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September 14-16th, Suva, Fiji

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Acknowledgement

prepared by Sunil R. Prasad

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A special 'vinaka vakalevu' is due to our key note speaker Professor Ove Hoegh-Guldberg, inaugural Director of the Global Climate Change Institute at the University of Queensland and the holder of a Queensland Smart State Premier fellowship, for taking time out of his busy schedule to attend this 3-day Forum, and to share lessons learnt about current climate change issues facing the region. A big 'vinaka vakalevu' also goes to Bernard O'Callaghan (IUCN) for his excellent facilitation of the closing discussion 'Does conservation science in Fiji represent good value-for-money?' Samisoni Pareti was an eloquent host for the public panel discussion entitled 'Climate change: catastrophe or opportunity?' We are extremely grateful to our panel guests for giving their time to be questioned by the public: Professor Ove Hoegh-Guldberg, Professor Bill Aalbersberg (USP IAS), Kriti Chaya (Department of Environment), and Dr Morgan Wairiu (PACE-SD).

We also thank the session co-chairs: Sanivalati Navuku, Aaron Jenkins, Miliana Ravuso, Sunil R. Prasad, Jan Steffen, Merewalesi Laveti, Helen Sykes, Semisi Meo, Rebecca Weeks, James Comley, Ron Vave, Kirti Chaya, Etika Rupeni, and Loraini Sivo.

The progress we have made collectively during the Second Fiji Conservation Science Forum (FCSF) would not have been possible without the contributions from over 50 speakers and the active participation of participants.

This Forum was made possible through the support and commitment of the FCSF organising team: Natalie Askew, Janette Kaipio, Stacy Jupiter, Nischal Narain, Margaret Fox, Akanisi Caginotoba, Waisea Naisilisili, Yashika Nand, Akuila Cakacaka, Kinikoto Mailautoka, Ingrid Qauqau, Rebecca Weeks, Sunil R. Prasad and Alumeci Naneke.

[1] EBM – Ecosystem-based Management

Preface

prepared by Stacy Jupiter

Between August 5-7, 2009, the Fiji Ecosystem-Based Management (EBM) partnership of the Wildlife Conservation Society (WCS), WWF South Pacific Programme, and Wetlands International-Oceania, hosted the inaugural Fiji Conservation Science Forum. The main goal of the Forum was to provide a platform to consolidate and synthesize the science that has been conducted in Fiji. We were also very aware at the time that, due to few opportunities to present science locally, most of our good work was being presented overseas. Therefore, the Forum represented a unique opportunity, particularly for students, to showcase their work among their peers and colleagues.

The 1st Conservation Science Forum was attended by 115 participants from various national, regional and international organizations, including participants and visitors from Australia, New Zealand, Solomon Islands, Indonesia, Palau, Papua New Guinea, Madagascar, and the United States. The plenary speaker for the event, Dr. Robin Yarrow, summarized the good will experienced by all with the statement, "To researchers it is a great opportunity to present their findings and to receive professional feedback and input. For post-graduate students, it is a wonderful opportunity to learn and network."

Based on the positive feedback from the 1st Forum, WCS secured support from the David and Lucile Packard Foundation and the John D. and Catherine T. MacArthur Foundation to host a 2nd Fiji Conservation Science Forum between September 14-16, 2011 at Studio 6 in Suva. The Forum received additional local support from Fiji TV, Ricoh, Quality Print Ltd., Clariti (South Pacific) Ltd., Supreme Fuel, and Flour Mills of Fiji Ltd, to whom we are grateful.

The main theme of the 2nd Forum was "Confronting the Climate-Biodiversity Crisis" in recognition of the fact that climate change is an overarching threat that may be exacerbating impacts to species and habitats in Fiji and the region. As a lead off to the event, Professor Ove Hoegh-Guldberg, Director of the Global Change Institute at the University of Queensland, highlighted the many ways that climate change is affecting biodiversity in the region and offered some thought-provoking solutions for managing the problems.

The keynote presentation was followed over the course of three days by seven thematic sessions on (1) Ecology and Management of Fiji's Watersheds, (2) Terrestrial Species, (3) Marine Species, (4) Results from Fiji's Locally Managed Marine Areas, (5) Scaling-up Local Management to Meet National Priorities, (6) Socio-Ecological Tools for Climate Change Adaptation, and (7) Adaptive Management. Due to the successful advertising campaign, the room at Studio 6 was consistently full with at least 195 participants from 64 different organizations across academia, development, community, government, non-government, and the private sector.

During the first evening, WCS and SeaWeb hosted a public panel event on "Confronting the Climate-Biodiversity Crisis: Challenge or Opportunity?" The four panelists (Prof. Ove Hoegh-Guldberg of the University of Queensland, Prof. Bill Aalbersberg of the Institute of Applied Sciences at the University of the South Pacific (USP), Dr. Morgan Wairiu of the Pacific Centre for Sustainable Development at USP, and Ms. Kirti Chaya of the Department of Environment's Climate Change Unit) kept the audience engaged with responses to questions such as, "What are the opportunities to use climate change mitigation and adaptation funds to protect biodiversity?". Prior to the closing of the event, Mr. Bernard O'Callaghan of IUCN Oceania, facilitated a lively discussion on some of the main issues arising from the Forum that included debate on how we widen focus from marine to terrestrial and other areas and whether doing conservation science in Fiji is good value for money.

Overall, there was a strong feeling of camaraderie throughout the event, in support of the collective good work that is being conducted across Fiji. Further, by bringing together people from across the environment, planning, community, disaster risk management, health and development sectors, we were able to identify potential new partnerships for future collaborations. WCS looks forward to the opportunity to host a potential 3rd Fiji Conservation Science Forum and we welcome other organizations to work with us to continue the tradition.

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Keynote Address

Climate change: the conservation challenge for Pacific marine resources and people

Professor Ove Hoegh-Guldberg – inaugural Director of the Global Climate Change Institute at the University of Queensland

Thank you very much Stacy. Let me begin by saying what a great honour it is to be here at the invitation of the Fiji Conservation Science Forum 2011. It is also wonderful to see so many people that share a similar passion and ethic with me. I feel a great sense of friendship with this audience already.

One of the things that never fails to get me out of bed each morning, is the question of how to solve the problem of climate change. As I lie there in the dark of the early morning, my thoughts invariably lead to the question: What sort of world are we leaving for our children?

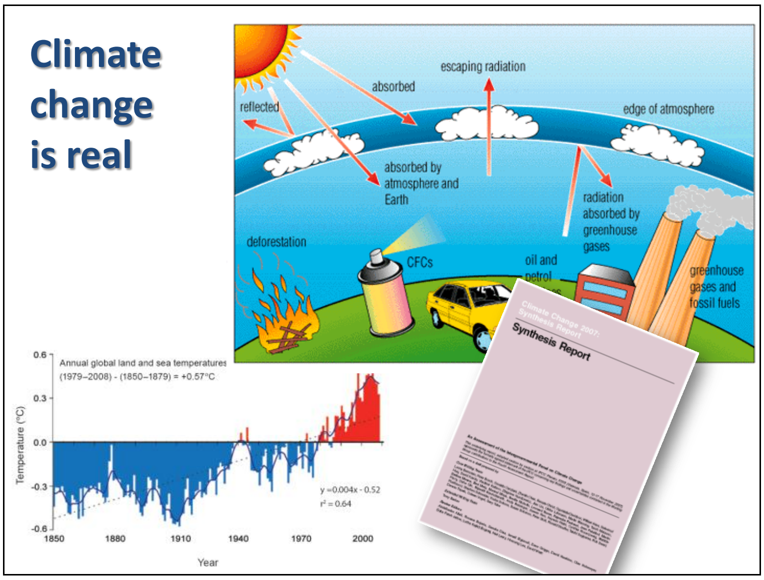
I think of my own children at this point - Fiona and Chris - who are young teenagers who love life and nature, and aspire to be part of a world that is fair and equitable. As I lie there, I think: will we see a world in which the Tiger, Komodo dragon and coral reefs will disappear and become a distant memory.

I think of the fear of world food shortages and rising terror driven by dwindling resources. And then it hits me - we can and must do something to save our planet. At this point, I'm on my feet and out the door.

And this is what will talk about today. This is the notion that climate change is a huge problem but we do have avenues as a global society to solving it. And if we solve it, then the benefits flow to everyone.

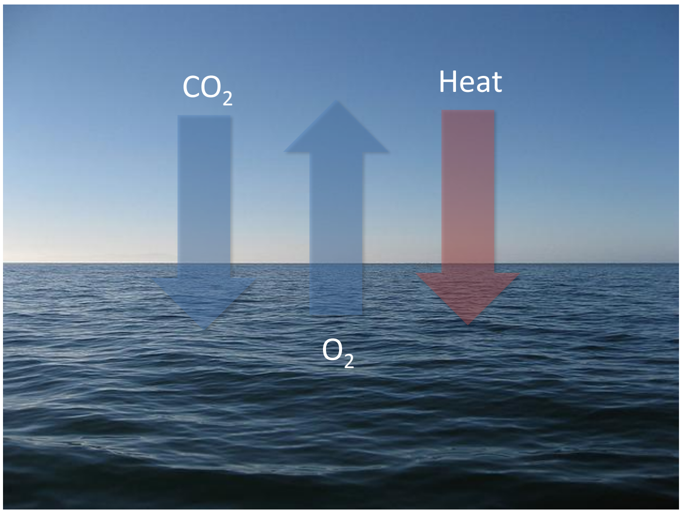
So here is what I will talk about today:

1. Climate change in the Pacific: what changing and how fast?
2. Impacts on marine ecosystems and people
3. What can we do about it? Mitigate and adapt
4. The changing paradigm of conservation: move, stay, protect, abandon, all-in-one?
5. Conclusion: the urgent need for global action. Why are we not being heard?



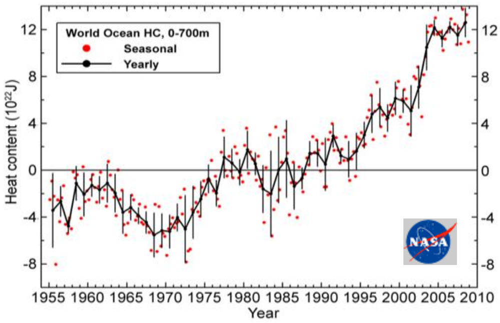
There is no longer any credible doubt that climate change is occurring and that is being driven by the massive amounts of carbon that we are adding to the atmosphere. My objective today is not to drag you through all of the evidence that has built up over time with respect to this very important and worrying problem. That has been done adequately in many places, most credibly in the documents produced by the Intergovernmental Panel on Climate Change.

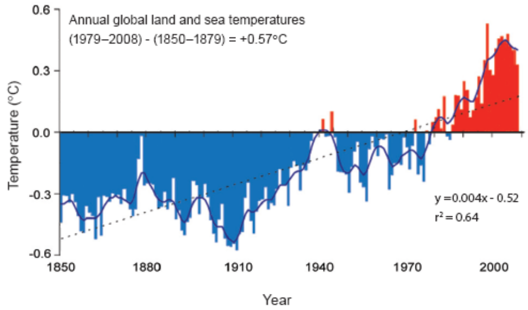
What is more important to consider is how climate change is affecting the world's oceans and ecosystems. This aspect of climate change has received less attention than other areas, but as I will show you today, as serious implications not only for the many people and cultures that depend on the ocean for their survival, but for people everywhere.



The earth's oceans play an overriding important role in the climate system. Of the anthropogenic carbon being pumped into the atmosphere, one third of it is absorbed by the ocean. In addition to this, over 90% of the extra heat trapped by the enhanced greenhouse effect disappears into the ocean. At the same time, the world's oceans provide 50% of the oxygen in the atmosphere and supply protein to 25% of the world's population. These are massive roles in terms of how our planet works.

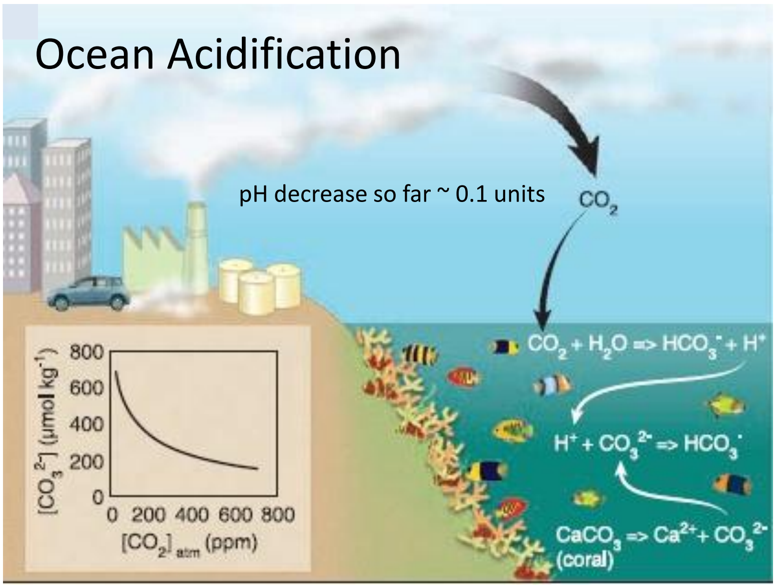
OCEAN HEAT CONTENT **OCEAN TEMPERATURE**





The absorption of heat and carbon dioxide has been significant in terms of the ocean budgets - and has resulted in major shifts in both heat content and carbon dioxide. These two graphs show the increase in heat content in the world's oceans alongside the change in the average temperature of the ocean over the past 50 years.

In the same way, the huge amounts of carbon dioxide that have disappeared into the ocean have also changed the chemistry of the ocean. When CO2 goes into the ocean, it reacts with water to create carbonic acid, which releases a proton that likes to scavenge carbonate ions, turning them into bicarbonate ions.



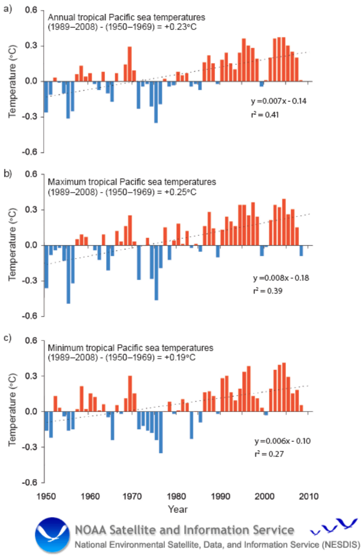
(Hoegh-Guldberg *et al.* 2007; Science)

This has the effect of decreasing the concentration of carbonate ions. Carbonate ions, of course, are extremely important because they are an essential ingredient in the deposition of calcium carbonate.

But what these changes mean to the world's largest ocean and people? The Pacific Ocean covers 165 square km or 35% of the earth surface. Its deepest point is 11 km below the surface. This big basin of water is one of the key features of our planet. And of course on the ground, is the home to millions of people.

Are conditions changing?

1. Sea surface temperatures have warned since 1950
2. Average ocean pH has dropped by 0.1 pH units
3. Rainfall patterns have changed significantly



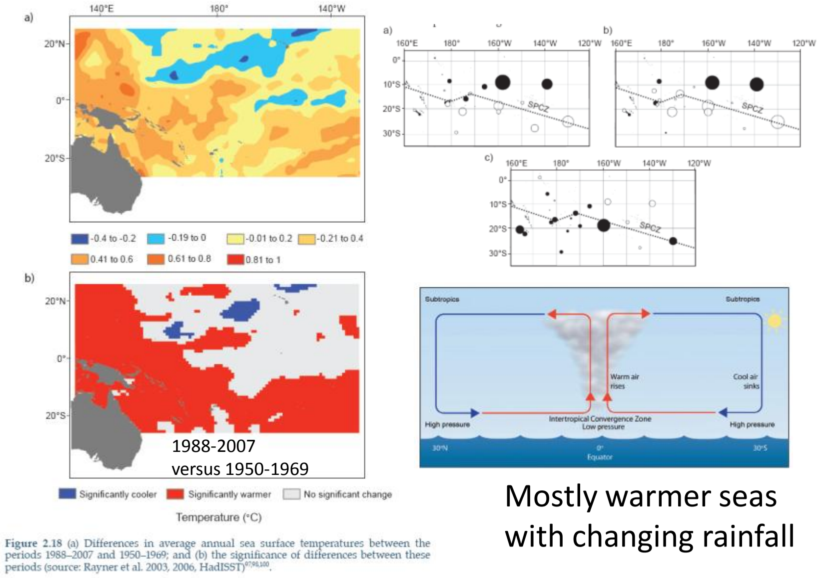
There is very clear evidence that conditions are changing rapidly in the Pacific.

a. Sea surface temperatures from 1950 to 2007 averaged over the tropical Pacific (25°N–25°S, 130°E–130°W) also show significant warming.

b. The average alkalinity has declined by 0.1 pH units.

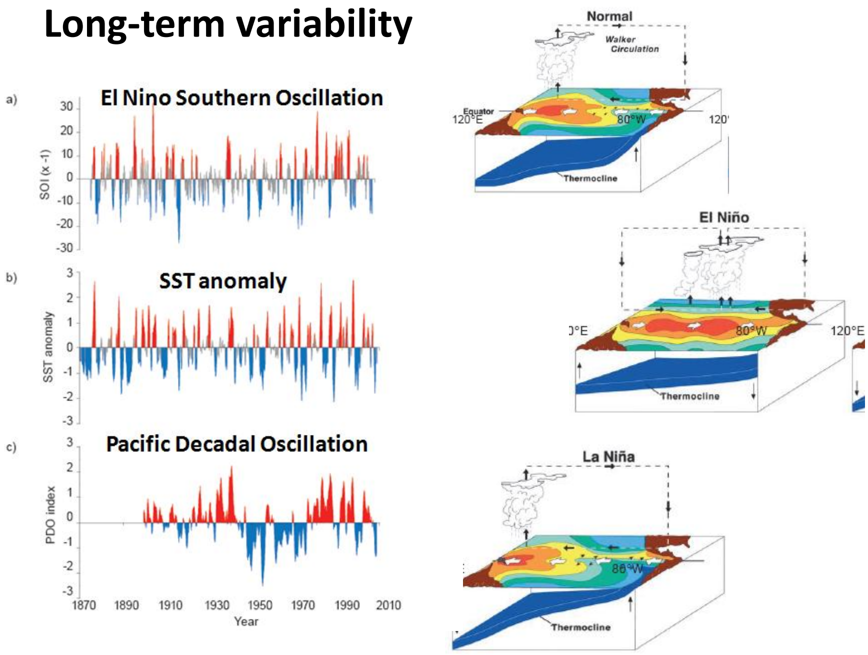
c. Rainfall patterns are changing - sites on the northern side of the South Pacific convergence are getting increased rainfall while those on the south side of the South Pacific convergence are experiencing lower rainfall and longer dry spells.

Observed changes in the Pacific



(Lough *et al.* 2011)

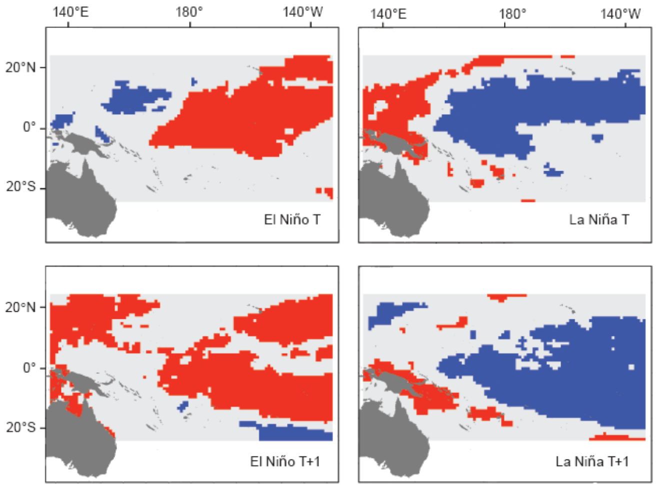
Any analysis of the trends within the Pacific Ocean must take into account the long-term patterns of variability that are associated with the region.



(Lough *et al.* 2011)

In this respect, the region is strongly influenced by long-term weather patterns associated with the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). The effects of El Niño are well-known in terms of influence on winds, sea temperature and rainfall.

