the tools to solve problems now and in the future.”
A total of 487 households were surveyed from 12 of the 52 villages in the six sub-districts of Selayar Island. The surveyed villages were Bonea Timur, Maharayya, Mekar Indah, Bontomaranu, Benteng Selatan, Kalepadang, Bontotangnga, Bontolebang, Binanga Sombayya, Laiyolo, Laiyolo Baru and Appatanah. From each of the villages, two sub-villages were selected for surveying, with approximately 40 households randomly selected for sampling.

Household surveys gathered information about household roster and demographic information, household production activities (fishing, agriculture, livestock and enterprise), purchases, food security, and finance. Of the 487 households sampled, 152 households engaged in fishing activities, 245 households engaged in agricultural activities, and 180 households operated small businesses.

Households engaged in fishing activities were asked questions about fishing trips in the wet and dry season. Details on the location of fishing activities, boats and gear used, time spent fishing, and fish harvest, were gathered for unique trip types. Households could define up to three types of fishing trips per season, distinguished primarily by location or gear used. Of the 152 households engaged in fishing activities, 144 households fished during the dry season and 116 households fished during the wet season.

A total of 256 registered businesses were surveyed from Benteng, Benteng Utara and Benteng Selatan. Business surveys collected information detailing each business’ use of hired labour, expenses, sales and financing. When applicable, information on fish inputs was collected.

Overall, the Bio-LEWIE data collection was a great success. The enumerators enjoyed the experience as they learned more about Selayar and the importance of local coral reef ecosystems.

## TRAINING IN RESEARCH METHODS

During August, UC Davis researchers held survey training and capacity building workshops in Makassar at UNHAS. The workshop, open to interested researchers and professors at UNHAS, detailed the research methods employed to create and collect data for the Bio-LEWIE in Selayar. Over 40 researchers and professors from UNHAS attended the workshop in addition to the 17 members of the Indonesian Bio-LEWIE survey team. After participating in this workshop, local experts and local researchers are better equipped to learn from future Bio-LEWIE results and reports, making the research more accessible to a wider audience of local experts and researchers.

**COASTAL DEFENCE**

Protecting shorelines is a service provided by coral reefs — safeguarding communities, livelihoods and coastal infrastructure across the East Asia-Pacific.

CCRES researchers from The University of Queensland’s Coastal Engineering Group are developing tools to demonstrate the role that reefs play in protecting shorelines and what might happen to those shorelines if reefs are damaged or sea levels rise. This knowledge can inform coastal management and planning decisions.

The work of the team of Professor Tom Baldock, Dr David Callaghan and Dr Behnam Shabani to date has involved wave modelling at both the El Nido and Selayar pilot sites. They have also looked at the geomorphology (size and shape) of a range of coral reefs, and developed a model to predict the degree of protection given to beaches by these reefs using parameters such as reef geometry, reef health, reef-bay configuration and wave height.
The team is now creating a web-based tool to illustrate what is likely to happen to the shoreline behind a reef when various factors in the environment change. Users of the tool will be able to easily and rapidly estimate the effectiveness of local reefs as a defence against waves and storm surges, without the need to understand complex models or access engineering expertise.

Users will enter parameters describing the reef (e.g. width, length, depth of the reef flat, wave height, lagoon depth), and then change these parameters to create a new scenario for that reef. Comparing the two scenarios will show users the impact of the changed conditions. For example, if the measure for reef crest depth were lowered from 1 metre to 1.5 metres to simulate sea level rise or loss of coral through degradation, the tool will demonstrate the extent of the coastal erosion that can be expected in a particular location with sea-level rise.

Users will also be able to predict wave induced flow velocity and wave height on the reef flat under different scenarios. The wave induced flow velocity is important in terms of the degree of turbidity, which can damage reef health, but is also important in delivering nutrients and mixing. Increased wave height can create unsafe conditions for fishers or tourism activities or lead to breakage of coral.

The tool can also be used to predict the impact of a change in reef structure from practices such as bombing that alter the shape and roughness of a reef.

The team also hopes to develop a communications tool for use at the community level to demonstrate the vital role reefs play in coastal protection. This may help to discourage destructive practices and encourage the conservation of reefs.
HUMAN HEALTH AND SEAGRASS

Dr Joleah Lamb from Cornell University and her colleagues, including researchers from UNHAS, have found seagrass ecosystems are important to the health of people and marine organisms, including coral reefs, fisheries (wild and farmed) and seaweed in coastal areas worldwide.

The study, co-funded by CCRES, found seagrass meadows reduce bacteria pathogenic to humans and marine life by up to 50 percent.

In addition, not only could seagrasses help with improving water quality in ever more populated coastal zones (it is estimated that one billion people will inhabit low-lying coastal zones by 2060), they could also play a key role in sustaining the rapid increase of aquaculture in the face of global food shortages.
Removing human pathogens from water is essential for human health. Plants, with their natural biocides, play a vital role — one that can offer significant economic benefits. Although seagrasses are known to produce natural antibiotics, they had not been evaluated for their ability to remove pathogens from the ocean, or for their ability to mitigate disease there.

Working off four islands in South Sulawesi, Indonesia, the research team, including Prof Drew Harvell, Cornell University, and Prof Jamaluddin Jompa and Ms Nur Abu from Hasanuddin University, Makassar, sought to assess the influence of seagrass on marine microbial pathogens and disease. They found the presence of the bacteria Enterococcus to exceed recommended human health level by 10-fold. However, levels of the bacteria were reduced three-fold in the presence of seagrass.

Further studies revealed that the abundance of marine fish and invertebrate pathogens were 50 per cent lower when seagrass was present. And, field surveys of over 8,000 reef-building corals adjacent to seagrass meadows showed two-fold reductions in disease compared to corals without seagrass neighbors.

Findings demonstrate that by reducing waterborne pathogens and improving water quality, seagrass ecosystems provide coastal communities with an essential service — water filtration — with a substantial economic value.