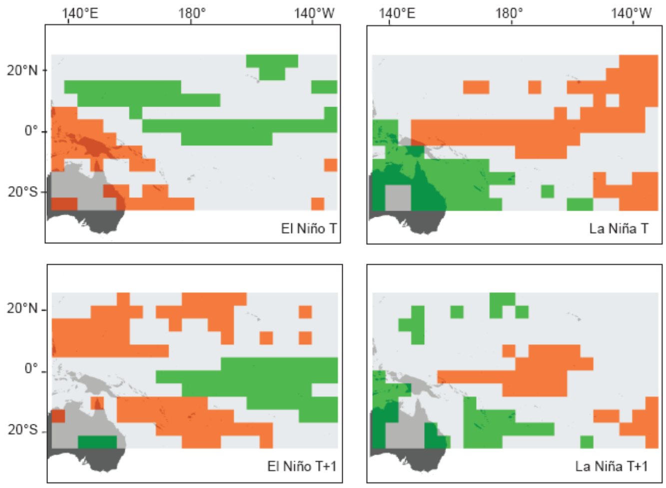
Long-term variability: Sea temperature

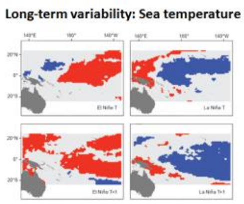


(Lough *et al.* 2011)

These data summarise the outcomes of 20 El Niño and 20 La Nina events tested against 20 neutral El Niño years - for the first year and the following year. What you see is that sea temperatures in parts of the Pacific are significantly warmer during El Niño periods and significantly cooler in la Nina periods. And the reverse is true, depending on where you are.

Long-term variability: Rainfall

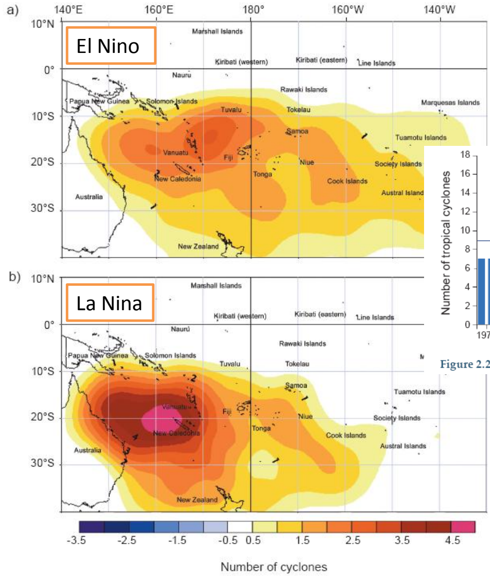




(Lough *et al.* 2011)

Changing patterns of sea temperature leads to changes in rainfall. Basically, if the ocean is cooler, then dry conditions prevail. The reverse is true if you have warmer seas.

Cyclones



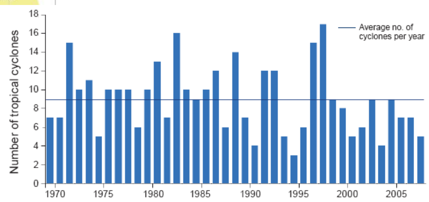
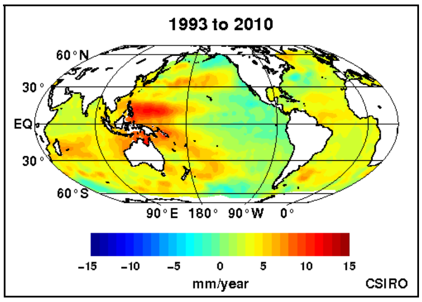


Figure 2.24 Annual number of tropical cyclones in the southwest Pacific, 1969/70–2007/08.

(Lough *et al.* 2011)

These patterns are also reflected in the distribution of cyclones between El Niño and La Nina years. Cyclones are more concentrated in the Western Pacific during La Nina conditions. This variability aside, most of the evidence is suggesting a long-term decrease in the number of cyclones. However, there is an upward trend in the intensity of those cyclones that do occur.

Sea level rise



Recent short-term relative sea level trends in the project area based upon SEAFRAME data through June 2009

	Location	Installation Date	Trend (mm/yr)	Change from June 2008
1	Cook Is	19/02/1993	5.3	0.3
2	Tonga	21/01/1993	9.4	0.6
3	Fiji	23/10/1992	5.4	1.5
4	Vanuatu	15/01/1993	5.8	1.6
5	Samoa	26/02/1993	6.0	-0.5
6	Tuvalu	02/03/1993	5.6	-0.5
7	Kiribati	02/12/1992	3.3	-1.1
8	Nauru	07/07/1993	4.3	-0.8
9	Solomon Is.	28/07/1994	8.7	0.9
10	PNG	28/09/1994	8.1	0.3
11	FSM	17/12/2001	20.2	-2.2
12	Marshall Is.	07/05/1993	4.2	0.3

Range: 5-20 mm/year

Another consequence of warmer oceans and planet is the increasing volume of the oceans, which manifests itself as sea level rise. Currently, sea level in many places in the Pacific is increasing at a rate which is greater than that of the average for the world's oceans (around 3.4 mm/year).

From the preceding information, we can conclude that environmental conditions across the Pacific Ocean are changing rapidly.

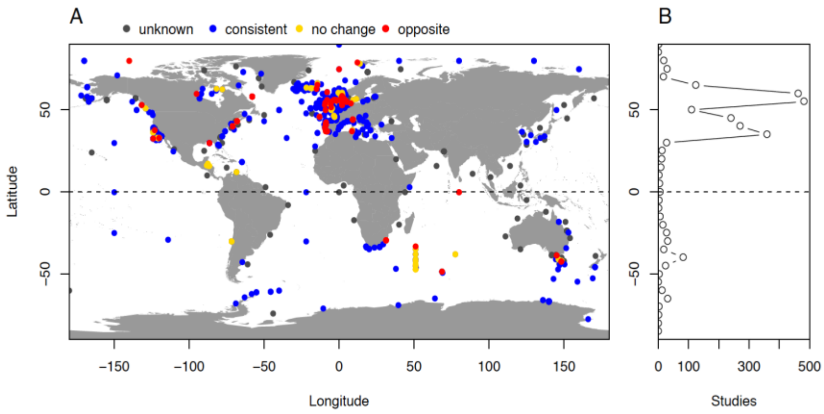
a. Warmer sea temperatures (although variable between El Niño and La Nina conditions)
b. More acidic oceans and less carbonate ions
c. Greater rainfall in some areas and longer droughts in others
d. More intense but less frequent cyclones
e. Higher sea levels

The big question is: is this enough to cause problems to the natural ecosystems and human communities across the region?

I want to now focus in on the issue of how these changing conditions are likely to affect marine ecosystems within the Pacific region. In the simplest terms, organisms are adapted to the local environment which ultimately means the conditions under which they have evolved. Within this range, organisms adjust themselves to optimise their physiological performance to conditions within this range. This is referred to as acclimatisation.

If organisms venture outside these conditions, there are physiological costs which increase the further they move outside the environmental envelope under which they have evolved. This ultimately impacts the ability of the particular organism question to grow, compete and reproduce. And, ultimately, if the organism moves far outside is coping range, death will ensue.

Biological responses within the world's oceans



Global	Pacific	Indian	Atlantic	Semi-enclosed
2006	533	18	1134	174
74.4%	70.2%	61.1%	72.8%	93.0%

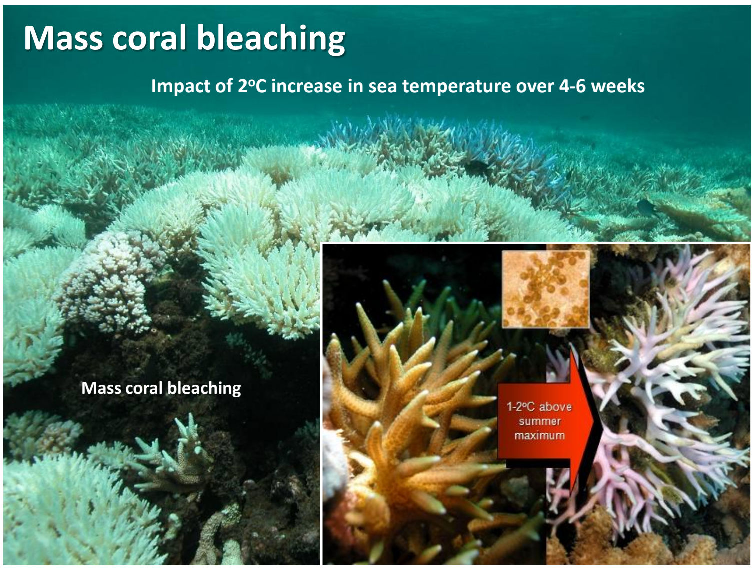
NCEAS Marine Climate Change Impacts Working Group

One might be forgiven for thinking that the current amount of environmental change is small and potentially trivial with respect to marine and other ecosystems. After all, we are talking about less than 1°C change in global temperature, and around 0.1 pH unit change. You might even consider the shifts in rainfall and storm intensity to be also relatively minor. The question, of course, is whether ecosystems have begun to respond.

Elvira Poloczanska and Anthony Richardson and a group and the National Centre for Ecological Analysis and Synthesis have been exploring this question by cataloguing the changes that have been occurring globally with respect marine ecosystems. This figure is one of the summaries from their soon to be published meta-analyses. So, globally, around 74% of long-term studies are showing changes in ecosystems which are consistent with climate change. In the Pacific Ocean, our 533 studies, 70% showed a pattern that was consistent with the direction and intensity of climate change.

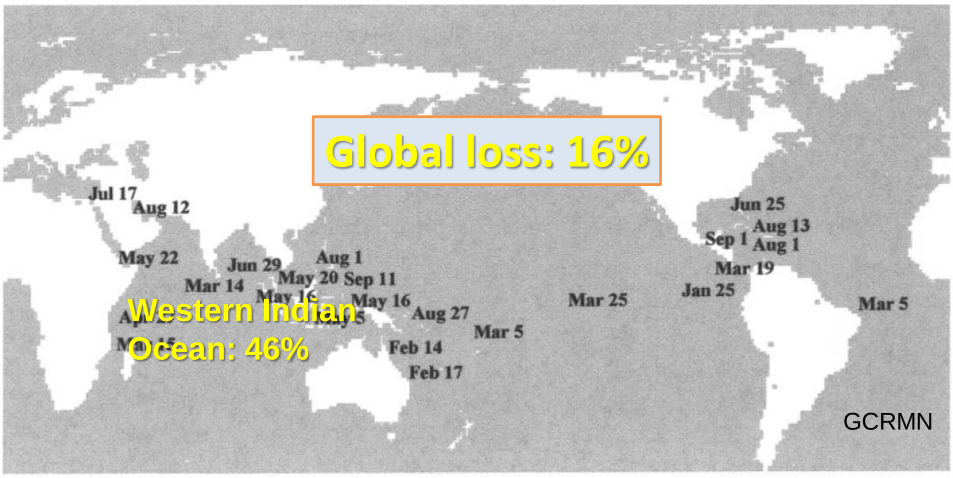
Naturally, there are some trends within these changes that are organism and ecosystem specific.

While, the average speed at which organisms are shifting their distributions towards the higher latitudes is around 50 km per decade, some highly mobile organisms such as copepods and seabirds are moving very rapidly to higher latitudes. Some organisms such as sharks and other cartilaginous fish appear to be moving in the opposite direction. In addition to changes in the distribution of organisms, the timing of particular events has also begun to shift in directions suspected as far as climate change. On average, the timing of particular behaviour patterns is shifting forward by five days per decade. Again, there is variability among organisms with respect to this sensitivity. With seabirds showing the least change while fish and turtles are showing the most.



No discussion about climate change in the Pacific would be complete without a discussion of mass coral bleaching and mortality. Like coral reefs around the world, mass coral bleaching has been affecting the health of reefs since the late 1970s when it was first reported on coral reefs. Mass coral bleaching occurs when the fundamental symbiosis between corals and dinoflagellate algae from the genus *Symbiodinium* breaks down. The symbionts are absolutely crucial for the highly efficient trapping of sunlight which ultimately gives corals the power to create carbonate structures that ultimately house the extraordinary biodiversity that is typical of coral reefs.

Impacts are global:
e.g. Loss of corals during global cycle of
mass bleaching events in 1998



Hoegh-Guldberg (1999, Mar Freshwater Research)

During the exceptionally warm conditions of 1998, coral reefs across the planet underwent mass coral bleaching. At the end of that year, an estimated 16% of corals have disappeared from the world's oceans. In some cases, such as Australia's Great Barrier Reef, the loss was only around 5 to 10% of the corals. In other places, which were warmer for longer, such as the Western Indian Ocean, the mortality of corals was 46%.

Number of regions experiencing mass coral bleaching

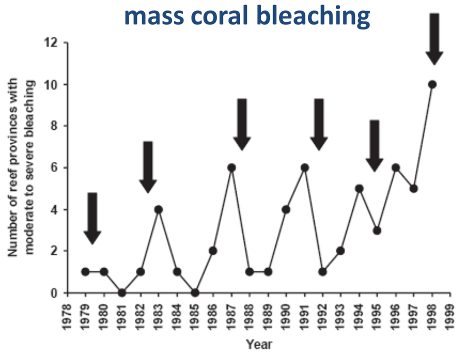


Fig. 3. Number of reef provinces bleaching since 1979. (Graph modified from Goreau and Hayes (1994) with data added for 1992 onwards.) Arrows indicate strong El Niño years.

Hoegh-Guldberg (1999)

Heat stress in the Caribbean

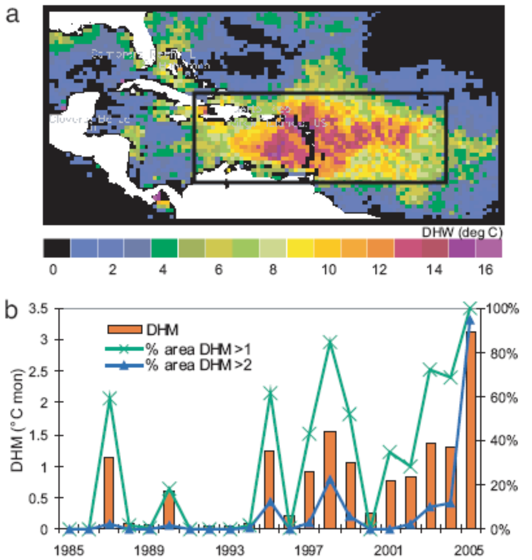
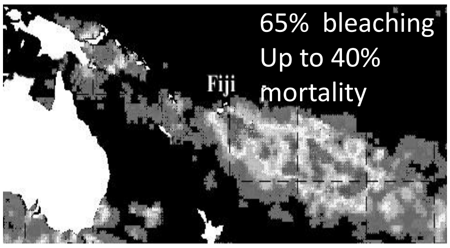


Fig. 1. Satellite-observed thermal stress on Eastern Caribbean coral reefs. (*a*) Map of 2005 maximum thermal stress, expressed as degree heating weeks (°C-week). The study region is marked by the black line. (*b*) Maximum annual thermal stress during the 1985–2005 period over the study region, reinterpreted as degree heating months (°C-month).

Donner et al. (2007)

Heat Stress in Fiji in 2000



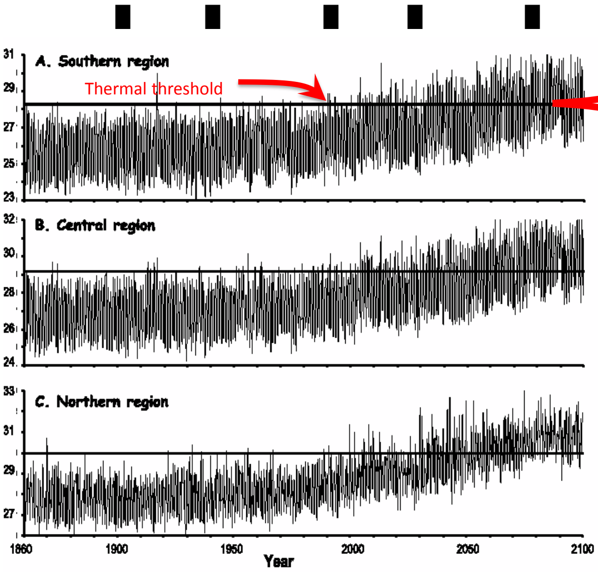
Cumming et al. (2001)

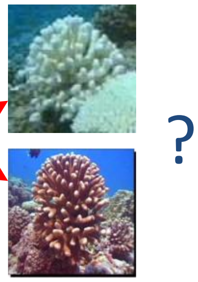
And of concern is the steadily increasing frequency and intensity of events. The top left here shows the number of regions being affected by mass coral bleaching and mortality over time, while the top right (also from Donner et al. 2007) shows the record heat stress that accompanied the mass coral bleaching event in the Caribbean. This figure below shows the rising heat stress over time in this region.

As you know, Fiji has also experienced warm conditions leading to mass coral bleaching and mortality in 2000 - leading to 65% of coral bleaching with a 45% mortality. Fortunately, Fiji has not experienced these types of conditions since.

Environmental projections

Extrapolating from the past 30 years to the future

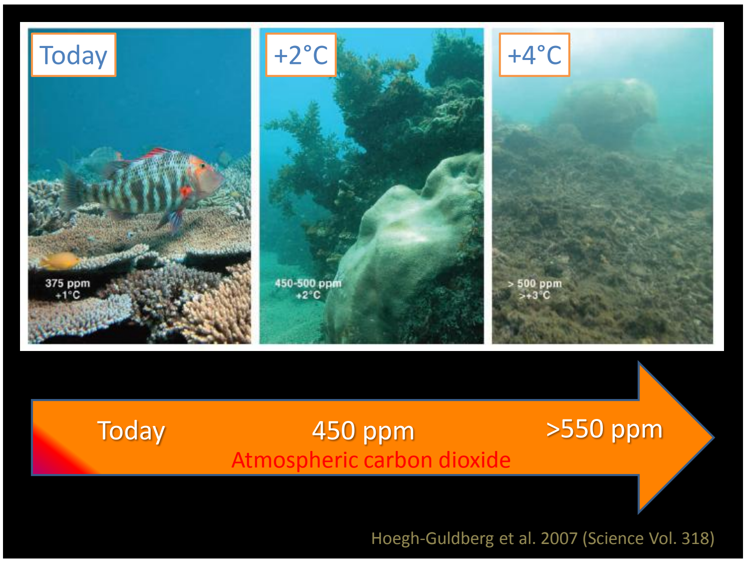




Hoegh-Guldberg (1999) – Trajectories based on IS92A (doubling of CO_2 by 2100)

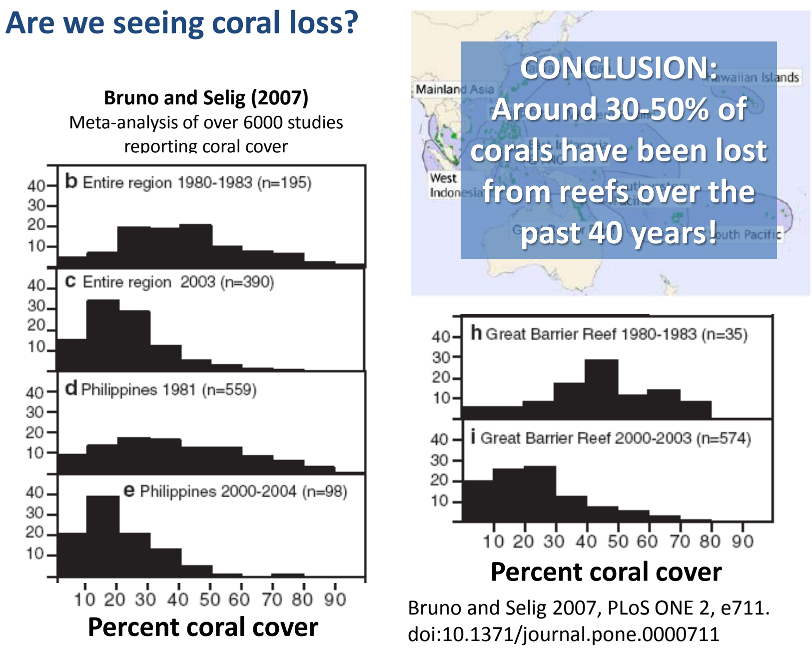
The future is of great concern. From the simple relationship between mass coral bleaching and mortality, we are able to ask the question going into the future - what will happen to coral reefs if they continue to warm?

This figure is an analysis that I undertook in 1999 - which shows model output for sea temperature data under a doubling of atmospheric carbon dioxide. These horizontal lines represent the known thermal thresholds of corals in each of three regions of the Great Barrier Reef (this holds for most global sites). As you see, conditions steadily worsen for corals until the thresholds for coral bleaching and exceeded on a yearly basis by 2030-2050. At this point it is hard to envisage healthy populations of corals. These stresses and that of rising ocean acidity lead to the conclusion that coral reefs are set for a series of steady changes as carbon dioxide increases in the atmosphere.



This figure summarises a large number of scientific studies that have found that corals and the reefs that they build face increasing stress as we move from the carbon dioxide concentrations today (390 ppm) to 450 ppm and beyond. In addition to the impact on ocean temperature, these concentrations of atmospheric carbon dioxide will drive fundamental changes to these important tropical ecosystems.

The important question is: are we already seeing changes to the abundance of coral on coral reefs? A study by Bruno and Selig in 2007 explored how reports of coral cover have changed over the past 40 years and came up with the surprising result that average coral cover throughout Southeast Asia and the Western Pacific has been declining at around 1 to 2% per year.



Of course, these changes are not just occurring in reef-building corals. Because of the primary role that reef building corals have in constructing the habitat for large numbers of other organisms, the loss of corals will also drive the loss of many other organisms. Wilson et al (2006) explored the impact of the 1998 bleaching event on fish populations. What they found was that at least 50% of species showed reduced abundance as coral cover was reduced.

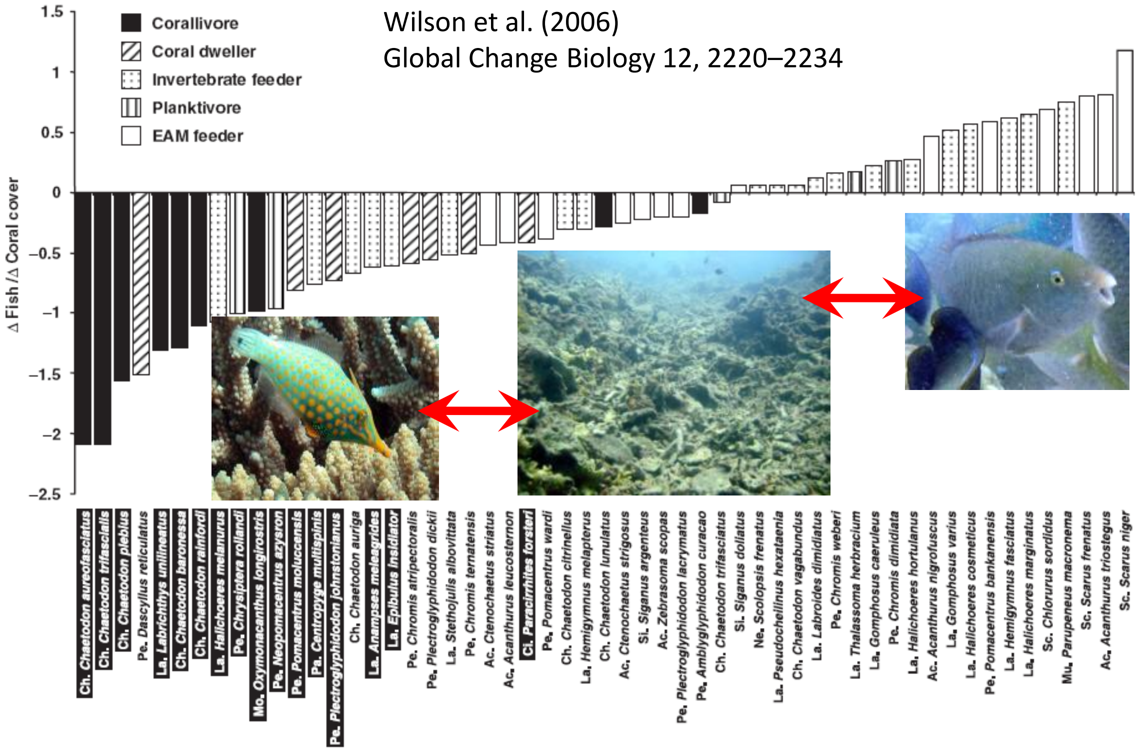


Fig. 2 Response of 55 fish species to decline in coral cover. Responses are mean values, calculated from four or more locations. Species names are highlighted if mean value with 95% confidence interval fails to intersect 0, indicating consistency of response among locations. Letters preceding species name indicate family: Ac, Acanthuridae; Ch, Chaetodontidae; Ci, Cirrhitidae; La, Labridae; Mo, Monacanthidae; Ne, Nemipteridae; Pa, Pomacanthidae; Pe, Pomacentridae; Sc, Scaridae; Si, Siganidae.

While these studies have focused on fish so far, there is a growing literature on the many other organisms that depend on the three-dimensional structure of coral reefs for their existence. Relatively subtle changes in the three-dimensional structure of coral reefs can affect growth, recruitment, predation and competition between organisms. How these changes are likely to play out over the coming years is uncertain although likely to be extremely negative. It is vitally important that we examine how these will affect the ecosystem services that coral reefs provide for many millions of people across the planet. After all, this is the blunt end of climate change and its influence on natural ecosystems.

So I would like to summarise where we are right now. These are the three conclusions I think we can make with some certainty at this point. They lead to a series of likely consequences or changes.

Three conclusions

1. Without strong mitigation of emissions (zero in 30 years) the game is lost. No amount of adaptation will make a difference.

2. The notion that the evolution of organisms and ecological communities can keep pace with extraordinary rate of environmental change is unsupported in the literature and is largely fanciful.

3. Strong mitigation must be accompanied by a strong adaptive measures.

Likely changes

1. Species will have moved 300-600 km poleward, and up the slopes of mountains (where possible).

2. Some forests will be wetter and some forests will be drier – coastal processes may change as a result (more, less sediment etc)

3. Mass bleaching and mortality events will become more and more, accelerating the decline of coral reefs.

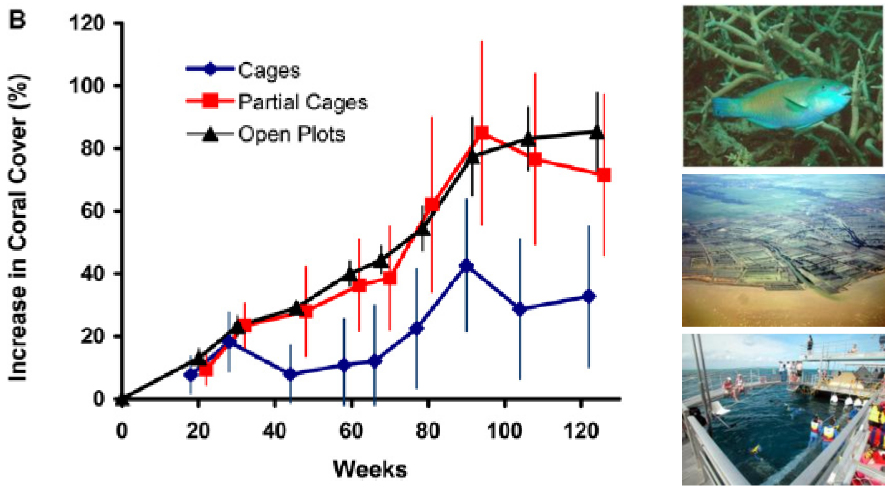
4. Some fisheries species will continue to migrate from where they are today, following isotherms that are optimal for their biology

So far, we've heard a lot about the potential role of protecting reef resilience to buy important time and it comes to climate change. I want to support this idea by asking the question, does protecting reef resilience really have a role to play?

In 2002, 60% of the Great Barrier Reef bleached. Many corals died, especially those on inshore reefs of the Great Barrier Reef.

Terry Hughes and the Australian Research Council Centre for Excellence in Coral Reef studies undertook a study in which they limited the number of fish grazing on reefs that were recovering from this large-scale mass coral bleaching and mortality event. On other reefs they let grazing parrotfish continue to do what they normally do which is to graze back seaweeds.

Reefs visited by grazing fish recover much faster from mass bleaching and mortality.



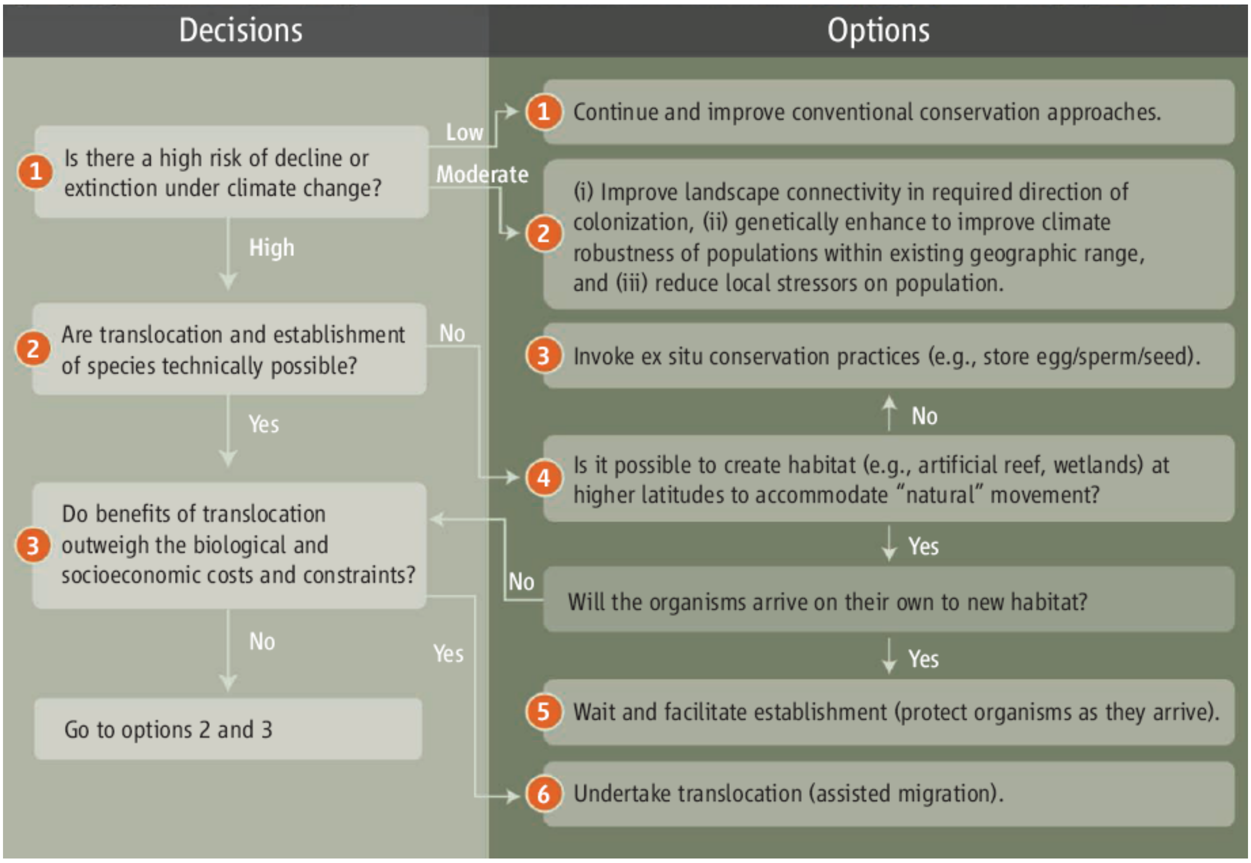
Reducing impacts and buying important time

What this study was able to show is that coral reefs that are left open to grazing parrotfish were able to bounce back almost 3 times as fast as reefs where the fish had not been allowed to graze the seaweeds. The mechanism is quite straightforward. When fish are allowed to graze on coral reefs, seaweeds are unable to dominate the substrate, thereby allowing coral recruits to settle and grow, while at the same time adult corals were not being smothered by seaweeds.

This is a direct demonstration that protecting coral reefs from overfishing through the provision of marine protected areas is likely to have a positive impact on the ability of reefs to recover from climate impacts such as mass coral bleaching and mortality.

Similar principles should apply when it comes to preventing the decline of water quality along coastlines, and preventing the overuse of coral reef areas prone to bleaching by tourism and other uses.

In addition to protecting coral reefs from other more local stresses, other ideas have been considered. A couple of years ago, we convened a working group to discuss whether or not moving species around might have some benefits. While we do not correctly advocate moving species around, we do believe that it's important to consider in the light of the rapid changes that are occurring around us. For example, one has to ask the question, that if we know a species is about to go extinct due to the loss of habitat as a function of environmental change, should we be exploring strategies to move it to a more suitable habitat and thereby save it. This type of thinking led to a decision framework such as this one shown here. Only by a careful evaluation of the risks and benefits, can these types of strategies work.

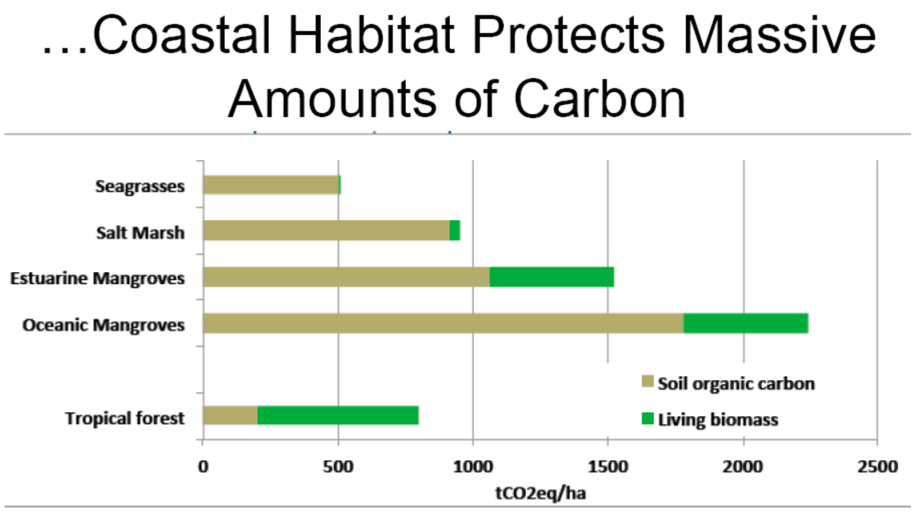


Hoegh-Guldberg *et al.* 2008 (Science)

I want to finish now by talking about another set of opportunities for protecting marine ecosystems from degradation while the same time improving their ability to help ameliorate the problem of climate change by acting as sinks for carbon.

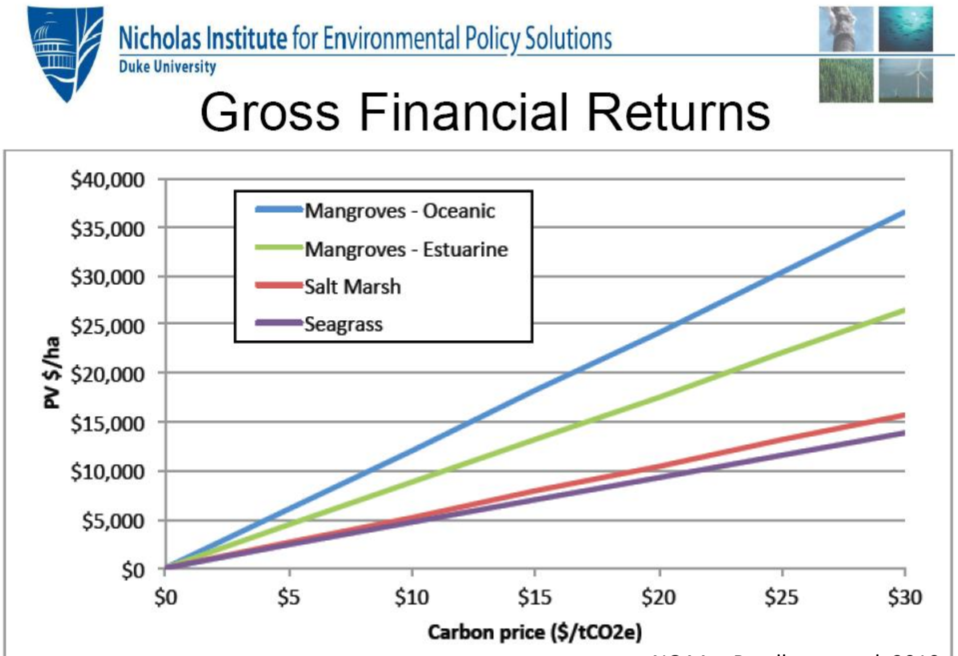
At the outset of this lecture, we talked about the role that the ocean has as a sink for CO_2 and heat. In the former case, the role that terrestrial ecosystems have as a sink for CO_2 has led to the idea that there could be a trade in the carbon credits associated with the ability of marine ecosystems to sequester carbon dioxide as part of their normal functioning. In fact, when one looks at the amount of carbon that can be contained in various marine communities, we find that the carbon that is locked up in these habitats rivals that of tropical forests. For example, the amount of soil organic carbon contained within mangroves is far higher than that of tropical rainforests, which store large amounts of soil organic carbon relative to other terrestrial ecosystems. These are some numbers calculated by Pendleton *et al.* 2010.

Valuing ecosystems:



Soil carbon estimates for top meter.

NOAA – Pendleton et al. 2010



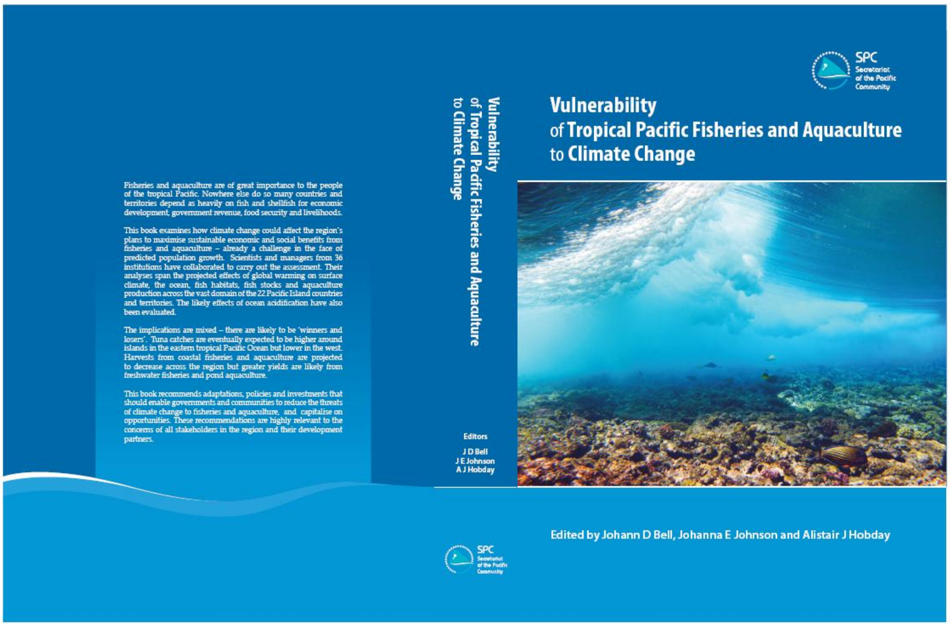
NOAA – Pendleton et al. 2010

When one does the numbers, it is clear that there is a potentially viable market for the carbon sequestration services of marine ecosystems such as mangroves, coral reefs and seagrass beds. Given the associated benefits of protecting these ecosystems for other services that are provided to humans, the idea of developing a trade around 'blue carbon' (i.e. that associated with marine ecosystems) starts to have traction. At this point, one wonders whether it might be possible to develop a market which would bring funding into local communities, alleviating poverty to some extent and stimulating local communities to look after mangroves, seagrass and coral reefs ecosystems in return.

I want to now finish up my address today by making the following conclusions.

Conclusion

1. Climate change is having discernible influence over natural ecosystems within the Pacific Ocean. These impacts will increase, adding to uncertainty over the future
2. The cause of the problem of fossil fuel emissions and deforestation that must be reduced to 0 within 30 years.
3. Adaptation will be critical while mitigation is occurring.
4. Conservationists and natural resource managers may need to rethink their strategies for preserving biodiversity within the Pacific.
5. New approaches must adopt increasingly ecosystem-based and dynamic management strategies.
6. Synergistic benefits for people and ecosystems exist in valuing ecosystem service and establishing markets.



Available on line: http://www.spc.int/climate-change/fisheries/assessment/.

I would also like to bring the new book, "Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change" which has been produced by the Secretariat of the Pacific Community and which is freely available via the following web address. Thank you very much for listening.