The findings were published in Science magazine in February 2017.
Reef fish. Rebuilding fish biomass is an outcome from better marine reserve design.
Photo: P. Mumby
MARINE SPATIAL PLANNING AND RESERVE DESIGN

MARINE RESERVE NETWORK DESIGN

Work undertaken on the marine reserve network design has been very successful with the completed design aiming to:

- Optimize reserve areas
- Optimize reserve sizes
- Model larval connectivity of important fisheries and/or conservation species
- Optimize reserve network designs
- Measure the value of reserve networks
- Integrate ecological and economic reserve network optimization

Progress has been made in both major components of this activity: (1) advancing generic models for rule-of-thumb decision-making on marine reserve network design under data-poor fishery conditions, and (2) developing holistic marine protected area optimization methods. However, progress for this activity goes beyond initially proposed aims, including the development of novel MPA design algorithms and their integration into the standard MPA design software Marxan.

Generic models for rule-of-thumb MPA design

Due to insufficient data on the catch composition and relative importance of fishery species at both field sites in El Nido and Selayar, generic modelling scenarios were used to support decisions on the total coverage and local size of individual no-take MPAs needed to rebuild fishery productivity.

In line with scenarios representative of fishery conditions in Selayar and El Nido, the research team’s recommendation is to close about 30 per cent of fished coral reef habitat to any fishing. Achieving this target should help rebuild fish biomass in protected areas to such an extent that the subsequent export of young fish from MPAs to fishing grounds will deliver net increases in fishery catches. The recommendation is based on the assumption that fishing activities are highly diverse (multiple species and types of gear used) and that overfishing is considerable or heavy.

The modelling approach used to make the above recommendation calculated numbers of fish protected in reserves of various sizes, and compared these values to expected fish densities in a pristine scenario without any fishing. The approach is described in detail in a draft manuscript that is now ready for submission, representing the third CCRES publication on advanced MPA designs. Calculations of larval export for various reserve sizes formed part of a complementary analysis that used the first comprehensive data on realised larval dispersal distances of two key fishery species in the Indo-Pacific: the stripey snapper *Lutjanus carponotatus* and the bar-cheeked coral grouper *Plectropomus maculatus*. 
Holistic reserve network optimisation frameworks

The team has recently finalised the development of a novel technique to optimise the dispersal of marine larvae within and among MPAs. Larval dispersal is a critical component of marine population dynamics and thus MPA design for both biodiversity conservation and fisheries. The new technique is based on a combination of formulas (objective functions), which allow spatial planners to reconcile potentially conflicting treatments of larval dispersal characteristics in support of biodiversity conservation and fisheries objectives. Currently available MPA design methods tend to either ignore larval dispersal entirely (most common), or they focus on retaining larvae within MPAs in order to support the persistence of protected populations. Uniquely, the team’s novel approach can reconcile this simple conservation-focused objective with various other management objectives and more advanced, associated treatments of larval dispersal information. For example, this includes the export of fish larvae from MPAs to highly fished sites, a process known to be the most critical driver of the fishery functioning of MPAs.

This approach allows for a balance of three principal dispersal characteristics: larval retention in MPAs, larval import into MPAs, and larval export from MPAs to unprotected locations. It also allows users to adjust whether the strength (numbers of larvae) and/or diversity (numbers of larval sources) of larval connections between sites are prioritised. For example, prioritising the export of many larvae from MPAs to highly fished sites can be expected to support fishery productivity while prioritising the protection of many larval sources of highly fished sites can be expected to support fishery persistence. To ensure that high priority locations for MPAs are selected so that, for example, they will maximally support fisheries, export destinations need to be ranked according to their fishery value. Various other rankings are equally feasible, and rankings can be included not only for export destinations but also to prioritise the sources of larval import. For example, high priority candidate locations for MPAs can be identified based on both (1) the degree of larval export to important fishing grounds, and (2) the import of larvae from putatively undisturbed sites, which will help safeguard protected populations against unforeseen disturbance.

Along with generic recommendations on the coverage and size of no-take MPAs described above, our larval dispersal optimisation approach is currently being applied to advise government officials on the modification and extension of MPA networks across the Sunda Banda seascape in Indonesia. These and more specific local recommendations on the total coverage, size and placement of MPAs (and reserves within them) have been made in collaboration with WWF Indonesia for areas around southern Sulawesi, the Forgotten Islands (between Wetar and Tanimbar), and the Kei islands.

In September, a marine spatial planning workshop was held in Denpasar bringing together expertise from UQ and the University of Melbourne (Dr Nils Krueck, Prof Peter Mumby, Dr Eric Treml, Prof Hugh Possingham) and four previously trained supervisors based at WWF Indonesia (Estra Divari, Christian Handayani, Dirga Daniel and Taufik Abdillah) to train 30 workshop participants in basic and advanced MPA design methods. Participants had a diverse level of prior expertise, ranging from very little to a primary work focus on MPAs. Most participants were government employees (16) in charge of decision-making on marine spatial plans while others worked for locally active NGOs (8) and universities (6) who support decisions on marine spatial plans. Most government participants were CCRES associates working for Indonesia’s Ministry of Marine Affairs and Fisheries (MMAF).

The training included a combination of introductory lectures, presentations of case studies, and hands-on exercises. WWF will include all workshop materials and models in an advocacy and national marine critical habitat campaign that will be held from January to June 2017. As one of the activities, WWF is developing various publication materials such as infographics and factsheets for the public and government/MPA managers to emphasise where new MPAs are to be located and how big no-take zones should be. Publication materials will be distributed across all campaign activities, including educational site visits, field expeditions, and a national symposium on MPAs. In the meantime, the advocacy team continues to promote and integrate CCRES results into national programs of Indonesia’s MMAF.
UNDERSTANDING THE MOVE TO PELAGIC FISHERIES IN INDONESIA

Are fishers at Selayar willing to shift from fishing on coral reefs to pelagic (open sea) fishing?

This is the question that research led by Masters student Lisda Haryani from UNHAS — under the supervision of Prof Jamaluddin Jompa from the Faculty of Marine Science and Fisheries at UNHAS and CCRES Chief Scientist Prof Peter Mumby — is seeking to answer for provincial policymakers.

Heavy fishing of coral reefs has had a serious effect on coral reefs in Selayar. With most small villages relying on fishing for their livelihoods, local communities find themselves facing increasing levels of poverty associated with declining reef ecosystems.

In each location, reef fishers, village staff and local business people involved in coral reef fishing, selling, trade and management were surveyed. In the end, 92 respondents ranging in age from 15 to 85 years old were surveyed (some have fished in coral reefs since the 1930s).

Some of the findings show that the estimated annual catch by weight per family for coral reef fishers has moderately decreased. Most of the reef fishers in the six villages fall into the lower income category, meaning that most of them cannot afford their daily needs and their children’s education needs. All of the reef fishers in the surveyed villages have some alternative livelihood, besides fishing. Based on three different levels of monetary incentives and catch scenarios, most of the fishers would be willing to shift to pelagic fishing.

The punishing effects of reef ecosystem damage have made sustainable management of coral fishing more important than ever. One potential solution being evaluated by the researchers is encouraging local fishers to move from coral reefs towards the open sea.

Bu Lisda is exploring the situation in six local villages in Selayar to gain an understanding of the pressures currently felt by reef fishers and their willingness to shift their fishing ground. The study sought to look at how urgent it was for local fishers to shift to pelagic fishing, what challenges they would face in the move, and how they would be encouraged.
DESIGNING MARINE RESERVES TO RECONCILE ECOSYSTEM SERVICE TRADE-OFFS

The Fisheries for Sustaining People’s Access through Conservation and Equitable Systems (Fish SPACE) model, which is being developed by a team from the UPMSI and DLSU, is nearing completion, with all necessary programming being finalised. The model is currently being tested and refined to improve performance, and to consider how information from its supporting models will be integrated. Simulations are being run using different variables to force the standing stock biomass to collapse and recover, with subsequent results being compared across relevant parameters and variables. Simulations are also being run for various levels of fishing pressure and protection to understand the interaction between the two parameters and their effect on the standing stock biomass and model performance. Local fish and fisheries experts have also been initially engaged to gain feedback and buy-in for the model.

Complementary models to provide inputs to Fish SPACE are the hydrodynamic and connectivity models, and watershed and plume models. The hydrodynamic model has been field validated for the final time, further refined, and is now complete. It has been used to produce hourly current vector outputs for El Nido for the period January 2014 to February 2015. In turn, these outputs were used to simulate fish spawning and larval dispersal in the connectivity model. Using a modified particle dispersal model, connectivity matrices were developed for the relevant spatial domain.

Using the random Forest model package, coral reef condition data was interpolated across all the reefs in El Nido to generate a habitat quality map. This map will eventually be integrated into Fish SPACE with corresponding carrying capacity and growth values for different reefs with different conditions. It was also used as the basis in scaling connectivity for the Fish SPACE domain. Data from the resulting connectivity matrices will be integrated into Fish SPACE as a static parameter that represents a time-averaged connectivity pattern. Information derived here will then be used to develop fish recruitment rates that vary across the spatial domain of the main model.

Fieldwork was completed for the watershed and plume models. Results from this work are being compiled in a separate technical report.

Fish SPACE and its supporting models will contribute to describing ecosystem processes, which will also be considered in the development of a MPA network design framework. For this particular work, a literature review has been conducted to describe the trade-offs in the achievement of objectives such as connectivity and fisheries, and to evaluate the likelihood of implementation for the different governance modes across the Philippines. It has been found that governance modes such as the national government protected areas and local government alliances have the ability to achieve connectivity and fisheries’ objectives more efficiently compared to individual local governments. However, the likelihood of implementation of network designs for these scales can also have high costs, which should be considered in the planning processes. The document is being prepared and will be finalised in concert with the completion of the models.

Expert Feedback Workshop at UPMSI with local fish and fisheries experts.
Photo: UPMSI
UNDERSTANDING GOVERNANCE FACTORS IN MPA NETWORK DESIGN

Activities for the governance research are also continuing to provide inputs to contextualise the management and policy recommendations that can be derived from the use of the models, and to facilitate their uptake. The governance research also presents an opportunity to provide for an MPA network design framework that considers a system’s social, political and economic factors, apart from its ecological and biophysical attributes. This year it has yielded preliminary results on the history and transformation of governance in El Nido, and for a social network analysis on key actors.

Using consolidated innovation history data, a comprehensive timeline of events has been built to describe various conservation initiatives, human disturbances, natural catastrophes, and other events that led to the current condition of resources in El Nido.

Initial analysis of the timelines showed the peak of conservation initiatives from 2006 to 2009, with only a few human disturbances identified. Most of these conservation initiatives were related to coastal and marine ecosystems implemented to address habitat degradation caused by fisheries and some tourism activities. The next steps include further analysing the data by looking at different themes across the timelines, and using interview data to understand the causes of such trends. There are also plans to use empirical data (e.g. tourism data, road development) to understand the causes of transformation of El Nido, and its development trajectory.

Preliminary analysis of stakeholder network maps showed different configurations and densities of ties across different stakeholders. Key stakeholders have also been identified based on calculated centrality scores.

SHARING OUR RESULTS

Some of the updates described here were presented at the Annual Planning and Stakeholder Forum in Manila in February, the 13th International Coral Reef Symposium (ICRS) in Hawaii in June, the Annual Palawan Council for Sustainable Development Forum in Puerto Princesa in the Philippines in September, and the Sustainable Initiatives for the Marginal Seas of East Asia (SIMSEA) Symposium in Manila also in September. An Expert Feedback Workshop with local fish and fisheries experts from different institutions was also organised at UPMSI in November. These knowledge and information sharing platforms have enabled the researchers to gain valuable feedback on model improvement, research approaches, and the proposed MPA network design framework.