Theme 1. Ecology and management of Fiji's watersheds

Chaired by Sanivalati Navuku (IUCN) and Aaron Jenkins (Consultant)

SUMMARY

prepared by Natalie Askew

All presentations made clear the importance of the "ridge-to-reef" approach in managing water catchments. The five presentations in this Theme described many threats to the ecosystems depending on Fiji's watersheds: infrastructure development, deforestation of catchments especially along river banks; non-native species; and excessive use of chemicals, including use of pesticides for killing large numbers of fish. Studies highlighted the impacts of these threats on freshwater and marine ecosystems, as well as the consequences of increased flood risk associated with poor watershed management. A community-based disaster risk management project in Ba river basin is establishing a system for appropriate evacuation of residents in the case of flooding – for example through capacity-building for hazard mapping, evacuation drills and early warning systems. Proper management of catchments will have benefits for marine ecosystems as well as for people living in areas at risk of flooding. Reefs up to 8.5km from Nadi river mouth show impacts from flood-associated sediment plumes.

A study in Nakorotubu found that stream volume has a significant effect on fish diversity and abundance, especially for three important freshwater food fish (e.g. *Kuhlia rupestris*). Therefore infrastructure development should consider the effects of reducing stream volume on fish populations. The diversity of Fiji's freshwater fish has been undervalued: in Nadi basin and bay alone, 15 endemic fish species have been identified. 98% of freshwater fish make contact with the sea during their life cycles: their use of diverse habitats during their life cycle increases the likelihood that they will come into contact with a degraded habitat, and therefore presents an urgent need for integrated catchment to reef management. Where waterways are bisected by infrastructure (e.g. dams, culverts, weirs), retrofitting of fish ladders or passageways was strongly advocated, and for new infrastructure these should be included from the outset.

Studies of freshwater fish diversity across Fiji found that the non-native tilapia has a clear negative effect on species richness, because of its feeding habits which stirs up sediments. The need for increase awareness around the environmental risks of tilapia aquaculture was discussed; importantly no studies have been able to demonstrate the containment of tilapia without escapes. Once established, it is almost impossible to remove tilapia. Therefore in areas where tilapia are known to be established, there is no risk to continued aquaculture. Conversely, the positive impact of a community tabu on fish diversity gave communities in Kubalau strong grounds to identify two additional freshwater protected areas and three proposed catchment headwater protected areas.

Community-based watershed management projects (COWRIE and WANI) urged that management needs to occur at a catchment scale rather than be restricted by village boundaries. Community empowerment in resource management, ownership of the resources, and strong leadership were critical to the success of these projects. A significant challenge for workers in this field is to change from government or academic approach to managing the environment, to a style that suits the local approach to management. Restoration steps taken by communities include planting vetiver grass along river banks and replanting native trees, for which training manuals have been produced. A study in Nadi basin and bay recommended riparian buffer replanting as a community participatory process for the Nadi and Sabeto rivers. After implementation of management measures, changes to ecosystems may be slow, and therefore presenters reminded of the need ongoing monitoring of catchments on a 3-5 year timescale.

Presentation 1. Fishes of the Nadi basin and bay, conservation ecology and habitat mobility

Jenkins, A.[1, 2] and Mailautoka, K.[3]

This study provides the first comprehensive listing of the species of fishes occurring in the Nadi basin & bay vicinity, their life histories, feeding guilds, conservation status and cross-habitat mobility. To develop a comprehensive listing of fishes for the Nadi Basin and Bay area we used a combination of intensive field sampling and information from past studies. At least 335 species of fishes from 158 genera and 73 families reside in the Nadi Basin and Bay area representing 27% of Fiji's coral reef, estuarine and freshwater fish fauna. Of these, 317 are indigenous, 15 are endemic and 3 are introduced species. There is a clear attenuation of species proceeding from the outer reefs inward to the Nadi River Basin with 211 species on outer reef areas, 133 species within the strict confines of the bay and 35 species recorded within the Nadi river.

Fifteen species of endemic fishes from six families occur in the Nadi Basin and Bay area representing approximately 58% of all (26) of the endemic fishes in Fiji. 70% (234) of species listed in this study have not yet been evaluated using IUCN Red List criteria, 27% (89) are listed as Least Concern (LC), 2% (7) are Near Threatened (NT), two species are Vulnerable (VU) and one species is listed as Endangered (EN). This equates to around 3% of the fish fauna being officially listed as threatened, although the actual figure is likely to be higher. Threatened species are mostly associated with river mouths for feeding and breeding as well as prime targets for the reef fish trade. 69% of the fishes in this area are largely reef associated throughout their lives, although over half of these species can move into bays and estuaries. The remaining 31% of the fauna commonly use bays, estuaries and freshwater for feeding, breeding and development in nine separate and distinct life history patterns.

About a quarter (23%) of all of the fishes are carnivorous, closely followed by invertivore generalists (20%) and generalist feeders (14%). Specialist feeders, such as piscivore specialists, coral polyp specialists and insectivore specialist are the rarest feeding guilds. There is a high degree of cross habitat mobility among the fishes of this study region. At very least, 67% of all of the species of fishes within Nadi Basin and Bay will move across different aquatic habitats during their lives. Over 27% of fishes will cross three or more habitat types during their lives and the most highly mobile group, crossing four and five habitat types, represents almost 10% of the entire fauna.

Reefs up to 8.5 km from river mouths show evidence of impacts of sediment plumes associated with floods, while inner bay reefs (1.5 - 2.5 km from river mouths) are heavily and chronically impacted by sediment deposition. Indigenous fish diversity of

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[2] Presenter: apjenkins@connect.com.fj

[3] Wildlife Conservation Society

Nadi river basin has been heavily impacted by land clearing, bisection of waterways (roads, culverts, dams) and also likely the presence of introduced species. Water quality of Nadi basin & bay is generally poor with implications for both aquatic life and human health. Recommendations are provided for integrated water resource management of Nadi basin & bay

Presentation 2. A social and Biophysical Reconnaissance of the six upper Ba Watershed communities

Orcherton, D.[1, 2] and Veitata, S.[1]

The FORENET research Project helps facilitate community-based sustainable natural resources management and development planning to improve livelihoods and to enhance the protection and conservation of the natural resources and ecosystems. During March to May, 2011, a team of researchers from PACE-SD, USP undertook a semi-detailed reconnaissance study of rural communities in the upper Ba watershed area (Viti Levu, Fiji) with the medium-term goals of developing an Integrated Watershed Management Master Plan for the area. The reconnaissance objectives were to gather (qualitative and quantitative) information from six rural communities in the Upper Ba watershed. Using a modified PACE-SD-V&A methodology, and participatory ethnographic analysis techniques , community facilitators and FORENET researchers gathered baseline socio-economic, cultural, demographic and community governance information and carried out a preliminary biophysical assessment of major land-use types and ecosystems (e.g.: characterization of terrestrial ecosystems, agriculture/cropping systems, crop husbandry practices and common crop or tree species). This also included the use(s) of non-timber forest products (e.g.: thatching for construction, handicraft, medicinal plants and/or other important value-added forest-products for improving livelihoods).

Results showed that all six communities showed similarities in terms of terrestrial ecosystems, forests and non-forest dependency, but there were differences in vegetation cover and anthropogenic and natural-land-use changes. Most of the communities were forest and non-forest dependent but had been subjected to considerable forest disturbance (in the past and more recently). Communities seem to be self-reliant on local resources to utilize or gain economic benefit from timber and non-timber products. Very little support (e.g.: reforestation) for climate change has been provided by government, institutions or non-governmental agencies. Average family income was low and number of support-services related to forestry agriculture/agroforestry, food security, community training, awareness building of capacity building other related activities, was minimal or nonexistent. There was a predominance of soil erosion on hillsides, caused by unsustainable land use practices or land-use change, forest loss through logging or selective harvesting of native or exotic species. This caused significant degradation of upland areas, with varying degrees of land slippage in gorges and exposed areas. The socioeconomic and cultural characteristics of each community are somewhat heterogeneous but there was a 'common denominator' in all of them; community cohesion is lacking, even with a well-established and functional governance structure within the villages. Health and sanitation is still a major concern, as well as water.

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Presentation 3. Lessons learned in community based watershed management and rehabilitation

Buliruarua, L.[1,2]

In Fiji, rapid shifts in land use patterns over the past hundred years has led to accelerated erosion, degraded water quality and loss of critical watershed ecosystem services and processes. These problems are further exacerbated by the impacts of climate change through more frequent and intense extreme events.

Historically, the approach to watershed management has often focused on the top-down approach with limited input from communities who usually are the key resource stakeholders. However, the unique tenure system over both marine and terrestrial resources in Fiji blended with the application of modern scientific techniques and recognized best-practice allows for the opportunity to arrest and restore this adverse trajectory through community-based management.

Two watershed management projects have been implemented in communities of two Provinces in Ra in the north-east of Viti Levu and the southern island of Kadavu to expand and compliment the marine community-based resource management approach to Fijian watersheds. Such as an approach provides an alternative method of maintaining the cultural, socio-economic and ecological integrity of Fiji's watersheds, and lessons learnt of how community-based management can be applied to holistic ridge-to-reef resource management.

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Presentation 4. Strengthening Community-Based Disaster Risk Management Project in the Pacific Region

Kameyama, K.[1,2]

Japan International Cooperation Agency (JICA) and National Disaster Management Officer (NDMO) have been implemented flood risks mitigation projects in Solomon Islands and Fiji since October 2010. The pilot sites for this project are: 1) Tamboko Village located in Umasani river basin; 2) Guadalcanal Province in the Solomon Islands; and 3) Nawaqarua and Nasolo villages located in Ba river basin, Western Division in Fiji. The expected outcomes of these projects are:

- a flood warning system is in place and appropriately managed by NDMO in cooperation with Meteorological Service and Water Authority.
- NDMO's disaster management capacity is developed
- the target community's awareness on disaster preparedness is enhanced.

As part of the flood risk mitigation program following activities have been implemented between January-July 2011:

- 3 rain gauges and 2 water level gauges were installed at Ba river basin. The gauges can transmit the real-time hydrological data.
- The draft Disaster Prevention Plans for community and Ba district were prepared.
- Baseline survey at Nawaqarua and Nasolo revealed the needs of the revision of community disaster plan and evacuation drills. The simplified hydro monitoring system will be introduced to both villages.
- A self-recording rain gauge and water level gauge were installed at Vatukanau in Tamboko.
- Disaster Simulation Exercise was conducted attending 22 participants.
- Socio-economic survey, community workshop and walkabout investigation were conducted to recognize risks for the residents in Tamboko.

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Presentation 5. Human and climate impacts on decline of Fiji's freshwater fishes

Mailautoka, K.[1,2], Jupiter, S.[1] and Jenkins, A.[3]

Freshwater fish species have been declining in terms of diversity and abundance in river systems around Fiji. We undertook surveys of freshwater fish species richness and abundance between 2006 and 2010 to investigate the main factors associated with this decline. Our initial investigations of 20 catchments in Fiji indicated that loss of catchment forest cover and presence of non-native tilapias were the strongest factors associated with loss of native fish species. The negative effects of catchment land clearing appear to be more pronounced in degraded catchments during the wet season. By contrast, increasing water level and flow during the wet season in near-pristine catchments provided more good habitable space for fishes. More recent surveys in Oct 2010 investigated the extent to which catchment land cover, water quality and riparian width impact freshwater fish communities on four districts of Vanua Levu. We found that the presence of overhanging culverts proved to be a major barrier for fish migration: we found low numerical abundance and few fish species in areas of otherwise intact habitat where culverts were present downstream. This provides evidence that the migration path for migratory species need to be maintained if we want to preserve the diversity and abundance of freshwater fish within Fiji's river systems.

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[3] Wetlands International - Oceania

Presentation 6. Factors Affecting Fish Assemblages in Wade-able Streams of Nakorotubu

Copeland, L.[1,2]

Various mechanisms have been studied to explain the relationships of abiotic and biotic factors on stream fish assemblages globally. However, information from Fiji is scarce in both large rivers and wadeable streams. This research focuses on various factors affecting fishes in wadeable streams of Nakorotubu. Three streams were sampled during the wet season and categorized into lower, mid and upper reach. At each reach there were five replicate stations and within each station water quality and habitat data was collected, fish was surveyed using a combination of electrofishing and beach seine. This data was analyzed using both univariate and multivariate statistical methods to elucidate factors affecting fish communities.

A total of 376 fishes ranging across seventeen different species belonging to seven different families (Ambassidae, Anguillidae, Eleotridae, Gobiidae, Kuhliidae, Moringuidae, Sygnathidae) were collected across the three streams sampled. Key findings include two endemic gobies *Redigobious leveri* and *Glossogobius* n. sp. (Hoese and Allen, in preparation). Longitudinal variation is fish assemblages were identified with species such as *Anguilla obscura* and *Sicyopus zosterophorum* abundant in mid to upper reaches. Species such *Ambiasis miops*, *Kuhlia munda*, *Microphis* sp. *Moringua* sp. and Hypseolotris guntheri were abundant only in lower reaches. The following species were present across all habitat types (lower – upper reaches) *Anguilla marmorata*, *Eleotris melanosoma*, *Kuhlia rupestris* and *Redigobious leveri*. However, they were more abundant in lower reaches. The gudgeon *Eleotris fusca* was the most abundant fish and represented 40% of the total fish caught.

The total abundance and diversity of fishes in streams is significantly affected by reach. With lower reaches having the highest diversity and abundance and decreases as you move upstream. In addition volume of water is a significant factor regulating fish communities across the three streams.

The result of this study governs the importance of a holistic management approach across all habitat types (lower, mid and upper reaches) for instream biota. Given the fragility of oceanic island ecosystems the results of this study further supports the global notion of maintaining natural flow regimes for the conservation of stream fishes.

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Theme 2. Terrestrial Species

Chaired by Miliana Ravuso (BirdLife International) and Sunil R. Prasad (CORAL)

SUMMARY

prepared by Sunil R. Prasad

The emerging effect of climate change is one of biodiversity's greatest threats. On land, grouped together with habitat loss and invasive species, is projected to cause biodiversity loss at high proportions. This session included presentations from researchers working on threats of climate change to forests and birds, floral diversity of degraded habitat, and efforts and techniques of reforestation.

Emphasis was placed on focusing future research effort on key invertebrates such as land snails which exhibits high level of endemism on Pacific island countries. However due to their small size and lack of taxonomic experts, their representation in the designing of reserves is missing. Bigger, more charismatic species such as birds have been well documented and high conservation priority areas such as Important Bird Areas (IBAs) have been identified and implemented as tools for management. Birds which are site specific and are habitat specialist are predicted to be affected by climate change. To mitigate species demise from climate change, proper reserves need to be designed which takes into account connectivity and resilient ecosystems.
Resilient and well connected ecosystems need to be managed with community participation. Surrounding degraded areas such as commercial plantations can harbor important species. Steep terrain can help with the allocation of protected areas however, it is essential to consider the effects of extensive degradation of surrounding areas.

Similarly, encroaching invasive vegetation can have a negative effect because of their increased competitive nature. The Sigatoka sand dunes are seeing a reduction in native species and an increase in non-native species. This shift in community species can have a profound effect on the dunes especially the stability of the sand. The eradication of these invasive plants is not considered a feasible option, whereas the Pacific rats of Vatu-i-Ra have been successfully eradicated. This eradication has led to an increase in Black Noddy and Red-footed Booby populations on this island, which holds the largest aggregation of Black Noddy in the Pacific. In the future it may be possible to encourage the Critically Endangered Fiji Petrel to return to Vatu-i-Ra by using solar-powered sound systems to attract individuals.

Reforestation of degraded areas need to take into account mixture of native and exotic species, and should promote establishment of buffer zones with native species. Reforestation sites, especially in the head waters, are essential for ensuring water sustainability and minimizing downstream effects of land based activities. During simultaneous reforestation projects, tree seedlings became a valuable commodity, and were actually traded rather than planted. Coordination between large-scale reforestation projects is essential to avoid creating markets for seedlings.

Presentation 1. Conservation of Fiji's Placostylid Land Snails

Bogitini, L.[1,2], Brodie, G.[1] and Barker, G.[3]

The world's biodiversity is in crisis. With this, our highly diverse land snails are of particular extinction concern globally. Pacific Island land snail diversity is significant because of its high levels of endemism and also it's alarming past extinction record. We examined the widely scattered literature relating to Fiji's native land snails. From the resulting information we determined priority snail groups that are likely to be in need of conservation action to prevent extinction. One of these groups is the relatively large placostylid snails which are not only endemic to the Oceania region but have several regional members that are already IUCN red-listed as endangered or extinct. Based on existing literature dating back over 100 years we have determined that Fiji has fourteen recorded endemic species of *Placostylus* snails, of which eight are recorded only on a single island. All species are closely associated with forest habitats, none of which has ever been studied ecologically or assessed for its conservation status. We are currently in the process of finalizing IUCN red-listing assessments for these fourteen species and are about to begin a study to assess, current species distributions and population genetics which will assist prioritization of any future conservation actions. We have also found some evidence of historic cultural linkages between *Placostylus* snails and Fijian people and these aspects will soon be further explored in cooperation with our local community collaborators.

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Presentation 2. Plant species and functional diversity in the degraded wet tropical forests of Kolombangara, Solomon Islands

Katovai, E.[1,2], Burley, A.L.[3] and Mayfield, M.M.[3]

Anthropogenic activities have resulted in extensive forest degradation in highly diverse islands of the Western Pacific. This study examines the non-tree plant species and functional diversity of remnant rainforest on Kolombangara, Solomon Islands. We compared this diversity to that found in secondary forests and common human-created vegetation classes common in the Solomon Islands at three elevational bands where possible. Data was collect in 48 sites nested in elevational bands within each vegetation class. Across all elevations, secondary forest was most floristically similar to lowland primary forest and commercial forest plantation was the human-created vegetation class most similar to forests. Primary and secondary forests differed significantly in species and functional diversity across elevation bands, while commercial forest plantations did not. No anthropogenic vegetation class was floristically similar to forest classes on Kolombangara. Traits were quite similar between forests and human-created vegetation and no trait varied enough to act as a proxy for diversity. Results indicate that forests are distinct across elevations, suggesting that forest conservation on Kolombangara needs to be multi-elevational in order to protect flora diversity of the island.

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Presentation 3. Threat of Climate Change to Fiji's endemic forest birds

Tabudravu, M.[1,2], O'Brien, M.[1] and Ravuso, M.[1]

Fiji has 27 endemic forest birds most of which are restricted range species. A conservation policy is to enable these birds to adapt to climate change by ensuring that high quality habitats are available to provide a buffer as conditions change. Species most at risk are likely to be those with the smallest populations or those with restricted distribution. Our studies in Viti Levu indicated that the majority of the endemic species are not restricted in their habitat use, so have developed adaptive features to changing habitats and thus are more likely to be resistant to climate change. Recently we have looked at species distribution around IBA's on Vanua Levu and Kadavu through monitoring of bird populations and assessment of habitat features. Here too many of the endemic species were observed to be utilising both forest and open habitats providing an indication that such species are likely to be able to adapt to climatic changes. Three species currently are identified as highly susceptible to climate changes, Red-throated Lorikeet (very small population), Pink-billed Parrotfinch and Silktail (specialised habitat within small range). Further monitoring to assess these populations should be a priority.

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Presentation 4. The Conservation Status of the Vegetation in the Sigatoka Sand Dunes National Park: Threats of Invasive Alien Plants

Takeda, S. [1,2]

The indiscriminate use of resources of the Sigatoka Sand Dunes in the past had resulted in the extensive losses of the original native forest cover and the rapid establishment and spread of invasive exotics by 1970's. Although the biodiversity loss due to direct habitat destruction has been reduced significantly since the establishment of Fiji's first national park in 1989, the disturbed plant succession has apparently continued unabated, causing a further change in species composition and community structure of remaining forest patches. The current status of the vegetation has, however, not been well understood because the heterogeneous and temporal nature of the coastal dune vegetation makes it difficult to perceive floristic patterns of the geographical scale on the ground or remotely sensed images. In this survey multivariate community data (i.e., plot-based quantitative species data) was, using GIS, converted to more informative spatial patterns, which made possible a close analysis of floristics and "invasability" of remaining forest patches, invasiveness of existing weeds, endangerment status of native species, and the direction of disturbed plant succession when compared with the 1978 survey data. The results clearly show that many original native forest species have since become less abundant, with some species having been either extirpated or on the brink of extirpation, mainly due to the increasing dominance of invasive exotics and more coastally-adapted, competitively-superior, native plants. The composite analysis also made possible the identification of priority habitats and species on which limited resources should be concentrated to ensure that conservation management is effective.