Rural communities at El Nido depend on fisheries for food and livelihood. Photo: M. Paterson
CCRES AT THE SIMSEA REGIONAL SYMPOSIUM

HOW do we design a research program for large marine ecosystems?

The Sustainability Initiative for the Marginal Seas of South and East Asia (SIMSEA), a regional program designed after Future Earth’s principles of transformative research and global sustainability, proposes an inclusive, transboundary approach.

From 26 to 28 September 2016, SIMSEA brought together more than 100 scientists and practitioners from about 30 institutions, for a regional symposium. A key objective was to explore opportunities for greater collaborative and integrative research for the sustainability of marginal seas.

CCRES team members from the Palawan State University (PSU) and UPMSI participated in the event, which was held in Diliman, Quezon City, the Philippines.

CCRES moderated a session on Building tools and knowledge to capture the value of ecosystem services, where Kubi Follosco, the Philippines Country Coordinator, provided an overview of the research being done in the project. In the same session, Vera Horigue, postdoctoral researcher at UPMSI, gave a presentation on how Fish SPACE, and a sound governance context can help inform marine reserve network planning.

The systems dynamics fisheries decline team from PSU facilitated a workshop on using the Socio-ecological Systems App for Mental Model Elicitation (SESAMME) in a participatory approach to build systems models. Marissa Pontillas, Eva Marie Ponce de Leon, Gianina Decano and Precious Latras engaged workshop participants in a mock focus group discussion, taking them through a condensed version of the process used at the CCRES pilot sites.

The participants remarked that SESAMME has many potential applications, and showed interest in the group’s next steps.

The regional symposium was organised by SIMSEA, in partnership with the UPMSI, the International Council for Science Regional Office for Asia and the Pacific (ICSU-ROAP), Future Earth and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC).
MEET THE TEAM

PROF CESAR VILLANOV

PROFESSOR Cesar Villanoy, CCRES project lead for UPMSI, loves tools. His favourite pastime is browsing hardware stores for gadgets to help his home handyman efforts.

He brings this love to the CCRES project where he is working on numerical models that underpin Fish SPACE, one of the suite of tools now under development.

Fish SPACE is a spatially explicit fish population and fishing model which can be used to guide MPA network design and marine spatial planning by demonstrating potential fisheries productivity, given varying levels of habitat quality, protection and fishing pressure.

“This focus on developing tools is one of the things which sets CCRES apart,” says Prof Villanoy.

“Most of our other projects focus on assessment or understanding processes, but CCRES is about making science directly useful to the community. This aspect, and the opportunity for international collaboration, offers a strong learning experience.”

Prof Villanoy specialises in oceanography — a relatively young science in the Philippines.

“As an archipelago, understanding oceans should be front and centre for the Philippines,” he says.

“We need to manage our oceans better — encouraging sustainable fishing and more sustainable use of resources. We are not very good at that.”

The pioneering efforts of Prof Villanoy have led to a higher profile for oceanography in the Philippines.

Passing on knowledge is a favourite aspect of his job where, as well as supervising many students at UPMSI, Prof Villanoy actively serves as a mentor and speaker for institute-led mentoring programs and capacity-building workshops.

“Seeing my students graduate, particularly PhD students, and feeling that in one way or another I have contributed to their lives, is the most rewarding part of my role.”

And what of his handyman efforts?

“They work out…most of the time.”
SYSTEMS & BUSINESS

GENERATING ROBUST LOCAL ECONOMIES THAT CAPTURE AND SUSTAIN MARINE ECOSYSTEM SERVICES

UNDERSTANDING DYNAMICS IN COASTAL COMMUNITIES

The systems modelling and analysis group continue to make progress in developing the models for the four socio-ecological problems in El Nido and one socio-ecological problem in Selayar. These models for both El Nido and Selayar cover:

- Catchment runoff (sediment)
- Crop and livestock production
- Fish populations (herbivores, predators, squid)
- Fishing (legal and illegal, entry, exit and effort)
- Coastal habitats (reefs, mangroves, seagrass)
- Land use (crops, livestock, urban)
- Population (domestic, tourists)
- Supply, demand and price (fish, crops, livestock)
- Household net income (from fishing, cropping and livestock production)
- Waste production (septic tanks, stormwater)
- Water use (domestic, crops, livestock)
- Water quality (phytoplankton [algal blooms], suspended sediment, nutrients)

The stock and flow structures for these models are close to completion and have already been lab tested; that is, tested for the conservation of matter, behavioural consistency and extreme conditions. Available secondary data from El Nido and Selayar has been compiled and is currently being used to parameterise the models so that they can be field tested against the known patterns and trends in El Nido and Selayar.

To field test the models with the communities and other end-users, the team will be undertaking field trials in April and May.

ANALYSING VIABLE BUSINESS OPPORTUNITIES FOR COASTAL COMMUNITIES

Two of the key aspects of the Business Development Framework are the Nascent Entrepreneurs Workshop (being delivered in El Nido in May, and expected in Selayar in June/July), and the Second Tier Business Workshop (being delivered in Selayar in April).

Delivery of the Second Tier Business Workshop and ensuing support program in El Nido will be contingent upon resources, and time. It is expected that a lighter version of the workshop will be possible in the second half of 2017, which does not rely on extensive data collection. The intent for the Second Tier Business Workshop in El Nido is to utilise the results of other CCRES activities such as the
Bio-LEWIE, Systems Dynamics and community programs, as well as the wealth of information and data from previous studies and from enterprise and local government partners to compile the list of potential participants. The interviews undertaken for Selayar provide an opportunity to measure the difference in awareness pre- and post-workshop, and then to measure the impact post-workshop and the initiation of a local support program. While a data collection stage prior to the workshop would have been ideal, these two time points should still enable measures of initial exposure and impact.

**BUSINESS ROUNDTABLE**

A Business Roundtable with participants from industry, NGOs, donor organisations, regional organisations and research institutions was conducted in Manila in June. It focused on developing commonalities including identification of business opportunities, challenges and emerging opportunities around new business investment, barriers and catalysts for business scaling and replication, and building entrepreneurial infrastructure and support.

Outcomes from the Business Roundtable included:

- Engagement with stakeholders working in the coastal ecosystems and ICM space.
- Knowledge sharing of opportunities, issues, barriers, gaps, tools and new platforms around business opportunities in marine environments where the ecosystems are under threat and there is a focus on alignment of business activity with marine ecosystem health and value.
- An understanding of the PEMSEA knowledge bank platform and how it can integrate with what CCRES is setting out to achieve.
- Engagement with our local partner DLSU and the development of a team plan for proceeding with the Business Development activity for discussion with CCRES team leaders.
MEET THE TEAM

LISDA HARYANI, HASANUDDIN UNIVERSITY, INDONESIA

Lisda Haryani doesn’t allow fear to prevent her from doing the things she wants to do.

“Sometimes we just need to breathe, trust, let go and see what happens,” Lisda reminded herself before stepping off the boat and plunging into the ocean — despite the fact that she does not know how to swim.

Lisda studies coral reefs — or perhaps more accurately, the people and communities who benefit from coral reefs. She began her work with CCRES as a Masters student under the supervision of Professors Jamaluddin Jompa (Hasanuddin University) and Peter Mumby (The University of Queensland).

“I am identifying opportunities for local fishers to shift from coral reef fishing to pelagic [open sea] fishing,” she said.

The research involves interviewing fishers in Selayar, to map out the quantities of fish they are catching and the methods that they use.

Her preliminary results indicate that fishers are experiencing a significant reduction in overall catches, and that destructive fishing methods (including explosives and cyanide) employed by rogue fishers are risking the livelihoods of local people.

“If villagers can make the transition to pelagic fishing, it will help to improve their livelihoods and the economy of Selayar, and give coral reefs a chance to recover.”

Lisda says that working with CCRES has given her access to expert knowledge and discussions which have inspired her research.

“All the CCRES team are really willing to help, and provide advice for any obstacles that I face. My supervisors Prof. Peter and Prof. Jamal have provided a lot of support and encouragement. I’m grateful for their experience and advice.”

Lisda feels proud to be a part of CCRES, and hopes her work will one day lead to a better outcome for the people of Selayar.

In her spare time, she loves to visit local historical places and cook traditional foods, such as ‘kapurung’ — a Paloponese dish made with sago, vegetables and fish. She is also a music lover and listening to a song each morning is one of the top-three things she does every day.
Focus groups with coastal communities are fun, members of the behaviour change team found when they visited Bontolebang village, Selayar, Indonesia. Photo: M. Paterson
The People & Engagement team has continued to build the knowledge management platform to support the distribution of the project’s knowledge and technical outputs at local, national, regional and global levels.

The group of communication, engagement and outreach specialists, led by Currie Communications and with the support of in-country coordinators, researchers, partners and stakeholders, delivered 14 information-sharing and dissemination campaigns during 2016 (see box right).

In building the national and regional end-user networks, the People & Engagement team has brokered relationships in Indonesia, the Philippines and across the region with government at all levels, NGOs, academia, regional institutions, and other donor projects. This network of established stakeholders will become important in the dissemination and uptake of the project’s information and tools in the remaining 18 months.

During 2016 the team enlarged an already solid communications-based knowledge platform including a website (www.ccres.net; 8063 visits), social media channels Facebook (+36 per cent 'likes' higher than 2015) and Twitter; (+46 per cent followers) and an e-newsletter (which is circulated to almost 1000 subscribers, +20 per cent) from which to promote project information, tools and products.

Technical Steering Committee members visited CCRES pilot sites in El Nido in February and Selayar in May to gain an understanding of the challenges in coastal communities which the project is aiming to address.

Business Development (Philippines) team members Yasuhiro Karakawa (Cornell University) and Dr Sue McAvoy (The University of Queensland) conducted interviews with stakeholders and businesses in El Nido in February, to inform the development of business models.

2016 COMMUNICATIONS CAMPAIGNS

1. CCRES Philippines Stakeholder Forum/Annual Meeting, Manila (February 2016)
2. 2015 CCRES Annual Report (February 2016)
3. CCRES e-newsletter (March 2016)
4. 8th International Waters Conference, Sri Lanka (May 2016)
5. CCRES Advisory Board/Technical Steering Committee Meetings, Jakarta (May 2016)
6. International Coral Reef Symposium (ICRS), Hawaii (June 2016)
7. PEMSEA regional Blue Economy Report Planning Workshop, Manila (June 2016)
8. 2016 CCRES Progress Report (July 2016)
9. CCRES e-newsletter (July 2016)
10. Scoping visit to Selayar for behaviour change research (September 2016)
11. SIMSEA Conference, Manila (September 2016)
12. CCRES e-newsletter (October 2016)
13. Focus groups for behaviour change research, Selayar (November 2016)
14. CCRES e-newsletter (December 2016)
A webinar titled *A New Tool for Simulating the Impacts of Fisheries Policies in Developing Countries: the Bio-LEWIE Model* was presented by Prof Jim Sanchirico and Ted Gilliland from UC Davis in June 2016. The Bio-LEWIE model combines methods from development economics and natural resource economics. It can be used to show the impacts of policies such as the promotion of alternative livelihoods (e.g. tourism) and the creation of new MPAs.

A business development roundtable was held in Manila in early June with business stakeholders hosted by members of the Business Development (Philippines) team Prof Mark Milstein (Cornell University), Dr Arnel Onesimo Uy (De La Salle University) and Dr Sue McAvoy (UQ Business School).