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Presentation 5. Assessing different tree species and planting techniques for grassland reforestation

Naikatini, A. [1] **and Dayal, B.** [2,3]

The University of the South Pacific together with the Fiji Forestry Department carried out a trial reforestation project on 30ha of degraded land dominated by grass (*Pennisetum sp*) in the Naroko district, Ra Province through the COWRIE project. The main objective of the project was to trial out as many native and exotic tree species in restoring degraded watershed areas. Tree species were selected on the basis of availability of seedlings however the following factors were taken into account; potential timber tree species, fruit tree species for food security and fuel wood. Tree seedlings used in the demonstration included three exotic species, 15 indigenous species and six fruit species. Planting was carried out by the people of Naroko from February to April, 2010 coinciding with the rainy period. We carried out mixed species planting except along waterways where only the indigenous species were planted. Seedlings were planted along lines running in East – West direction to maximize sunlight coverage and planting space of six by six meters as recommended by the Fiji Forestry Department. More than 10,000 tree seedlings were planted in the 30ha demonstration plots. Survival assessment of the different species was carried out one year after planting. The implementation of the project in Fiji would provide baseline information of restoration activities that can be undertaken by communities located on the leeward sides of the main islands towards managing their watershed environment from the ridge to reef.

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Presentation 6. Monitoring seabirds in Fiji: Responses to rodent eradication and climate change

Tuamoto, T.[1,2], Cranwell, S.[1], Bird, J.[1], Seniloli, E.[1] and Rasalato, S.[1]

Several islands in Fiji support internationally significant seabird populations and qualify as Important Bird Areas (also Key Biodiversity Areas). Many sites are remote and survey visits are infrequent, but historic data exists for a number of islands and BirdLife International has implemented a regular monitoring programme at the Ringgold Islands, Vatu-i-Ra and Mabulau as part of an island restoration programme. We analyse survey results to date for annual variation in the timing of breeding events, and population trends over time for multiple species to assess whether any preliminary responses to rodent eradication can be detected. Seabirds are known to be susceptible to inter-annual climatic variation which can radically affect breeding success. The data collected will help to monitor longer-term responses to a changing climate.

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Theme 3. Marine Species

Jan Steffen (IUCN) and Merewalesi Laveti (WWF)

SUMMARY

prepared by Natalie Askew

The seven presentations in this Theme demonstrated how much there is still to learn about Fiji's unique marine species, from taxonomy to behaviour. Recording traditional knowledge played a vital role in many of the studies presented here. Work is underway to implement policies for protection of these species and to raise awareness of marine conservation, as well as to continue to collect valuable data through established monitoring programmes.

Fiji is home to four species of sea turtle (Green Turtle, Hawksbill, Leatherback, Loggerhead), with one species occurrence still to be validated (Olive Ridley). The Department of Fisheries reported recently updated estimates of foraging and nesting turtle populations. This included a significant decrease in nesting populations of Hawksbill turtles, for example on Namenalala Island approximately 150 nests were recorded in the 1970s, but now only 5 nests have been sighted in past 2 years. Priority areas for sea turtle conservation in Fiji have been identified through mapping of traditional knowledge ground-truthed by nesting beach surveys. Satellite tagging studies by SPREP reveal the Great Sea Reef as a key foraging ground for Loggerhead, Hawksbill and Green Turtles. Interestingly, no migration out of Fiji's waters was observed in the seven individuals tagged, and those individuals also showed high site fidelity.

Little is known about the current status of cetacean species in the waters of Fiji. The subpopulation of Oceania Humpback whales has recently been classified as Endangered by the IUCN Red List. Anecdotal data collected in 2011 identified four cetacean hotspots from interviews of 90 people in 30 coastal villages around the coasts of Viti Levu and Vanua Levu. Building on this anecdotal evidence, in August 2011 the Department of Fisheries led a cetacean survey in the Lomaiviti channel, using boat-based and land-based observations: ten cetacean sightings were made.

Traditional knowledge was also valuable to inform a study of parrotfish diversity around Kia island. Fishers were interviewed as part of an ethno-biodiversity study, and vernacular names for initial and terminal phases of parrotfishes were collected, amounting to a total of 31 species of parrotfish. Parrotfish were suggested as having an important role in climate change adaptation, because of their integral role in the sand cycle (one adult *Bulbometopon muricatum*, or kalia, contributes $1m^3$ to the sand cycle yearly) and ability to stabilise reefs against phase shifts by intensive grazing. It is estimated that 3000-4000 *B. muricatum* individuals were netted yearly between 1968 and 1970, contributing to their current low populations in Fiji.

Closer to Suva, another taxon that has suffered declines in recent decades is the crabs. Over the last 60 years crab populations in Vanua Navakavu have been threatened by overharvesting, pollution, habitat destruction and infrastructure development. A locally managed marine area was established in 1998 (subsequently a marine protected area covering 18% of Vanua Navakavu fishing grounds). A comparison of a 60 year timeline with anecdotal evidence on changes in crab abundance indicates that this conservation initiative has likely been responsible for a return or increase of many crabs that have never been seen by the current generation of fishers. For example, there has been a recovery in populations of *Scylla serrata* (qari) and a return of *Calappa* spp. Crabs were suggested as an excellent indicator species for use in monitoring progress in marine conservation.

Fiji has been part of the Global Coral Reef Monitoring Network since 2000, with the aim of coordinating scattered reef monitoring efforts. Monitoring results show that in years with over 80 consecutive days with mean sea water temperatures above 29°C, mass bleaching occurs, whereas in years with 35-60 days above this temperature, only partial bleaching occurs. Monthly means of sea surface temperature data from NOAA between 2001-2007 show a trend consistently 1°C higher than the trend from the same data collected in the 1980s, supported by data from Fiji's Coral Reef Monitoring Network temperature loggers. Consequently, in most years Fiji's waters exceed the stated 'bleaching threshold' which triggers alerts from the Coral Reef Watch satellite bleaching alert system, yet mass bleaching events are uncommon. Therefore, is Fiji's bleaching threshold set too low, or are corals adapting to higher temperatures after previous bleaching events?

There are 58 species of shark reported from Fiji's waters, of which 35 coastal species are thought to occur in the shark fin trade operating out of Fiji. The shark fin trade started as tuna bycatch from longliners (approximately 900 sharks were caught by tuna longliners in Fiji waters in 2005), but in recent years the fishery has started to target sharks for their fins. An undercover investigation in Suva revealed dealers in shark fins who were able to supply 1 tonne of dried shark fins per month.

In response to these threats to Fiji's sharks, the Fiji Government has launched an initiative to create a shark sanctuary across the entire Fiji exclusive economic zone, a first for the South Pacific. This initiative is supported by the Fiji Shark Sanctuary Campaign[1]. The Department of Fisheries reported the positive news that the impacts of turtle conservation awareness-raising work are starting to be seen in the communities. Turtles are already protected under the Turtle Moratorium (2009-2018) and Endangered and Species Protected Act. For cetaceans, a Whale and Dolphin Action Plan has been drafted for consultation with stakeholders, in order to implement the Whale Sanctuary in Fiji's exclusive economic zone which was declared in 2003.

[1] www.facebook.com/FijiSharkDefenders

Presentation 1. Critical habitats of sea turtles in Fiji

Laveti, M.[1,2]

Fiji waters are known to be a critical habitat for foraging sea turtles population in the Pacific region. Recent surveys by the Secretariat of the Pacific Regional Environment Programme on satellite tagging revealed the migration of sea turtles to Fiji waters for feeding. Areas of importance for sea turtle conservation in Fiji were identified through community based sea turtle monitoring and research, traditional knowledge and consultation with partners who have worked in these areas. The collated information were consolidated and mapped out revealing these critical habitats for protection. The great sea reef is one of the critical foraging sites identified given the results of the satellite telemetry in Fiji. It also highlighted that Fiji's sea turtle population are residential. More satellite telemetry works needed to be conducted to allow for a stronger justification of the migrating behavior of sea turtles in Fiji. All the seven satellite tagged turtles in Fiji did not show any migration out of Fiji. The migration patterns of the seven turtle species including loggerhead, green and hawksbill were mainly movements within inshore waters of more than one customary fishing grounds. It also showed the ecological connectivity of these marine protected areas and the greater need to enhance community based conservation and engagement in sea turtle monitoring to allow for an informed decision in the protection of sea turtles.

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Presentation 2. Conservation and Management of Sea Turtles in Fiji

Batibasaga, A.[1,2]

In this sea turtle presentation, the Fisheries Department is attempting to review and update previous stock status estimates of the four known sea turtles species occurring in Fiji, which are the Green (*Chelonia mydas*), the Hawksbill (*Eretmochelys imbricata*), the Loggerhead (*Carreta carreta*) and the Leatherback (*Dermochelys coriacea*) sea turtles. Previous estimates were undertaken by the Department from the year 2000 (Batibasaga, A. *et al.* 2004).

The paper attempts to show the improvement in local knowledge available for sea turtle nesting populations, which has been markedly improved from recent research and data collection work undertaken since 2005. Very little research has been undertaken for sea turtle foraging populations across Fiji, and this assessment tries to recommend what should be done to improve knowledge and data collection on foraging populations, and how to improve current information on sea turtle stock estimates. The Department is currently promoting the improvement in Fisheries stock assessment work to include all sightings of highly threatened species like sea turtles, Humphead wrasse, and sharks. Five species of marine turtles have been reported to exist in Fijian waters and the 2008 IUCN Red List of Threatened Animals lists the global status of these marine turtle species as follows:

- Green Turtle - Endangered
- Hawksbill Turtle - Critically endangered
- Leatherback Turtle – Critically endangered
- Loggerhead Turtle – Endangered
- Olive Ridley – Vulnerable (The Fisheries Department has yet to validate the occurrence of Olive ridley sea turtles in Fiji waters as to date).

The status of marine turtles in the Pacific Islands region is relatively poorly known. A recent questionnaire based survey conducted by SPREP in the region (12 member countries and territories responded) identified the lack of data and limited research and monitoring as the two main challenges for effective marine turtle conservation in the region. The lack of data is a direct result of the limited research and monitoring initiatives that has been undertaken from the last 10 years, and is due mainly to the lack of resources. This fact is also relevant to Fiji. With the "**10 Year Sea Turtle Moratorium"** in place from 2009 to 2018, and under the Fiji Sea Turtle Recovery Plan framework endorsed by the Fiji Government in 2010, the identification of nesting and foraging grounds and collection of baseline field data and monitoring is a priority target area.

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Presentation 3. Current Assessment of Cetacean diversity in the Lomaiviti Channel

Sharma-Gounder, S.[1,2] and Miller, C.[3,4]

Historical anecdotal and documented information indicate the presence of cetaceans in Fiji waters. Over the years numerous sighting reports have been reported from various areas in Fiji. For the purpose of these report, whales and dolphin presence documented over the past few years in the Lomaiviti channel will be discussed. There is a strong emphasis on the behaviour patterns of the Humpbacks which indicate breeding and calving in our waters. An overview of unpublished data gathered by Dr Bill Dawbin, accessed by David Paton will also be used to assess the difference in the number and diversity of cetaceans in the Lomaiviti channel during the 1950's and the current research that has been carried out in the last few years.

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Presentation 4. Status of shark fishing and conservation efforts in the Fiji Islands

Sykes, H.R.[1,2], Chapman, D.D.[3], Villagomez, A.[4] and Brown, K.T.[1,5]

Many shark populations are declining world-wide and several species are already classified as Endangered, Vulnerable or Near Threatened on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. Sharks have a life-history strategy that involves late age at maturity, small litter sizes and infrequent reproduction, which makes them extremely vulnerable to overfishing. Sharks are top predators and it is thought that they can play a critical role in maintaining the balance of marine ecosystems. The removal of top predators from an ecosystem can cause cascading changes throughout the food web and have serious ecological and economic consequences.

In Fiji, live sharks have great environmental, economical and traditional value. Regional linkages with sharks of legend mean that shark fishing directly contradicts traditional values of indigenous Fijians. Sharks are also living tourist attractions, attracting millions of dollars in tourism revenue from divers who come to Fiji to see them. Coral reef ecosystem health, which is potentially related to the health of top predator populations, is vital to the country, protecting the coastline from erosion, sea level rise, cyclones and flooding. Without healthy reef ecosystems, subsistence fisheries will collapse and the tourism industry will decline.

Despite their tremendous “living value”, Fiji’s shark populations are threatened by the shark fishing industry. What used to be a low level trade in sharks accidentally caught as by-catch during tuna fishing, has, over the past few years, become an industry in of itself. Tens of thousands of shark fins are now being exported to Asia per month from Fiji. A rapid assessment of this trade is presented.

This trade is unlikely to be sustainable and would be difficult to control. Once depleted, shark populations take a long time (decades to centuries) to recover, which means that their removal is largely irreversible within our lifetime. Action to raise awareness and install mechanisms to protect Fiji’s sharks before this point is vital, and a campaign is underway as part of a global effort to conserve shark stocks.

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Presentation 5. The Conservation Status and the Return of Crabs in Vanua Navakavu

Bukarau, S.[1,2]

Crabs are an important ecological and cultural resource for people all over the world, especially on islands and in Fiji. Their value is seen in their use for food, income from sale, as important fish bait and in providing environmental services as detrivores and prey for finfish, seabirds and other marine organisms. For the renown fishing community of Vanua Navakavu, crabs are among the most important marine resources. They have also shown to be among the resources that are particularly vulnerable to overfishing, with many species having disappeared over the past half century

Crabs are found in a range of habitats including the mangroves swamps, seagrass beds, intertidal flats, reefs, the sandy substrates of lagoons and along beaches and coastline in the supratidal zone. These habitats and crab populations have historically deteriorated due to pollution, development of infrastructure like roads, settlements and factories, destructive fishing methods and overharvesting of the resource. As a result, populations of many species are threatened or extirpated.

This study, a taxon by taxon study of crab species, shows that conservation initiatives in Vanua Navakavu, which have been done in close collaboration with FLMMA, IAS and USP, have probably been responsible for a dramatic return of many crabs that have never been seen by the current generation of fishers or which are dramatically increasing in abundance since the establishment of the MPA in 2001. The current study clearly shows that these conservation interventions have played a positive role in marine conservation and that crabs are an excellent indicator species of the success of marine conservation and the restructuring of marine ecosystem.

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Presentation 6. Ecological Importance and Ethnobiodiversity of Parrotfishes (Scaridae): A Kia Island Perspective

Fong, T.[1,2]

Parrotfishes (Scaridae) are a socio-economic and culturally important fish family in Fiji and other tropical regions of the world. Their close association with corals has placed them as amongst the few indicator species that may signify changes in coral reef ecosystem functioning and healthiness.

Parrotfishes are among the most common, diverse and prolific of reef food fishes and play critical ecological roles in marine ecosystems. Some species are also under threat from overfishing, while others may be among the best indicators of the health of our marine environment. Parrotfishes have major impacts on coral reefs through intensive grazing and associated bioerosion. Grazing patterns of large schools of parrotfish prevent algae from choking out corals.

While there are direct threats to parrotfishes in Fiji that include habitat degradation, disruption of ecosystem connectivity, over-fishing, and the use of destructive fishing methods, pollution, and coastal development amongst them; parrotfishes, with the exception of *Bolbometopon muricatum*, may be the most resilient of all nearshore fishes. Parrotfishes are being increasingly sold at fish markets around Fiji while other nearshore target species like the groupers, snappers and goatfishes are disappearing slowly. Could their reproductive behaviour and perhaps lack of reliance in mangrove ecosystems be a reason for this resilience?

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Presentation 7. Fiji Coral Reef Monitoring Network: an overview of a current partial coral bleaching event as related to sea water temperature recordings

Sykes, H.R.[1,2]

The Fiji Coral Reef Monitoring Network (FCRMN), a node of the Global Coral Reef Monitoring Network (GCRMN) includes scientists, tourism operators, and community members, and has carried out long term monitoring of reefs across the Fiji Islands since 2000.

During this period, crisis events such as temperature related mass coral bleaching, cyclones, and Crown of Thorns outbreaks have negatively impacted coral health across the Fijian reef system. However, long term monitoring has identified areas of rapid recovery and high resilience, leading to an optimistic evaluation of the Fijian reef system's ability to withstand and recover from many damaging events.

In early 2011, sea water temperatures recorded by loggers placed by the FCRMN, and bleaching alerts posted by the National Oceanic and Atmospheric Administration (NOAA), predicted that a large-scale temperature-related bleaching event was likely to occur in Fiji. Surveys and observations made in April 2011 identified extensive areas where partial bleaching or "brightening" was occurring, and a bleaching watch was put out across the network. A drop in water temperature was recorded in late May, and a widespread mortality did not occur.

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Theme 4. Results from Fiji's marine managed areas

Helen Sykes (Marine Ecology Consulting, Fiji) and Semisi Meo (USP-IAS)

SUMMARY

prepared by Natalie Askew

Four presentations in this Theme reported results from Fiji's Marine Managed Areas, with study sites situated on the south coast of Viti Levu and on Taveuni. Key topics discussed were the increase of fish biomass within MPAs, spillover of adults and juvenile fish from MPAs to surrounding areas, and the role of herbivores in reducing macroalgae biomass and therefore increasing reef resilience.

Between 2004 and 2007, significant increases in abundance of Lethrinids, Lutjanids and Acanthurids were found both within the MPA (established 2002) and in fished areas of the Korolevu-i-wai qoliqoli. The significant increase in coral cover within the MPA and in fished areas is hypothesised to be caused by this increased abundance of these herbivorous fish. The next steps in this study are underway to collect fish biomass data in order to determine whether herbivore biomass increases as well as herbivore abundance.

Small MPAs (less than 1km^2) were shown to offer fisheries benefits such as spillover of adults and increased fish biomass within MPAs. For four MPAs on the Coral Coast, total biomass caught per unit effort was significantly higher within the MPAs than in the adjacent fishing grounds. A significantly higher percentage of fish reaching or exceeding the size at sexual maturity was caught within the MPAs than in the fishing grounds. Capture-release-recapture results demonstrated movement of fish from within MPAs to fished areas, but with fish moving only relatively short distances (high site fidelity).

At the Navakavu MPA, catch per unit effort (CPUE) and underwater visual census were used to identify any measurable spillover of adult fish into immediately adjacent fishing grounds. No measurable spillover benefits were recorded, although CPUE fish biomass was significantly higher within the MPA. Observations indicate that community are fishing within the protected area. Fish caught outside and at the boundary of the MPA were below breeding size, indicating overfishing. A potential limitation of CPUE was discussed: fish in the fishing grounds might be more wary than those within the MPA, and therefore this might bias CPUE results to be lower in fishing grounds than underwater visual census might record.

A combination of underwater visual census, algal assays, and assessments of benthic cover were used to determine: whether the MPAs at Navakavu and Waitabu had

increased abundance of herbivorous fish relative to the fishing grounds; whether increased grazing occurred as a result of greater numbers of herbivores; and whether this led to a reduction in algal overgrowth. The underwater visual census revealed a significantly higher biomass of herbivores within the MPAs compared to in the fishing grounds, and the results of the algal assay showed a significantly higher rate of grazing within the MPAs compared to outside. For both sites a significantly lower *Sargassum* biomass was recorded within the MPA than in fished areas. The increase in herbivory within MPAs counters the phase shift from coral to algal dominated reefs and therefore helps to increase resilience to climate change.

In summary:

- Fish abundance and biomass increase within MPAs, and some fishery benefits are shown even from small MPAs less than $1km^2$.
- MPAs increase grazing and reduce the likelihood of phase shifts, therefore increasing reef resilience to climate change.
- Communities can easily reduce size of fish to non-breeding size outside an MPA.

Presentation 1. The role of marine protected areas in the protection of herbivorous fishes and their ability to control brown macroalgae

Waqairagata, F.[1,2], Simpson, R.[1], Ratuniata, R.[1] and Comley, J.[1]

Many coral reefs around the world, including Fiji, are experiencing coral-algal phase shifts and this can cause social, economic and environmental impacts on a nation especially those island and coastal communities that depend heavily on marine resources. The cause of such phase shifts has been majorly due to loss of herbivorous fishes as a result of continuous fishing pressure. Therefore, many researchers are studying the impacts of MPAs as a means of replenishing herbivorous fish stocks to control nuisance brown algal growth. In this research, we looked at the impact of a MPA in Navakavu, Rewa on the protection of herbivorous fish and their ability to control the growth of brown macroalgae. The result of the survey showed an increase in herbivorous fish biomass and abundance inside an MPA as compared to outside and rate of grazing was higher inside as compared to outside the MPA. The Algal survey recorded four main species of brown macroalgae, that is, *Sargassum* sp, *Turbinaria* sp, *Dictyota* sp. and *Padina* sp. and showed higher biomass and abundance in the open areas as compared to the MPA. This outcome demonstrates the effects of herbivory on the rate of grazing of these brown algal species. More importantly, it demonstrates the critical role of marine protected areas in protecting and replenishing these key fish species, as well as maintaining the natural cleansing process, ensuring good reef health. The information gained from this research is important for communities to be aware of as it will enable their ability to make informed decisions about resource use as well as aid in the enhancement of on-going community management plans.