A large contingent from UPMSI and UQ represented CCRES at the International Coral Reef Symposium — ICRS 2016 in Hawaii in June. CCRES Chief Scientist Prof Peter Mumby gave a plenary presentation, *Embracing a world of subtlety on coral reefs*, and Prof Porfirio (Perry) Alino presented *Designing an Asian marine heritage: Fishing for peace*.

Kubi Follosco, Philippines Country Coordinator, represented CCRES at a regional State of the Oceans & Coasts (SOC) planning workshop convened by PEMSEA in April, and a subsequent national inception workshop for the Philippines led by the DENR in June. PEMSEA is consolidating information for the SOC reports of its member countries, and the East Asian Seas region as a whole.

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**DEVELOPING A TOOLKIT FOR ADAPTIVE COASTAL GOVERNANCE AND MANAGEMENT**

UNDER the promotion of behavioural change, a new activity on adaptive coastal governance and management commenced in 2016 with a scoping visit to Selayar, Indonesia.

The team consisting of Prof Helen Ross (The University of Queensland, Australia), Dr Dedi Adhuri and Pak Ali Yansyah Abdurrahim, (Indonesian Institute of Sciences [LIPI]) is developing a toolkit which will provide end-users with an understanding of the dynamics of change-making in coastal social-ecological systems. In particular, the team is analysing the formal and informal social and policy contexts and dynamics influencing the use of key coastal resources. Part of the exploration will be in understanding how individual, household and community behaviour patterns are nested within district to national and international policy and practices, and cross-scale and cross-sectoral collaborations.

The output from the activity will be a diagnostic toolkit, comprising a user manual together with a set of linked frameworks, principles, case studies and strategies. The toolkit is designed to assist governments, communities and NGOs to assess the capacity of a coastal community to change the way it governs and manages marine resources. The toolkit will comprise:

- A conceptual and procedural framework for adaptive coastal governance (policy, planning and management).
- A set of principles and success factors for enabling adaptive coastal governance.
- A suite of strategies for enabling adaptive coastal governance, based on examples recorded at Selayar, Indonesia, and potentially elsewhere.
The regional SOC report and those for each member country shall highlight the blue economy, focusing on ecosystem services, losses from unsustainable activities, opportunities for innovative and sustainable investments, and supporting governance mechanisms.

In September, CCRES members from UPMSI and PSU participated in a regional symposium organised by SIMSEA, a regional program designed after Future Earth’s principles of transformative research and global sustainability. With more than 100 scientists and practitioners across the region, the symposium aimed to explore opportunities for greater collaboration and integrative research for the sustainability of marginal seas.

CCRES members Melanie King, Damian Hine and Andy Harvey were invited to attend PEMSEA’s Regional Workshop on Catalyzing Blue Economy in East Asia held in Xiamen, China, in November.

Blue economy offers a practical, ocean-based economic model using sustainable infrastructure and technologies, innovative financing mechanisms and effective institutional arrangements for protecting our oceans and coasts and enhancing economic development.

The workshop provided background on blue economy investment in the region and explored the potential for developing a pipeline of bankable investment opportunities.

Outcomes from the workshop included:

- Understanding the state of blue economy investment in East Asia and exploring examples of potential investments from the region.
- Discussion on the barriers, solutions and actions towards establishing a pipeline of blue economy investments.
- Connecting with finance and investment experts and project proponents to share ideas on emerging practices, technologies and enterprises in China and around the region.
PROMOTING SUSTAINABLE HOUSEHOLD CHANGE

The behavioural change component of CCRES has made substantial gains across the duration of 2016 towards our global aims. CCRES’s main objectives are to enhance the factors that lead to protection of marine ecosystems and overall communal wellbeing. CCRES has made significant strides towards identifying the key determinants underlying behaviour, attitudes and values of local households. These steps are vital to the construction of a behaviour change program that will promote positive behaviour towards the environment, and instilling the psychological competencies to secure brighter futures for villagers.

Project activities during the past year have involved interacting directly with villagers by collecting data through surveys and focus groups. Surveys focused on unearthing how attitudes, values and social norms contributed to the perceptions of destructive practices. Focus groups focused on investigating the perceived social factors and behavioural characteristics that blocked or empowered the individuals to act against non-sustainable behaviour.

This work involved numerous partners both in Indonesia and from UQ, and primarily included in-country coordinators (Ibu Yuni Kumoloraras, Pak Andi, DINAS Marine and Fisheries), local research partners (IPB), translator (Pak Ibnu Najib), and Currie Communications (Mark Paterson and Paula Bradley). The work has been an exemplary prototype of international collaboration.

Outcomes include intensive engagement with well-regarded social constituents of coastal villages (i.e. hamlet camats, local imams, island entrepreneurs, government officials, school officials, heads of community groups). The diversity of participants covered a range of age groups, professions and income levels.

Within the scope of the research, CCRES collected data from 105 surveys and conducted nine focus groups across various villages on the island, with women comprising 49 per cent (51 individuals) of participants.

The team has provided a platform for all villagers to discuss the problems their villages face, and the solutions they would like to see enacted. An interactive discussion forum was facilitated to talk about empowering and realistic solutions with local leadership. Villagers benefitted from both survey work and focus groups by being exposed to an environment conducive to productive dialogue.

The team is now focused on developing a scalable, cost-effective, generalisable program — consisting of numerous, proven behavioural change strategies — to be disseminated and trialled in Selayar. This program will aim at instilling psychological skills and competencies in villagers that allow them to enhance the value of the environmental assets around them, as well as promote greater overall wellbeing. It is intended that this program will be able to benefit every constituent of every village, and be used by NGOs, community groups and government officials alike.
MEET THE TEAM

**DR DEDI ADHURI**

AN anthropologist by training, Dr Dedi Adhuri has more than 20 years experience in researching social conflict; ethnicity; marine resource management and governance; fisheries conflict; post-disaster coastal and fisheries rehabilitation; and community development.

In the past five years, as a coordinator of the Maritime Study Group at LIPI, Dr Adhuri has become increasingly involved in studies on coastal communities and climate change. He also works on cultural heritage management in Indonesia.

Together with Prof Helen Ross of The University of Queensland, he is co-leading a study of adaptive coastal governance and management in villages at Selayar, Indonesia.

“Our project is about developing participatory methods to help communities, with government, to manage their marine resources and livelihoods. We are collaborating with community and government to establish coastal resource management processes,” says Dr Adhuri.

Dr Adhuri is responsible for leading data collection, networking and facilitating collaboration of stakeholders.

Outputs from the project will be a ‘toolkit’ explaining how communities and governments in other places can work (framework, processes); and a set of strategies that communities can use. It will deliver examples of how particular individuals, or communities, have worked to make changes such as stopping destructive fishing, managing protected areas, and fishing rules.

So what attracted him to CCRES?

“CCRES is a strategic project for supporting coastal fisheries which are very important for food security, poverty alleviation and coastal resource sustainability in Indonesia. We need multidisciplinary projects like CCRES to tackle the problems of coastal fisheries comprehensively.”

Dr Adhuri himself has a history of tackling big problems. He has been involved as an expert witness in two historic legal cases that did much to protect coastal communities.

One case in the constitutional court challenged certain verses (clauses) in the Law of Coastal and Small Islands Management which would have potentially marginalised fishers and coastal communities.

“The constitutional judges cancelled the verses that we saw as potentially threatening the lives and livelihoods of fishers and coastal communities,” says Dr Adhuri.

In the second case, three poor fishers were being prosecuted for fishing in Ujung Kulon National Park in Western Java, however they were freed and avoided any conviction. Dr Adhuri is proud of his role as an academic advocate in both cases.

“A conservation approach that excludes the community and small scale fishers will not work and will just create conflict. I have been a part of helping to change perspectives from working against fishers to working collaboratively and incorporating their needs.

“It’s proof that our science can really help local communities.”
Leilani Solera and Patrick Pata (front left) from UPMSI and the research team head out in search of currents at El Nido in the Philippines.
Photo: A. Gammaru
OUR PEOPLE

ADVISORY BOARD

The CCRES Advisory Board provides independent oversight of the annual work plans and budgets; advice on the linkages and synergies with World Bank investment projects and other regional and national projects and activities; and advice and linkages on project outputs to policy and management.

The members of the CCRES Advisory Board are:

- Ms Cary Anne Cadman (World Bank)
- Undersecretary Analiza Teh (Department of Environment and Natural Resources, the Philippines)
- Ms Carolina V. Figueroa-Geron (Philippines Rural Development Project)
- Dr Stephanie Sieber and Ms Maya Villaluz (Wealth Accounting for the Valuation of Ecosystem Services Project)
- Mr Adrian Ross (Partnerships in Environmental Management for the Seas of East Asia, PEMSEA)
- Dr Zainal Arifin (Lembaga Ilmu Pengetahuan Indonesia, LIPI)
- Dr Firdaus Agung (COREMAP-CTI and Ministry of Marine Affairs and Fisheries, Indonesia)
- Professor Andrew Griffiths (The University of Queensland, Australia)
- Ms Melanie King, Ex-officio (Senior Advisor, Project Executing Agency)

LEADERSHIP GROUP

The CCRES Leadership Group consists of the component team leaders and the project director/senior advisor with external input as required. Leadership Group members are:

- Prof Peter Mumby, Chief Scientist (The University of Queensland, Australia)
- Prof Damian Hine (The University of Queensland, Australia)
- Dr Carl Smith (The University of Queensland, Australia)
- Mr Mark Paterson (Currie Communications, Australia)
- Ms Melanie King (The University of Queensland, Australia)

TECHNICAL STEERING COMMITTEE

A Technical Steering Committee has been convened to support the project with technical oversight of activities and to guide strategic direction. The committee members are:

- Prof Alasdair Edwards (University of Newcastle, UK)
- Dr Tiene Gunawan (Indonesia)
- Anthony Hooten (AJH Environmental Services, USA)
- Ms Mariglo Laririt (Ten Knots Corporation, Philippines)

CCRES team meets in Manila for the annual planning workshop.
Photo: M. Paterson
CCRES MEMBERS

Management
- Ms Melanie King, Project Director
- Ms Noreen (Kubi) Follosco, Philippines Country Coordinator
- Ms Harjunani Kumoloraras, Indonesia Country Coordinator
- Ms Romelyn (Lyn) Riveral, Admin Assistant
- Ms Phoebe Coulon-McIntosh, Project Officer
- Mr Roy Bero, El Nido Site Coordinator

Component One: Science & Discovery
Harnessing the value and market potential of coral reef and mangrove ecosystem services

The University of Queensland
- Prof Peter Mumby, Chief Scientist and Team Leader
- Prof Tom Baldock
- Dr David Callaghan
- Dr Nils Krueck
- Dr Alice Rogers
- Dr George Roff
- Dr Behnam Shabani

University of the Philippines
- Prof Cesar Villanoy
- Dr Annette Junio-Menez
- Prof Perry Aliño
- Ms Bayosa Aya Carino
- Dr Vera Horigue
- Ms Miledel Quibilan
- Ms Leilani Solera
- Mr Adrian Chester Balingit
- Ms Rouenne Camille de Castro
- Mr Patrick Pata

De La Salle University
- Dr Al Licuanan
- Dr Maricar Samson

Hasanuddin University
- Prof Jamaluddin Jompa
- Ms Nur Abu
- Ms Lisda Haryani

BPSPL Makassar (MMAF)
- Mr Kris Handoko
- Mr Andi Jaya

Ministry for Marine Affairs and Fisheries
- Dr Ir. Subandono Diposaptno
- Mr Abdi Tunggal Priyanto
- Mr Arief Sudianto
- Mr Lantip Wratsangka