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Presentation 2. Small Community-Based Marine Protected Areas in Fiji Offer Measureable Fisheries Benefits

Clements, C.[1,2], Bonito, V.[3,4], Grober-Dunsmore, R.[5,6] and Sobey, M.[7]

Community-based marine management plans have commonly applied no-take Marine Protected Areas (MPAs) to sustain and enhance coral-reef fisheries for food security. However, many community-based MPAs are relatively small (<1 km2) and little data exist in regards to the potential fisheries benefits acquired through these MPAs leaving their contribution to management largely unknown. We examined four relatively-small (<1km2) MPAs on Fiji's Coral Coast (three current, one former) to assess whether any commonly-sought fisheries benefits were derived. All MPAs had maintained no-take status for over four years, though the former MPA was opened to fishing four months before our study commenced. Hook-and-line fishing surveys were used to assess whether MPAs exhibited greater catch and biomass per unit effort, individual fish biomass, and/or percent of reproductive-size fish than in the adjacent fished areas. All factors examined exhibited significantly-greater values within the current MPAs, while this effect was not found at the former MPA. Additionally, movement of fish from MPAs to fished areas was examined based on tag and recapture data. Most tagged fish were recaptured near their initial capture location suggesting site fidelity of these fishes. However, fish initially captured in all four MPAs were later caught in fished areas indicating that there is indeed movement of fish between MPAs and fished areas. While the combination of these findings supports the utility of even relatively-small MPAs as effective tools for enhancing certain fisheries stocks, it also suggests that management schemes based on temporary closures may be insufficient for ensuring long-term fisheries sustainability.

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Presentation 3. Assessing spillover of commonly caught adult fish from Navakavu no-take marine protected area using Catch Per Unit Effort (CPUE) survey and Underwater Visual Census (UVC)

Loganimoce, I.[1,2]

No take Marine Protected Areas (MPAs) are increasingly used as tools to manage fisheries. The theory behind these reserves is that when an area of the fishery is closed, more fish survive. Over time, these fish reach maturity and the no take area gets full. When this happens adult fish spill over into the surrounding fished areas. In Fiji and globally the increase of fish abundance inside no take areas is now well demonstrated scientifically. However, the occurrence of spill over is less clear. This study will try to provide evidence of spill over by assessing the no-take MPAs using a Catch Per Unit Effort survey and UVC survey and try to determine if there are likely fisheries benefits after setting up a no-take marine protected area. From these findings, it can determine if no-take MPAs can be used as an effective tool for recovery of fisheries resources within local fishing grounds ensuring food security for local communities in the long term.

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Presentation 4. Assessing MPA effectiveness using fin fish biological indicators – a case study of Korolevu-i-wai Qoliqoli

Simpson, R.[1,2]

This work was conducted in the Korolevuiwai district of the Fiji Islands. The focus of this work was to assess the effectiveness of Marine Protected Areas (MPAs) through studying the relative abundances of community biological indicators; namely; target fin-fishes, invertebrates and coral cover, over time. These indicators were selected by the communities because of their high subsistence, commercial and ecological value. The study involved comparing two major datasets; firstly the 2004 dataset consisting of the baseline data and secondly, the data collected for this thesis research in 2007. Both datasets were collected at around the same time of the year, between July and November and all surveys were done at rising to high tides. Preliminary results indicate that the biological indicators provide sufficient basic information for assessing the performance and effectiveness of local MPAs. Common food fish such as Emperors, Snappers and Groupers have increased in numbers over the last three years within the MPAs. Herbivorous fishes like Rabbitfish and Surgeonfish have also increased in both the MPAs and non-MPAs; and as a result the algal cover has significantly reduced with an equally high positive response in Coral cover. These have been quite encouraging results for the local communities, and in response to these positive changes in their fishing grounds more effort is being taken to develop management objectives and strengthening village governance. Selecting the right biological indicators is critical for evaluating the effectiveness of a village MPA; the best indicators were found to be species that were easily identified by the communities and shared a common name, species that had a particular value to the communities and species that were territorial in the fishing grounds. The MPAs of Korolevuiwai can be an effective tool for managing marine resources and protecting natural wealth for future livelihood. This goal however cannot be accomplished without proper continual evaluations; selecting the correct indicator species for a particular site is a basic and effective tool that may be used for assessing ecological changes in a coastal ecosystem.

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Theme 5. Scaling up Local Management to meet National Priorities

Chaired by Rebecca Weeks (WCS) and James Comley (USP-IAS)

SUMMARY

prepared by Rebecca Weeks

Following on from presentations demonstrating the effectiveness of Fiji's locally managed marine areas, the theme of this session was how to build upon the success of local management initiatives to develop protected area networks that will achieve national conservation objectives. These include the Fiji Government target to protect 30% of inshore marine areas, and commitments under the Convention on Biological Diversity to effectively conserve at least 17% of terrestrial and inland water, and 10% of coastal and marine areas by 2020.

Presentations in this session ranged in scope from a single reef to Fiji's national protected area network, and contained important lessons for how to effectively scale up local management. Extensive research conducted at Moon Reef led to the discovery that this site has cultural importance for both human and cetacean communities, and highlighted the need for careful management of ecotourism opportunities to maintain a delicate ecosystem. At the other end of the spectrum, we learnt about challenges facing the implementation of Fiji's National Biodiversity Action Plan, including the need to balance development needs with conservation priorities.

Lessons learned from two tabu areas in Korolevu-i-wai demonstrated that community respect for management institutions and participation in management activities are crucial to ensuring the ecological effectiveness of community-based management, and must not be overlooked in efforts to expand Fiji's LMMA network. Further work from Korolevu-i-wai indicated that site-level initiatives alone are likely to be insufficient to maintain populations of herbivorous fish that are vital to coral reef resilience, emphasising the need to scale up local marine management in Fiji.
Four presentations from researchers based at the University of Queensland demonstrated new and innovative strategies for conservation planning that might be applied to achieve this goal. The first of these highlighted the need to consider uncertainties in the spatial data that underpin conservation prioritisation, and to take into account how threats on land might influence the management of coral reefs. We also heard how integrating a systematic approach to conservation planning with the community-based implementation currently practiced by FLMMA might offer a more efficient way to achieve national conservation targets, and that marine zoning could offer a way to achieve conservation objectives whilst minimising conflict with resource users.

An idea common to all presentations was that whilst we need to scale up Fiji's successful community-based management initiatives in order to achieve national objectives, this process will not be easy. The question we have to answer is not whether to adopt a systematic planning approach or an opportunistic community-driven approach, but how to effectively integrate these to achieve the best outcomes for biodiversity and livelihoods.

Presentation 1. Lessons Learned From Two Co-Managed Fijian Fishing Grounds

Bonito, V.[1,2], Comley, J.[3], Simpson, R.[3] and Waqairagata, F.[3]

Climate change and local impacts have lead to global declines in coral reefs and are a direct threat to the livelihoods and food security of coastal communities. Community-based co-management has been widely-applied to address local threats to marine resources in South Pacific island nations, particularly where customary tenureships are still recognized. However, the varying levels success of these efforts amongst locations reiterates the need to evaluate key elements likely to lead to successful management in order to improve and refine co-management approaches. Here, we evaluate the management context and institutional factors that likely affected the biological outcomes of two Fijian community-based marine co-management regimes in adjacent fishing grounds five years after commencement. We found significant increases in the abundance of economically- and ecologically-important fish in one fishing ground, and significant declines in the other. Though both management regimes were taking place on similar reef habitats under similar socio-economic contexts, the regime which had the greater biological success had more community respect and support for the management body and rules. Higher respect for the management body and consensus for the management rules occurred where community participation and compliance to the rules was also greater. Furthermore, the biological success of the management regime in one fishing ground led the community to take further management actions hoping to improve the outcome of their regime. These finding reiterate the role of good governance of local management bodies in achieving both local and national management objectives, building ecosystem resilience, and ensuring local food security.

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Presentation 2. Designing marine protected areas using uncertain habitat information

Tulloch, V.[1,2], Klein C.[1], Roelfsema, C.[1], Jupiter, S.[3] and Possingham, H.[1]

The availability and accessibility of marine spatial data obtained through remote sensing has led to the growth of its use in conservation planning worldwide. Information on marine habitats and biota derived from these sources can be particularly useful in informing decision-making and planning processes for marine protected area design. However, we are often uncertain about the accuracy of information derived from remote sensing, making it challenging to make decisions about what and where to protect. Here, we develop a novel spatial conservation prioritisation approach that accounts for the uncertainty inherent in remote sensing habitat data. We use multi scale habitat maps depicting geomorphic zones and benthic communities provided by object based image analysis, where the accuracy of each habitat was estimated through validation with field data for each location within the study area. Using the Kubalau fisheries management area as a case study, we aim to design a network of protected areas that has a high probability of protecting every habitat type. We compare the outcome of our approach to those of standard protected area design approaches, where detailed habitat data or accuracy assessments are unavailable. These analyses can be used to inform decisions about the location of protected areas at various scales in Fiji.

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Presentation 3. Prioritizing Land and Sea Conservation Investments to Protect Coral Reefs

Klein, C.[1], Jupiter, S.[2, 3], Selig, E.[4], Watts, M.[1], Halpern, B.[5], Kumal, M.[6] and Possingham, H.[1]

Coral reefs are threatened by human activities on both the land (e.g. deforestation) and the sea (e.g. overfishing). Most conservation planning for coral reefs focuses on removing threats in thecsea, neglecting management actions on the land. A more integrated approach to coral reef conservation, inclusive of land-sea connections, requires an understanding of how and where terrestrial conservation actions influence reefs. We address this by developing a land-sea planning approach to inform fine-scale spatial management decisions and test it in Fiji. Our aim is to determine where the protection of forest can deliver the greatest return on investment for coral reef ecosystems. To assess the benefits of conservation to coral reefs, we estimate their relative condition as influenced by watershed-based pollution and fishing. We calculate the cost effectiveness of protecting forest and find that investments deliver rapidly diminishing returns for improvements to relative reef condition. For example, protecting 2% of forest in one area is almost 500 times more beneficial than protecting 2% in another area, making prioritization essential. For the scenarios evaluated, relative coral reef condition could be improved by 8-58% if all remnant forest in Fiji were protected rather than deforested. Finally, we determine the priority of each coral reef for implementing a marine protected area when all remnant forest is protected for conservation. The general results will support decisions made by the Fiji Protected Area Committee as they establish a national protected area network that aims to protect 20% of the land and 30% of the inshore waters by 2020. Although challenges remain, we can inform conservation decisions around the globe by tackling the complex issues relevant to integrated land-sea planning.

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Presentation 4. Use of science and local stakeholder engagement to progress a Marine Protected Area designation and management plan for resting spinner dolphins in Moon Reef, Viti Levu

Miller, C.[1, 2, 3, 4], Bau, J.[5, 6], Foster, H.[7], Koroi, I.[3, 5], Tokairavua, J.[5, 8], Cribb, N., Hunt, T.[4] and Williams A.[4]

Complimentary behavioural, acoustic, and habitat studies in Moon Reef, Viti Levu have highlighted the importance of this reef as a key resting habitat for spinner dolphins in Fijian waters. Research to date has indicated that a relatively small pod of semi-resident dolphins exhibit predictable diurnal behavioural patterns within Moon Reef on an almost daily basis. More specifically, it has been observed that animals typically enter the reef in the early morning and go into resting behaviour for most of the day, before slowly increasing their social behaviours in the afternoon, and then moving off into deep water foraging grounds in mid to late afternoon. Acoustic studies have shown that communication between animals in the reef mirrors these behavioural patterns, and also demonstrates their potential disturbance from boating activity. Furthermore, studies in the area demonstrate that the reef is unique perhaps in terms of environment as preference for resting within Moon Reef is evident. Cultural connections with local villages are also strong. Recent initiatives of local stakeholders are using these scientific findings to develop an integrated management plan for the proximal terrestrial and *qoliqoli* areas. As a positive first step a marine protected area was recently declared by the traditional owners of this important cetacean habitat.

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Presentation 5. Protected areas in Fiji: Ecological gap analysis

Erasito, E.[1] and Tora, K.[1, 2]

Fiji's National Biodiversity and Action Plan listed as a national priority the action to establish a representative system of protected areas. The intention is for the representative system of protected areas to be augmented by a large number and variety of protected areas which are important at the provincial or local level. This presentation looks at the ecological gap analysis carried out by the Protected Areas Committee of Fiji as an inventory of biodiversity in the to inform decisions on where and how new protected areas will be established and existing will be extended.

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Presentation 6. The Importance of Herbivory in Maintaining Coral Community Resilience

Bonito, V.[1, 2], Rasher, D.B.[3], Engel, S.[3], Fraser, G.J.[4], Montoya, J.P.[3] and Hay, M.E.[3]

Addressing key factors to prevent phase shifts from coral-dominated to algal-dominated communities is critical to sustaining coral reef ecosystem integrity. While the relative effects of herbivory and nutrient enrichment on algal proliferation remain debated, clearly the resilience of coral communities is partially determined by whether local processes promote coral growth and recovery or allow macroalgae to proliferate and displace corals. Benthic surveys conducted across the nearshore reefs of the Korolevu-i-wai district, Fiji illustrate the relative abundance of coral and lack of macroalgae in the four no-take Marine Protect Areas (MPAs) compared to adjacent fished areas. Paired herbivory assays conducted in the same MPAs and fished areas using the most abundantly-found macroalgae demonstrated that herbivory is a key factor behind the differences found in benthic composition between MPAs and unprotected areas. A factorially-manipulated herbivory and nutrient enrichment study conducted in one MPA and an adjacent unprotected area further demonstrated that overall, herbivory mediated the establishment and proliferation of macroalgae in both the MPA and unprotected area, while nutrient enrichment played a lesser role. Collectively, these studies illustrate the importance of protecting herbivorous fish to ensuring coral reef ecosystem integrity, particularly with the imminent threats to coral communities presented by climate change. While MPAs are certainly useful management and conservation tools, local and national-level approaches need to address the loss of herbivores across the entire ecosystem to build resistance against coral-algal phase shifts and ensure coral resilience and overall ecosystem integrity.

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Presentation 7. Where do national and local conservation actions meet? Modelling the differences between local implementation and national conservation planning in Fiji

Mills, M.[1, 2], Adams, V.M.[1], Pressey, R.L.[1], Ban, N.C.[1] and Jupiter, S.[3]

The marginal benefits of systematic over opportunistic establishment of protected areas are rarely measured, even though this information is crucial to inform government and conservation agencies on how to invest limited conservation resources effectively. We compared the future percent coverage of marine habitats by a simulated opportunistic and systematic selection of marine protected areas (MPAs) in Fiji, where ambitious national conservation goals for inshore marine waters rely on community-based actions for implementing the required management. We used data on established MPAs and key informant interviews to simulate the opportunistic expansion of community-based MPAs, and used Marxan with Zones to systematically design an optimal MPA network. Simulations were designed to reflect the existing expansion and characteristics (e.g. closure size) of the Fijian locally managed marine area network. The simulations of the systematic approach resulted in achievement of quantitative conservation objectives for fringing reefs, intertidal and other benthic habitats (divided into 4 depth based categories). Non-fringing reefs and mangroves missed their objectives by 2-5%. The simulation of the opportunistic scenarios achieved national conservation objectives for all depth categories of other benthic habitats. However, fringing reefs, non-fringing reefs, mangroves and intertidal habitats, which had higher targets than other benthic habitat, missed their objectives by at least 12-17%. Despite these differences, a merging of opportunistic and systematic approaches will be necessary to combine strategic perspectives with acceptance by communities. We discuss government incentives that could be established to steer community based action in Fiji towards better achieving national conservation goals.

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Presentation 8. Marine zoning of the Vatu-i-Ra ecoscape incorporating marine zone effectiveness and socioeconomics

Makino, A.[1, 2], Klein, C.[1], Beger, M.[1], Jupiter, S.[3], Selig, E.[1], Watts, M.[1] and Possingham, H.[1]

The Vatu-i-Ra ecoscape lies between Fiji's two main islands Viti Levu and Vanua Levu. The ecoscape is considered high conservation priority for Fiji due to high marine species diversity, endemism and resilience and because it serves as an important migratory corridor for cetaceans and turtles. To ensure high effectiveness of marine protected areas while also minimising user conflict, we have developed preliminary recommendations for zoning across the Vatu-i-Ra ecoscape. Five types of zones with different community-based management strategies were spatially distributed to meet ecological and socioeconomic objectives efficiently. Moreover, different zones contribute differently to the protection of biodiversity, because degree of protection of each zone differs. The effectiveness of each zone was determined through an expert based workshop. We compared potential priority areas for several different scenarios, each with different zone effectiveness values and number of zones. We found that the explicit consideration of zone effectiveness results in priorities for marine conservation that were more likely to deliver effective protected area networks that achieved Fiji's national conservation targets. If zone effectiveness is ignored we would overestimate the ability of protected areas to achieve conservation goals. These maps will be shared with stakeholders from across the four provinces of the Vatu-i-Ra ecoscape to discuss the viability of such a management scheme as part of the Fiji National Coastal Plan.

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Theme 6: Socio-ecological Tools for Climate Change Adaptation

Chaired by Ron Vave (USP-IAS) and Kirti Chaya (Department of Environment)

SUMMARY

prepared by Natalie Askew

This was the largest Theme of the Forum, with thirteen presentations given over two days. Key messages included:

1. *Building ecosystems and communities which are resilient to climate change*. The importance of ecosystem-based management in building ecosystem resilience was outlined: intact ecosystems will be more likely to absorb shocks, resist change and recover from disturbance. Different ways that coastal ecosystems such as reefs and mangroves could be resilient to climate change were explored. The session discussed the need to understand basic species distributions in Fiji (especially of threatened endemics), as a first step to understanding ecosystem dynamics and how they might be affected by climate change. In terms of building resilient communities in the Pacific, function-based adaptive capacity was found to be more appropriate to island cultures (compared to asset-based adaptive capacity) because it emphasises the relationships between actors and institutions within socio-ecological systems (rather than access to resources such as finance and technology). A study of community adaptive capacity across the Pacific found that key areas to focus on were leadership and community cohesion, where adaptive capacity was currently felt to be the lowest.
2. *Communication* was raised by many presenters and observers as a critical part of adaptation. For example, analogies appropriate to Pacific culture should be used to describe climate change. A set of frequently translated English-Fijian conservation science terms (e.g. resilience) is in preparation and will be shared through FLMMA. The benefits of technology were discussed: using mobile phone technology to source revenue for resource management, and using digital education to teach coral reef biology and engage youth in marine conservation. In terms of awareness, there were interesting parallels between the bacteria hidden from view on our hands (and therefore often ignored), and protecting the marine environment hidden from view beneath the waves. In both scenarios it is observation by peers that has the power to bring about behaviour change.
3. *Collaboration* between organisations carrying out climate change adaptation work was seen as having huge potential for saving costs and maximising benefits. For example, the “climate-ready” crop collection of SPC’s CePaCT is a valuable resource for those organisations interested in food security, such as PACE-SD in the Global Climate Change Alliance project. The SPC “one laptop per child” project has potentially great benefits for collaboration with digital education projects presented in this Theme, particularly in expanding this work to rural communities. Medical scientists are collaborating with climate change experts to reduce the incidence of climate sensitive diseases in Fiji (leptospirosis, dengue,

typhoid and diarrhoeal illness) in the project Piloting Climate Change Adaptation to Protect Human Health. Conversely, the poor coordination between projects and the economic costs this can have were discussed, with water resources projects in Tuvalu as a case study. In spite of this lack of coordination, the results found a A$4.1 return for every A$1 invested across three projects spanning 20 years – a powerful figure for decision-makers.

4. *Capacity-building* was a common thread to many presentations, particularly the "train the trainers" approach – employed by the FLMMA network in the area of reef resilience, and by LMCCA (Locally Managed Climate Change Adaptation – an initiative of the EU Global Climate Change Alliance project) network in the area of climate change adaptation.

Presentation 1. Working towards biodiversity targets in order to meet international commitments under the Convention on Biological Diversity

O'Callaghan, B.[1, 2]

In 2002, at a meeting of the Convention on Biological Diversity (CBD), parties to the Convention set a target: "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth." It is clear that this target has not been met, but there are important lessons to be learnt from our failure. Targets must be clearly articulated, with different targets for different habitats. Furthermore, there should be increased focus on mechanisms to support countries in meeting these targets.