DINAS Fisheries, Selayar
- Mr Zul Janwar
- Mr Andi Penrang

Component Two: Systems & Business
Generating robust local economies that capture and sustain marine ecosystem services

Cornell University
- Prof Drew Harvell
- Dr Joleah Lamb

The University of Queensland
- Dr Carl Smith, Activity Leader (Systems Analysis)
- Dr Russell Richards
- Mr Siham Afatta Taruc
- Ms Melanie King
- Dr Sue McAvoy
- Dr Damian Hine, Activity Leader (Business)
- Mr Andy Harvey
- Dr Anya Phelan

De La Salle University
- Dr Arnel Onesimo Uy
- Dr Raymund Habaradas

Palawan State University
- Engr Ma. Rosario Aynon Gonzales
- Dr Patrick Regoniel
- Engr Agustin Miraflores, Jr
- Prof Marissa Pontillas
- Ms Eva Marie Ponce de Leon
- Mr Dante P. Basaya
- Ms Precious Joy Latras
- Ms Gianina Decano
- Ms Maricel Elorde
- Dr Ronald Ona

Palawan Council for Sustainable Development Staff
- Mr John Francisco Pontillas
- Ms Glenda Cadigal
- Mr Benjamin Adriano, Jr
- Mr Jesus Bream
- Mr Raul Maximo
- Ms Mary Grace Palatino
Center for Coastal and Marine Resources, Bogor Agricultural University
- Dr Luky Adrianto
- Mr Suryo Kusumo
- Dr Novie Setianto

Indonesian Institute of Sciences (LIPI)
- Mr Bintang Dwitya Cahyono
- Dr Agus Eko Nugroho
- Ms Nur Hadiati Endah
- Mr Pangky Febriansyah

Component Three: People & Engagement
Promoting behavioural change through outreach, decision support and regional learning

Currie Communications
- Mr Mark Paterson, Team Leader
- Ms Paula Bradley
- Ms Gabrielle Sheehan

The University of Queensland
- Ms Melanie King
- Prof Matt Sanders
- Mr Erik Simmons
- Prof Helen Ross

Indonesian Institute of Sciences (LIPI)
- Dr Dedi Adhuri
- Mr Ali Yansyah Abdurrahim

Center for Coastal and Marine Resources, Bogor Agricultural University
- Dr Yudi Wahyudin

ADVISORS
El Nido Local Government
- Mr Raffy Cabate
- Mr Rene Jay de la Calzada

DINAS Fisheries, Selayar
- Dr Ir. Marjani Sultan

University of the Philippines
- Prof Ed Gomez

OUR PARTNERS
The success of the CRES project depends on the skills, expertise, networks and commitment of our partners. In particular our in-country partners are critical to ensuring the tools developed by the project are usable, applicable, accessible and scalable. We would like to thank our partners for their participation during 2016.

International
- The World Bank
- Global Environment Facility
- The University of Queensland
  - Global Change Institute
  - School of Biological Sciences
  - School of Agriculture and Food Sciences
  - School of Civil Engineering
  - UQ Business School
  - School of Psychology
  - Centre for Biodiversity and Conservation Science
- Cornell University
  - Center for Sustainable Global Enterprise, Johnson School of Management
  - Department of Ecology and Evolutionary Biology
- University of California, Davis
- Currie Communications

Philippines
- University of the Philippines, Marine Science Institute
- Department of Environment and Natural Resources
  - Biodiversity Management Bureau
  - El Nido-Taytay Managed Resource Protected Area Management Board
- Palawan Council for Sustainable Development and Staff
- El Nido Local Government Unit
- El Nido Foundation, Inc.
- Palawan State University
- De La Salle University

Indonesia
- Indonesian Ministry for Marine Affairs and Fisheries
- BPSPL Makassar (MMAF)
- Indonesian Institute of Sciences (LIPI)
- Bogor Agricultural University, Center for Coastal and Marine Resources Studies
- University of Hasanuddin
- DINAS Marine and Fisheries, Selayar
# Glossary

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>Bio-LEWIE</td>
<td>Bio-economic Local Economy-Wide Impact Evaluation model</td>
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<tr>
<td>CCRES</td>
<td>Capturing Coral Reef &amp; Related Ecosystem Services project</td>
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<tr>
<td>DLSU</td>
<td>De La Salle University</td>
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<tr>
<td>IPB</td>
<td>Bogor Agricultural University</td>
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<tr>
<td>LIPI</td>
<td>Indonesian Institute of Sciences</td>
</tr>
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<td>MPA</td>
<td>Marine Protected Area</td>
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<td>UC Davis</td>
<td>The University of California, Davis</td>
</tr>
<tr>
<td>UNHAS</td>
<td>Hasanuddin University</td>
</tr>
<tr>
<td>UPMSI</td>
<td>University of the Philippines Marine Science Institute</td>
</tr>
<tr>
<td>UQ</td>
<td>The University of Queensland</td>
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</tbody>
</table>
Alice Rogers (UQ), Nils Krueck (UQ), Pete Mumby (UQ), Mags Quibilan (UP-MSI) and George Roff (UQ) during a field trip at El Nido to collect data for valuing coral reef fisheries productivity. See story, page 11.
The Capturing Coral Reef and Related Ecosystem Services (CCRES) Project is a regional technical support project that seeks to unlock new, sustainable income streams for coastal communities in the East Asia-Pacific region. CCRES will develop knowledge products — which inform the design of global, regional and national projects, plans and policies — and technical models and planning tools which assist with preparation of community-based coastal resource management plans.

PROJECT EXECUTING AGENCY
The Global Change Institute at The University of Queensland, is an independent source of game-changing research, ideas and advice for addressing the challenges of global change. GCI advances discovery, creates solutions and advocates responses that meet the challenges presented by climate change, technological innovation and population change.

CONNECT WITH US
CAPTURING CORAL REEF AND RELATED ECOSYSTEM SERVICES

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Tourism numbers continue to increase in El Nido.
Photo: G. Sheehan