At the tenth meeting of the Conference of the Parties to CBD (held in October 2010 in Nagoya, Aichi Prefecture, Japan), a revised and updated Strategic Plan for Biodiversity was adopted (decision X/2). This paper summarises the content of this Plan, in which the 20 Aichi Biodiversity Targets are nested within 4 strategic goals. The meeting agreed to translate this overarching international framework into national biodiversity strategies and action plans within two years. Additionally, in decision X/10, the meeting decided that the fifth national reports, due by 31 March 2014, should focus on the implementation of the 2011-2020 Strategic Plan and progress achieved towards the Aichi Biodiversity Targets. As we enter the United Nations decade on biodiversity, Fiji is working to meet these responsibilities, building upon the good models already established in the Pacific such as the Locally Managed Marine Areas Network, the removal of invasive species, and large-scale protection of the Phoenix Islands in Kiribati.

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Presentation 2. Enhancing climate change resilience using the national strategy and action plan on biodiversity in Fiji

Chand, R.A.[1, 2]

The convention on Biological Diversity was signed by Fiji and more than 150 other nations on 5 June 1992, at the United Nations Conference on Environment and Development in Rio de Janeiro. Fiji's Biodiversity Strategy and Action Plan (FB SAP) was Fiji's initial response to this international obligation. The National Biodiversity Strategy and Plan (NBSAP) for Fiji identifies actions to conserve, sustainably use and protect Fiji's biological resources and its diversity, as its contribution to the conservation and protection of global biodiversity. To achieve such a result, many of these actions will have to be undertaken at community level. Local benefits will aggregate to deliver a national benefit, and contribute to global benefit.

Climate Change is a harsh reality about an environment calamity that is reciprocating in response to man's greed, exploitation and lack of political willingness to cooperate and make genuine efforts in mitigating the problems at hand. It doesn't care about people's emotions, about threat to food insecurity that may lead to starvation and hunger, severe health implications such as outbreaks in diseases, mal-nutrition, and aggravate the already exiting problems of mass migration, leaving behind many displaced as refugees with a bleak future. The change in climate would have several implications on people such as increased climate variability and the likelihood that there will be less rain (seasonally) in the future; intense tropical cyclones will continue, as will el Nino associated droughts; temperature rise, which will have impacts on terrestrial ecosystem productivity (particularly crop yields) and on near-shore ecosystems (particularly coral reefs), sea-level rise, which will inundate coasts, cause shoreline erosion and groundwater salinization of low-lying areas, and allow larger-amplitude waves to cross offshore reef barriers than at present. The vulnerability of people living in Pacific Islands (low lying islands), the issue of sustainable development, and the threat of natural disasters such as the recent earthquakes, cyclones and tsunamis bring panic to everyone. The list of environment problems is intrinsically linked to human suffering and poverty. With the far reaching implications of climate change on everyday life – sociology, ecology, economy, geography and more – the reason of why climate change matters lie in that what human beings can do to embrace and address environmental challenges, keeping at the heart of all related development, the dignity and respect of all peoples and human rights (vulnerable populations and communities, women and children, people with disabilities etc.

This presentation will thus talk about the with various objectives of the NBSAP such as promoting community support for biodiversity conservation and ecologically

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sustainable development through improved understanding and awareness, providing adequate funding for protected area management, developing communities' capabilities to manage and utilise forest and marine resources in a sustainable manner. These discussions would relate to various thematic areas of NBSAP implementation framework such as the forest conversion, protected areas, and inland waters

Presentation 3. Building Social-Ecological Resilience as a Strategy to Protect Biodiversity and Adapt to Environmental Change

Jupiter, S.[1, 2]

Since 2005, the Wildlife Conservation Society (WCS) has worked with communities within the Vatu-i-Ra seascape to implement ecosystem-based management (EBM) for biodiversity conservation and natural resource management. EBM provides the double benefits of biodiversity conservation as well as maintenance or improvement of key provisioning (e.g. food and water security) and regulating services (e.g. storm surge protection, flood control), which are essential for climate change adaptation. However, to build adaptive capacity to climate change, EBM must also be coupled with policies and practices to increase social resilience, including: diversifying food and income sources; mobilizing communications and traditional social networks for knowledge transfer; and improving basic infrastructure. To address these issues, WCS is taking a threefold approach when working with communities throughout the Vatu-i-Ra. First, through focal group interviews, WCS is engaging local stakeholders in rural communities to identify climate hazards perceived to be the greatest threats to local resources. In the focal group interviews, participants are asked to consider whether their current strategies for coping with climate hazards are sustainable, and if not, to develop alternatives. Secondly, as many of the management strategies require designation of protected areas, WCS is using a science-based approach to assist communities to design resilient protected area networks. Priorities for network inclusion are given to sites with naturally high resilience, followed by sites whose resilience could be improved by effective management. Thirdly, WCS and conservation partners (the Coral Reef Alliance, SeaWeb) are working to strengthen community-based management institutions by: improving awareness of ecology and threats; strengthening ability to communicate the rationale for management decisions; improving monitoring and enforcement of current management measures; and helping decision-makers to recognize when it is appropriate to adapt management strategies to changing environmental or climate conditions.

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Presentation 4. Reef Resilience: A tool to protect coral reefs against climate change crisis

Nand, Y.[1, 2] and Weeks, R.[1]

Coral reefs are the largest living structures on earth, so rich with diversity yet are in crisis. Threat affecting coral reefs include anthropogenic as well as natural consequences. Climate change top the list of natural disturbance incorporating anthropogenic threats. Strategies and approaches such as tools like reef resilience are currently being employed by reef managers to conserve coral reef from climate change impacts. Resilience refers to the ability of a system to maintain key functions and processes in the face of stresses by either resisting or adapting to change (Holling 1973, Nyström and Folke 2001). Mostly biological and social aspects of resilience are addressed to face challenges of climate change, although social resilience is still a fairly new tool; biological resilience has been adapted by reef managers to conserve coral reefs in some regions. A community's resilience is determined by biological factors such as herbivory population, number of recruits, connectivity and diversity of species. Reefs that have recovered from past disturbance could be considered resilient sites and, if incorporated within MPA network can act as climate change adaptation for future conservation and food security. Hence, there we discuss reef resilience concepts as a tool to reef conservation from climate change impacts.

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Presentation 5. Protection of Mangroves for Coastal Resilience

Malani, U.[1, 2] and Fiu, M.[1]

WWF and partners are working with local natural resource managers and other stakeholders to integrate climate smart principles into adaptation strategies, management philosophies and plans. An exemplar of the link between adaptation and development is the scaling up of local initiatives via diffusion of lessons across communities within a national management approach to mangroves in the context of building coastal resilience. Reducing the risks associated with the impacts of extreme weather and climate variability is a fundamental development challenge faced by Fiji and other island countries in the Pacific, which must be urgently addressed in order to safeguard and improve livelihoods, economic well-being and health plus our islands' biodiversity and our heritage.

Project Portraits of Resilience-strengthening community adaptation measures to effects of climate change aims to identify, showcase and protect key biodiversity attributes which support the resilience of coastal ecosystems and communities to impacts of climate change. At the national level, work will focus on supporting the development and implementation of national adaptation management plans, support the mapping of critical and vulnerable coastal areas, and ensure policies are strengthened to include the adoption of community-based and ecosystem-based management priorities, approaches and mechanisms. Fiji has the third largest mangrove area in the Pacific region, the islands' climatic variation influence mangrove distribution and ecology including different impact levels and intensity from development. Such characteristics make mangroves especially important for coastal human communities and emphasize the need for greater efforts towards its management and protection on a national scale.

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Presentation 6. Using agro-biodiversity for climate change adaptation

Taylor, M.[1] and Tuia, V.[1, 2]

Agrobiodiversity is the diversity of plants and animals that underpin agricultural systems. It is the foundation of sustainable agricultural development, used by farmers for generations to sustain food production. Modern agriculture, however, is based on a small number of crops and animals, which in the current climate of changing and variable environments, puts at risk sustainable food production. Diverse agricultural systems have been shown to buffer farmers against changing circumstances, enabling farmers to adapt and meet their own needs often more rapidly than specific scientific breeding programmes. It is essential that farmers in the Pacific have access to diversity so they can meet the challenge posed by climate change. The Pacific region is home to some unique crop diversity, but there is an urgent need to use and evaluate this diversity to understand how it will adapt to the problems posed by climate change.

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Presentation 7. Assessing the Social and Economic Value of Climate Change Adaptation in the Pacific Region

Gerber, F.[1, 2]

Water is a critical issue in Tuvalu, a Pacific island atoll nation where groundwater has been declared unsafe for human consumption due to high salinity and pollution. As a result, rainwater is a key water source on the 8 inhabited atoll islands.

Unfortunately, the annual drought, which can last for up to 3 months, results in a scarcity of water with consequent frustrations and health problems in Tuvalu. This is especially the case on the capital atoll of Funafuti where most of the Tuvaluan population resides. Such drought episodes might be worsened by the effects of climate change.

As a result, there are a number of climate change adaptation projects underway to assist Tuvalu build capacity to improve water supplies, including work on rainwater tanks, composting toilets and awareness-raising. These projects are intended to achieve improvements within the next few years. Learning from the experiences of these projects will be crucial in designing climate change adaptation projects in the future. Consequently, SPC/SOPAC Division – on behalf of the IUCN-Oceania Regional Office – is undertaking an economic study of three projects: (i) the SPREP-executed Pacific Adaptation to Climate Change (PACC) project, (ii) the SPC/SOPAC-executed disaster risk management (EU B-Envelope) project, (iii) the SPC/SOPAC-executed GEF-IWRM project. This set of analysis is part of a suite of case studies that IUCN, in collaboration with SOPAC, is undertaking as part of DCCEE funded project on 'Economic and social values of CCA and DRR: strengthening knowledge based climate change adaption.

The economic study will identify key issues that affect the benefits of projects and that can be built in to the design of water adaptation projects in the future.

To collect data for the analysis, Federica Gerber – Natural Resource Economist of SOPAC – visited Tuvalu at the end of April. Following several meetings with community members and government representatives, good data has now been secured in a variety of areas, including health, water supply, rainfall and temperature. A formal economic analysis is now underway and preliminary results are expected in August 2011. The final report is due to be released in October, and after which time IUCN and SPC/SOPAC looks forward to sharing findings and recommendations with key stakeholders, including the Tuvalu Government.

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Presentation 8. Studying adaptive capacity in the Pacific

Aalbersberg, W.[1] and Dumaru, P.[1, 2]

Adaptive capacity is defined as the change made or actions taken to enable a system to deal with current or future changes in climate. It is especially being discussed currently in relation to the ability to address climate change and natural disasters such as floods and droughts. Criteria for judging adaptive capacity have been developed by the Intergovernmental Panel on Climate Change but these often relate more to developed countries and their situations.

As part of a study of their effort to develop an optimal strategy to assist Pacific island countries deal with climate change, the Department of Climate Change and Energy Efficiency of the Australian government has funded the University of the South Pacific to study adaptive capacity in the Pacific. Such a study will highlight areas which might be a primary focus for future support by AusAID. SPC , USP and Red Cross staff met to determine a Framework for determining adaptive capacity and then used this to study this at eleven sites in eight Pacific countries. Categories studied were: human capital; social capital; belief systems, worldviews and values; resource distribution; adaptation options; information and awareness; and history of dealing with climate events.

In addition, national adaptive capacity was analysed in terms of guidelines from the World Resources Institute which focused more of the ability of countries to perform certain functions (rather than the classical approach of looking at assets). These functions were: prioritisation of adaption at the national level; coordination of national adaptation activities; national adaption information management; and climate risk reduction.

Initial findings indicate that the main attributes that lead to strong adaptive capacity in most Pacific communities are good food security, especially in their fishery, strong traditional values, and a good community skills base. These need to be maintained and enhanced.

It was interesting that some attributes that might be considered strong points in the Pacific communities such as community cohesiveness and leadership were assessed as average; these are things that climate change adaptation projects can strengthen both through their activities and through the processes they use (such as participatory activities that empower communities).

The lowest category by far was infrastructure; there has been much rhetoric and some efforts to develop these in rural areas but more efforts are needed.

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At the national level it was noted with satisfaction that several Pacific countries, recognizing the threats that climate change can bring, have adopted quite effective systems to adapt to it; these efforts should be encouraged. Others perhaps need more effort.

Presentation 9. Community-based Climate Change Adaptation: An overview of Pacific Center for Sustainable Development (PACE-SD) Projects in Fiji

Yakub, N.[1, 2], Jacot des Combes, H.[2], Orcherton, D.[2], Limalevu, L.[2] and McNamara, K.[2]

Climate change impacts are already observed and recently considerable discussions and actions have been generated at international, regional and national levels among nations. The main cause of climate change is attributed to increasing atmospheric concentration of greenhouse gases (GHG). These gases are being supplemented by emissions resulting from human activities. Intergovernmental Panel on Climate Change (IPCC) has projected a global increase in temperature by further 1.4°C to 5.8°C by 2100. Climate change threatens the basic resources for life by limiting access to water, food and land, and affecting terrestrial and marine ecosystems and human health.

In Fiji, PACE-SD at the University of the South Pacific (USP) has initiated community-based climate change adaption (CCA) projects to strengthen local adaptive capacity, so that communities are able to adjust to and moderate climate-induced changes in their locations. In the region the focus is on adaptation, namely the adjustment in a natural or human system in response to actual or projected climate change impacts. The CCA project focused on twelve communities which developed and implemented climate change adaptation plans in the water security, water and coastal resource management (including health & sanitation) and food security sectors to sustain livelihood. These plans were implemented following a comprehensive vulnerability and adaptation assessment that has been undertaken in each location.

Another project, FORENET, focusing on the sustainable management and long-term protection of natural ecosystems within Ba Watersheds involved applied research in forestry and agro-forestry with focus on watershed protection and community-based assessments of natural resources. This project was targeted at vulnerable rural farming families within this watershed. A modified vulnerability and adaptation assessment was used, focusing on forestry, agro-forestry and biophysical assessments to develop detailed socio-economic and biophysical inventories in the six pilot communities previously mentioned.

Currently, PACE-SD is conducting regional review of best practices in CCA projects and gap analysis to identify 40 potential locations for demonstration and implementation of community engagement to adaptation. This is a European Union-Global Climate Change Alliance (EU-GCCA) funded project to provide capacity

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building, community engagement and applied research components for climate change adaptation in 15 island countries. The duration of this project is four years.

Presentation 10. Climate-sensitive diseases in Fiji – what do we know, and what do we need to know, to protect human health in Fiji from the worst impacts of climate change?

Naicker, J.[1, 2], McIver, L.[1, 2], Singh, S.[1, 3] and Hales, S.[4]

As of the year 2000, anthropogenic (human-induced) climate change was already responsible for 150 000-200 000 excess deaths per year around the world. Several categories of diseases, notably infectious diseases (food- and water-borne diseases, vector-borne diseases and zoonotic infections) are known to be particularly susceptible to changes in climate and weather patterns. Fiji is one of seven countries participating in a global project entitled "Piloting Climate Change Adaptations to Protect Human Health", which aims to strengthen the capacity of the health sector to manage the most significant health-related impacts of climate change. This project involves in-depth analysis of the relationships between climate variables and disease outcomes in Fiji, in order to inform and test strategies in selected pilot sites to avoid some of the current and future risk posed by climate-sensitive diseases. We present some of the early findings of this project, including the historical trends of priority climate-sensitive diseases in Fiji (including leptospirosis, dengue fever, typhoid fever and diarrhoeal illness) and a description of the relationships between these diseases and climate variables in Fiji. This will lead to identification of communities in Fiji that are at heightened health risk due to the effects of climate change, and will guide the adaptation strategies to be implemented in later stages of the project.

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Presentation 11. Effective Handwashing Campaign in Schools

Bakaniceva, I.[1, 2]

Handwashing is the single most important action you can do to prevent getting communicable diseases such as colds and flu. Almost 80% of all infectious diseases are transmitted by touch. Effective handwashing campaign targeting students and teachers is proven to be effective in reducing incidence of disease transmissions. Promoting the message of safe hygiene practices in schools, such as handwashing increases awareness at the local level, targeting children's homes and their communities focussing on positive messages for early behaviour change.

The project "Effective Handwashing Campaign in Schools" is being trialed in 4 schools in Taveuni, Fiji Islands in response to a typhoid outbreak after Cyclone Thomas in 2010. The four schools include 2 primary schools and 2 secondary schools in Taveuni. It is being implemented through SPC-SOPAC and Fiji Red Cross Society. The purpose of the campaign is to heighten students and teachers awareness on handwashing promoting behaviour change while also developing awareness materials through a participatory approach. The project is in three phases, 1) the scoping or research phase; 2) the development and pre-testing of the awareness materials; and 3) monitoring and evaluation of the project.

This presentation will report on the project activities and early findings as to the effectiveness and success of the approach with a view to its replication to other schools in Fiji.

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Presentation 12. Community Conservation and Climate-Change Mitigation

NatureFiji-MareqetiViti[1]

We have little or no idea how climate change may or may not affect Fiji's biodiversity, particularly for our endemic species. However, we do know this - until we have the local capacity to understand our endemic biodiversity, and the sound ecological knowledge about these endemic species, then we are guessing about climate change adaptation and resilience. This is a dangerous approach and an ill-affordable waste of resources, and should be the premises under which we train our future scientists or advise national decision-makers. NatureFiji-MareqetiViti, as Fiji's only domestic membership-based conservation organisation, is of the firm opinion that climate change issues are best addressed firstly by gaining sound ecological knowledge of our wildlife, and secondly, by empowering local communities to become involved in scientific research and conservation efforts. Only then, can sound monitorable mitigation measures be initiated. Our conservation efforts with several species have taken on this approach. For example, the Fiji Sago Palm or soga (*Metroxylon vitiense*), is an unrecognised, critically endangered endemic wetland species that is currently declining due to over-extraction and habitat loss. Despite this, our conservation approach is sustainable-use rather than total protection, a strategy developed through understanding soga's biology, its cultural use and current threats. Wetland habitats are very vulnerable to the kinds of scenarios being predicted by global climate change experts. We are currently involved in rehabilitating several soga-inhabited wetland areas, as well as assisting the landowning communities (and resource-users) that are responsible for these habitats in sustainable use practices.

[1] Presented by Tamara Osborne: osborne.tamara@gmail.com

Presentation 13. Using Digital Education to teach coral reef biology and engage youth in marine conservation

Drew, J.[1], Sanzenbacher, B.[1] and Caginitoba, A.[2, 3]

Effective conservation requires informed and engaged stakeholders. In order to address the ecological threats of tomorrow, we need to ensure that today's students are equipped with the appropriate knowledge and skills to effectively prepare them for challenges ahead.

Conservation Connection demonstrates how digital technology can be used to teach reef ichthyology, marine ecology and conservation to high school students simultaneously in the U.S. and Fiji. This program used multiple learning strategies, including digital media production (blogs, photos, videos), game play (virtual world simulations), peer-to-peer critique (via social media), and mentor-based instruction (e.g., scientists and educators). A major goal was to increase students' knowledge of functional morphology, trophic interactions, the impacts of disturbances, and current conservation practices. This program provided students with the opportunity to apply their new found knowledge to participate in conservation efforts for disturbed reef ecosystems in Fiji. With collaborating partners Wildlife Conservation Society Fiji (WCS-Fiji) and Fiji Locally Managed Marine Areas (FLMMA), students identified a conservation threat to Fijian reefs and authored a plan to mitigate that threat. Through participation in this project, students in two countries 1) gained knowledge of reef biology, 2) improved digital literacy skills, 3) became active stewards of the environment - three accomplishments that will make them more informed and engaged citizens in the future.

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Theme 7. Adaptive Management

Chaired by Etika Rupeni (IUCN) and Loraini Sivo (CI)

SUMMARY

prepared by Natalie Askew

Once protected areas have been established, adapting management rules, techniques, and the even the areas themselves based on monitoring data is critical for protected areas to most effectively achieve their objectives. A common lesson in this session was that outputs from powerful *decision-support tools* (e.g. MARXAN) can provide valuable inputs to community-based decision making, but is never a replacement for community decisions. For example, in Kadavu a new network configuration was developed with lower costs (e.g. lost fishing opportunities, cost of enforcement) and which better reflected the principles of network design such as representativity and replication of habitat types. In Namata River estuary a study is underway to marry local resource knowledge with spatial planning tools in order to inform management of the estuary.

Options for adapting a marine protected area network include adding new areas, changing boundaries or management of existing areas, or moving existing areas. *Resilience indicators* can be used to inform the adaptation of the network. For example, offshore areas were identified with high resilience because of their physical conditions (e.g. flushing), whereas some existing tabu areas had high resilience scores because the community management has already increased herbivore populations through protection. A presentation on conservation of marine plants in Fiji highlighted the possibility of using algae as resilience, because the presence of some species marks the boundaries of cold-water zones on the reefs – areas which are likely to be more resilient to coral bleaching events.

Socio-economic assessment formed a core part of studies discussed under this Theme. Surveys or interviews often revealed perception of poaching or over-harvesting by outsiders (e.g. Kia, Kadavu, Namata River and Natokalau), linked to the challenges of enforcement. Results were presented from opportunistic before-after-control-impact (BACI) surveys for a single, intensive harvest of reef fish populations at Kia Island. One year later, fish biomass was significantly lower at all areas than during the harvest, suggesting non-compliance with the reinstated fishing ban. Key recommendations from this study are that there should be a limit of 1 day harvest per year for tabu areas, and catch should go towards consumption rather than sale, to avoid establishing ties with middlemen which are subsequently hard to break. The importance of getting these findings back to the communities managing the tabu areas was re-enforced by the report that the tabu area at Kia has been opened once again and repeatedly harvested to raise funds.

Traditional knowledge is a valuable asset for understanding how the environment has changed, and for adapting to new situations that might arise as a result of climate change. It should be remembered that not all traditional practices are sustainable: compare the harvest method of a single large *kula* fish in Navatu – where only 1 fish is taken and others sent back to sea – with the *ikavoli* drive in Natokalau targeting mullet spawning aggregations, which no longer takes place because the mullet populations are too low to make the *ikavoli* drive worthwhile. Traditional taxonomic knowledge is important for the long-term perspective on ecosystem change, in order to set more realistic baselines. This knowledge is itself under threat, and an ethno-biodiversity study in Vanua Navakavu recorded local vernacular names for over 800 marine and examined perceived changes in abundance over the last 60 years, with many species having returned or increased in abundance since the establishment of the MPA in 1998.

A positive conclusion to this Theme was provided from the results of a review of community-based adaptive management in 30 FLMMA sites in Fiji, which found: "*improved household incomes, increased fish catches, enhanced community adaptive capacity, improved knowledge and attitudes, and restored a sense of ocean stewardship, ownership and pride back to communities.*" Furthermore, it has transformed decision-making for customary marine areas from a more traditional, autocratic style to a more participatory and democratic process of governance.

Presentation 1: Using local knowledge of traditional management practices from Kubulau District (Fiji) to inform current actions to maintain sustainable livelihood practices through future uncertain climate change

Fox, M.[1, 2], Tokota'a, M.[3], Dulunaqio, S.[2, 3], Williams, H.[3] and Jupiter, S.[1]

As new markets for terrestrial and marine resources have been introduced in Fiji in the past few decades, community residents have lost many traditional, more sustainable practices for farming and fishing. We conducted semi-structured interviews with village elders in the ten villages of the remote district of Kubulau in Bua Province, Fiji, to record local knowledge of traditional harvesting practices of terrestrial and marine resources. Respondents were specifically asked to recall past connections of the Kubulau people with charismatic and totemic terrestrial and marine species. We found that the large majority of traditional forms of management were no longer being practiced; moreover the youngest generation within each village was not familiar with most of the traditional associations with plants and animals. We highlight several key examples of extinct management practices which could be resurrected in Kubulau to deal with ongoing and future challenges of overharvesting and to maintain sustainable livelihood practices. We additionally highlight how these lessons are being used by the Kubulau Resource Management Committee and village chiefs to adapt their ridge-to-reef management plan for Kubulau District and adjacent fisheries management area, the first of its kind in Fiji.

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Presentation 2. Interrogating the Changing Baseline: A Retrospective Assessment of the Recovery of a Managed Fijian Fishery based on the Marriage of Modern and Indigenous Taxonomic Expertise

Thaman, R.R.,[1] Balawa, A.,[2] Fong, T.[1,3], Bakalevu, S.[1], Lalabalavu, J.[4], Gwilliam, M.[5], Biu, K.[2], Mudunasolevu, M.[2] and Taoka S.[2]

The paper presents the results of a taxon-by-taxon assessment of changes in species composition and trophic structure that have occurred over the past 50 years within the fishing area of Vanua Navakavu, located some 7 km to the west of the Suva Peninsula on the main island of Viti Levu in the Fiji Islands. The findings, which help to address the problem of a changing baseline, are based on a comparison of time-depth testimonies of the most knowledgeable older male and female fishers and ex-fishers with the results from more recent surveys in an effort to correlate observed changes with the recent establishment of an LMMA or other factors such as intense overfishing, increasing pollution, a 1953 tsunami and other extreme events, climate change, etc.

The results show that the combination of the successful restriction or reduction of unsustainable fishing practices such as the use of fish poisons, dynamite fishing, small-mesh gillnetting, night fishing and poaching and the establishment of a successful MPA, probably in combination with other factors, seem to be responsible for the return of many species and higher taxa not seen for decades or ever by the current generation, and the increasing abundance and size class of a very wide range of finfish species, invertebrates and seaweeds, most of which are sold and/or eaten. Most of these species are not normally inventoried in recent assessments of the status of coral reefs and marine protected areas, and the results give us a clearer picture of what the changing baseline of species richness used to be before the current generation of fishers, and what it could become if management interventions are continued and strengthened.

The results also show that the marriage of the best local and indigenous taxonomic knowledge with the best modern scientific and taxonomic knowledge maybe the only way of really determining how our efforts at marine conservation and the establishment of MPAs are impacting on, and will ultimately affect, marine biodiversity and the sustainability of it use by local communities.

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Presentation 3. The use of local resource knowledge and customary fisheries management to assist marine spatial planning in Fiji, using Namata River Estuary as a case study: the journey so far

Shaw-Brown, K.[1, 2] and Bollard-Breen, B.[1]

This study aims to determine the viability of marine spatial planning in Namata River Estuary. Fieldwork is ongoing for this project and therefore this paper reports progress to date. The Namata River estuary is situated north east of Nausori and is governed by several locally designated fishing grounds, connected to several surrounding villages. Namata River Estuary is also the location of several collaborative research projects with Fiji National University (FNU). Planned activities are:

a) To review existing marine management practices in Fiji.
b) To describe local knowledge of marine habitats, customary fishing grounds, significant fish species and their distributions and abundance in Namata River Estuary.
c) To validate local knowledge with the use of satellite imagery and in-situ sampling.
d) To explore the use of decision support tools for marine spatial planning in the Namata River Estuary.

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Presentation 4. Cakau Bula - Managing the marine resources of the Great Sea Reef, Fiji

Rokomate-Nakoro, A.D.[1, 2], Poonian, C.N.S.[1] and Qera, M.[1, 2, 3]

Kia Island, Fiji is home to a small and isolated community on one of the world's most important coral reef ecosystems, the Great Sea Reef. Sustainability of marine resources associated with the reef is of huge significance to local population. The Kia islanders are designated as the gonedau (traditional fishers) for Tui Macuata (provincial chief), and as such have an inherent interest and play a critical role in the effective conservation of the Great Sea Reef. We conducted an extensive socioeconomic survey of the community of Kia Island. Fishers were interviewed about the ecological and socioeconomic characteristics of the reef fishery, traditional knowledge and contemporary management. We also surveyed households to gather basic demographic data and information on household sources of income, socioeconomic importance and understanding of threats to coastal resources. Although we found that fishing was integral to the Kian lifestyle, there was also substantial evidence of effective customary management, which promoted the sustainability of traditional turtle and reef fisheries. We will present novel ideas that we have developed with the community of Kia to prevent the overexploitation of threatened species such as the humphead wrasse and green sea turtle. We hope to disseminate the results of this work to other Fijian island communities facing similar coastal resource management issues.

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Presentation 5. Conservation issues for marine plant biodiversity in Fiji

de N'Yeurt, A.[1, 2]

Marine plants include algae, seagrass and more broadly, mangroves and their associated marine flora. Past studies on the marine plant biodiversity of Fiji have shown a rich but often overlooked flora, especially for marine algae. Certain biodiversity hotspots containing new and/or endemic species are under direct threat from anthropogenic factors such as siltation, coral reef damage, pollution and coastal development. After highlighting such priority areas and their floras, measures are proposed in order to promote the conservation of these habitats for future generations.

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Presentation 6. Adaptive marine protected area management to improve reef resilience

Weeks, R.[1, 2] and Jupiter, S.[1]

Many existing protected areas are not located optimally to contribute towards local or national conservation objectives. Yet due to the perceived costs of relocation, protected area networks are typically designed to incorporate existing sites, rather than to remove or relocate them. We present two case studies from Fiji where social conflict over existing marine protected areas (MPAs), combined with new data availability and planning capacity, have led to MPA network reconfigurations. In Kubulau District conflict over the locations of two MPAs has resulted in non-compliance with management regulations. The need to improve management effectiveness, combined with a desire to ensure that the Kubulau MPA network is resilient to future climate change impacts, motivated a reconfiguration of MPA boundaries. In the Kadavu Province, MPA network planning was motivated by a desire to increase the area of coral reef habitats protected and the recognition that enforcement of existing MPAs in offshore areas was ineffectual. MPAs in offshore areas have been replaced and supplemented by new protected areas that have greater enforcement potential. Both case studies utilised conservation planning software as an input to community-driven decision-making. Whilst frequent or premature changes in the locations or boundaries of MPAs may undermine their ecological benefits, these case studies illustrate the benefits of active adaptive management in the context of community-based management.

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Presentation 7. Applying marine spatial planning tools to strengthen the design of a community based network of no-take protected areas in Kadavu

Wendt, H.[1, 2] and Comley, J.[1]

The residents of the Southern Island Province of Kadavu are leading Fiji's efforts to protect natural and cultural resources by establishing 60 locally-managed marine areas. These no-take areas were selected through a community-based adaptive management process aimed at meeting local-scale conservation and fisheries needs. While many of the management interventions of individual marine protected areas demonstrate well-defined success by ensuring food security at the individual community level, they potentially lack the coordinated island-wide outcomes desired for the wider area (or province) and the biodiversity conservation benefits associated with an integrated network of marine protected areas.

To evaluate the trade-offs of different approaches, reserve design software tools (MARXAN) are being used to examine how well the existing collection of locally-designed no-take protected areas addresses island-scale conservation and fisheries objectives. Local ecological, governance and socio-economic knowledge collected using participatory approaches are being spatially-integrated to evaluate the present design and assess whether or not the existing network in Kadavu can achieve protection for a province-wide marine protected areas network. Findings are crucial as Fiji strives to achieve bold conservation targets to effectively manage 30% of nearshore waters in a network of marine protected areas. Furthermore, results will be invaluable for developing marine protected area network design approaches that combine traditional knowledge with ecosystem-based management tools in a manner appropriate to a Melanesian context.

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Presentation 8. Community-Based Adaptive Marine Co-Management in the South Pacific: A Fiji experience

Tawake, A.[1,2,4], Meo, S.[2,5], Bogiva, A.[2], Fong, P.[2], Tawake, L.[3,4], Vave, R.[2], Comley, J[2]. and Aalbersberg, W.[2]

Marine resources, the mainstay of most Pacific Island people's livelihoods have been dwindling rapidly over the last several decades. This led to the judicious revival of local management practices since the 1990s utilizing community based adaptive management (CBAM) process. CBAM is based on progressive participatory community-driven approaches informed by marrying scientific and traditional knowledge. Despite the widespread promotion of CBAM, their role and effectiveness remains contested. Hence, this paper focused on the key question: to what extent does CBAM work as a practical and useful approach to marine conservation in the South Pacific?

The progress of CBAM initiatives in the South Pacific is first reviewed and both empirical and experiential evidences on successes and challenges of CBAM in Fiji presented as a case study. Household incomes have improved by as much as 30%, fish catches increased, communities' adaptive capacity enhanced, knowledge and attitudes improved and a sense of ocean stewardship, ownership and pride being restored back into communities. CBAM have also transformed decision making for customary marine areas from a more traditional, autocratic style to a more participatory and democratic process of governance. In addition, social learning motivated by the CBAM approach is clearly evident in the adaptive measures implemented by communities and in policies and legislation put in place by provinces and the national government. In conclusion, the Fiji study revealed that CBAM leads to improvements in all sorts of ways, both anticipated and unanticipated. One unanticipated outcome is that CBAM is a practical and useful starting point for marine management in the South Pacific but need not end there. Adaptive Co-management as a deliberate partnership strategy between communities with government, NGOs and bridging organization is the way forward for transitioning to a sustainable future.

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[4] Commonwealth Science & Industrial Research Organisation
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Presentation 9. Effects of a single intensive harvest event on fish populations inside a customary marine closure

Jupiter, S.D.[1,2], Weeks, R. [1,3], Jenkins, A.P.[4], Egli, D.P. [1], Cakacaka, A. [1]

In September 2008, the villagers of Kia Island, Fiji, opened their customary managed closure (Cakaulevu tabu) to fishing for a fundraiser that lasted for five weeks. We report on opportunistic before-after-control-impact (BACI) surveys describing changes to coral reef communities both four weeks into the harvest and one year later compared with pre-harvest conditions. Prior to the harvest, there was a natural gradient in mean fish abundance and biomass (kg/ha) per transect, with highest levels in the north of the closure (250 fish/transect, 8145.8 kg/ha), intermediate levels in the south of the closure (159 fish/transect, 4672.1 kg/ha) and lowest levels in the control area open to fishing (109 fish/transect, 594.0 kg/ha). During the harvest, there were large depletions in large bodied, primary targeted fish species, with significant loss in biomass of Carangidae the north and Lutjanidae and Serranidae in the south, but significant increases in Acanthuridae, Lethrinidae and Scaridae in the control, suggesting a "bail-out" effect whereby fish left the closure in response to fishing pressure. These changes were coupled with a large increase in turf algal cover at all survey areas, despite a large numerical increase in small, roving acanthurids (e.g. *Ctenochaetus striatus*) and scarids (e.g. *Chlorurus sordidus*). By one year later, fish biomass was significantly lower at all areas than during the harvest, suggesting non-compliance with the reinstated fishing ban. We use the lessons learned from this event to develop recommendations for improving the management effectiveness of customary closures, given that periodic harvests are a common feature across much of Oceania.

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Public Panel Discussion: Climate Change and Biodiversity - Catastrophe or Opportunity?

Moderator: Samisoni Pareti (SP)
Panelists: Professor Ove Hoegh-Guldberg, University of Queensland / Global Change Institute (OHG)
Dr Morgan Wairiu, Pacific Centre for Environment and Sustainable Development (MW)
Kiriti Chaya, Department of Environment Climate Change Unit (KC)
Professor Bill Aalbersberg, University of the South Pacfic Institute of Applied Sciences (BA)

1) What are some of the impacts that we can expect from climate change on Fiji's ecosystems and biodiversity?

BA: Coral reefs are going to suffer severe adverse impacts because we are already 'locked in' to a certain amount of sea temperature rise and acidification, although we were given reason for optimism about the resilience of Fiji's reefs by some of the presenters earlier today. Cloud forests are an example of an ecosystem in Fiji that may suffer adverse effects because if it gets warmer the clouds that keep these forests moist will disappear and this will change that ecosystem.

OHG: We really are in a very unusual time in human history. We're the first species that can go backwards and forwards with some level of precision and accuracy. We have a very good picture of what the options are right now. If we over the next 30 years reduce fossil fuel emissions to zero, we will have a difficult but manageable planet earth. Unfortunately there's climate change already locked into the system. But if we go down a pathway and we get to some sort of stability at or below 450ppm and +2°average global temperature, we will have a world where we will still continue to do some amazing things as a human species. But if we don't, with CO2 levels rising a thousand times faster than during ice-age transitions, we will get into very difficult circumstances over the next couple of decades, there's no question about that. I'm an optimist because I don't think we're that dumb: we're slow but we're not stupid.

2) What is the risk to biodiversity if all of the NGOs and aid organisations start diverting their attention from species and ecological science to focus on climate adaptation and disaster risk reduction?

MW: There is a strong interconnection between climate change and biodiversity; climate change impacts biodiversity and biodiversity impacts climate change. This has been taken on board especially between the Convention on Biological Diversity and the UN Convention on Climate Change, and there's a strong argument now that any support for climate change also addresses biodiversity.

Deforestation accounts for 17-20% of carbon emissions into the atmosphere. So if we don't protect the forests, then that's still the biggest source of CO_2 emissions that contributes to climate change. Although the focus might be on climate change, the role that biodiversity plays in addressing climate change is very important.

KC: Climate change and any environmental issue are intertwined. If you are addressing climate change issues, you are also addressing biodiversity issues at the same time, because everything is happening in our biological sphere. On the question that all of the funding is diverted towards climate change, I think that is a very drastic picture. At national level, we (DoE) receive a budget for the resource management unit and a separate budget for the climate change unit and wherever possible we try to use these together to make best use of the budget we have.

3) What are the opportunities to use climate change adaptation and mitigation funds to protect biodiversity?

MW: The introduction of mechanisms like the REDD+ would be an opportunity to conserve forests in high-island Pacific countries. Countries like Papua New Guinea and the Solomon Islands are losing their forests at very alarming rates of approximately 20% annually. With the introduction of the REDD+ mechanism, we can see an opportunity for communities to earn an income.

OHG: There are two fundamental problems with the way we've developed the rather primitive world economy that we have today. First, the environment is an externality in mechanisms such as REDD+. No one actually has the real price for what we're using. The second problem we face is that we've got an economy on a finite planet which is focused on growing the GDP. Well, that's not the way the world works: on a finite world, you cannot have growth forever.

So we need do two things, in my opinion. One is to cost the environmental services properly first so they become part of that equation in mechanisms such as REDD+. And the second thing is, now that we've got a model, it's not all about the GDP, it's also about how we feel; "are we happy"?

KC: From a practical view point in Fiji, let's consider a mangrove ecosystem. We need to really drive home the real value of a mangrove ecosystem as a message to the communities. It acts as a natural buffer, protecting villages from the onslaught of king tides. It also has economical value as a food source for important food fish like mud crabs and finfish which also have commercial value.

4) In the face of unsustainable human population growth, are the efforts and the resources we're putting towards climate change mitigation of much use if we don't control the population?

OHG: There are 3 riders that will affect the future: 1. Human population, 2. Climate change, 3. Evolution of technology. There are clearly no easy solutions to the population issue: One Child Policies and the consequent restriction of human rights can lead to other problems (e.g. the bulge in elderly population, which China is now facing). But beyond that, we really do have to deal with the population for our efforts on climate change to make a difference, but unfortunately there is no known answer at this point.

5) **How does the panel think we should prioritise our efforts in biodiversity conservation: do we look at the fact that we actually have very little baseline information so we're not sure which species we're losing; do we look towards the species that we know might be most severely impacted by changes that are occurring in the environment; or, do we just focus on education and awareness programs?**

OHG: Prioritisation is essential because there's only a finite amount of money available. And ultimately will this prioritisation lead to the conclusion that we can't save these species, we'll have to abandon them. It's a hard point to get to. We've got to be clever in what we choose; that we don't necessarily go for the charismatic megafauna when we know it's going to be hugely expensive and we not likely to succeed. It may come down to comparing species' roles in supporting our lives: an ugly thought, to be comparing tuna and tigers, with the latter not likely to be ranked highly on the scale.

BA: Since these decisions will be made by human beings, food security and things like that would ultimately take precedence. I think the best we can do is to have havens of biodiversity and functioning ecosystems, while we hope that the optimists are right and that technology and human-will will come to the fore.

6) **The importance of ecosystem-level functions is not a new idea, so what's the next idea?**

OHG: I don't think we've really stepped up to the challenge yet. At the moment, we quibble over fractions of a percent of global earnings that goes in to solving these problems. Guess how much we were willing to spend when we were engaged in a mortal combat between nations in World War II? 50% of our income. If you take the words of Nicholas Stern, "we are facing a catastrophe greater than 2 World Wars at once". So why are we still sitting around quite comfortably in many countries and not saying, "OK, I'm willing to give 20% of my income to solve the problem"?

Countries like Fiji that are facing front-line issues should be putting pressure on my country and the United States to stand up and do the right thing, because at the end of the day it's only a small amount of money that needs to go into fixing the problem. And when all these other pains go away (despite coral reefs in the next 30 years facing some problems), it's going to be a bright future and not a complete nightmare.

MW: The signs of climate change are very clear. The issue is not about using science to convince people. When you sit down at the international negotiation tables, one thing is clear: it comes down to politics. Unless we sort out the politics of negotiation, we will continue to be faced with this problem.

KC: With climate change, the threats are there, the opportunities are there and the funding is available also. We are more concerned about and striving towards a holistic approach to climate change, biodiversity and conservation activities.

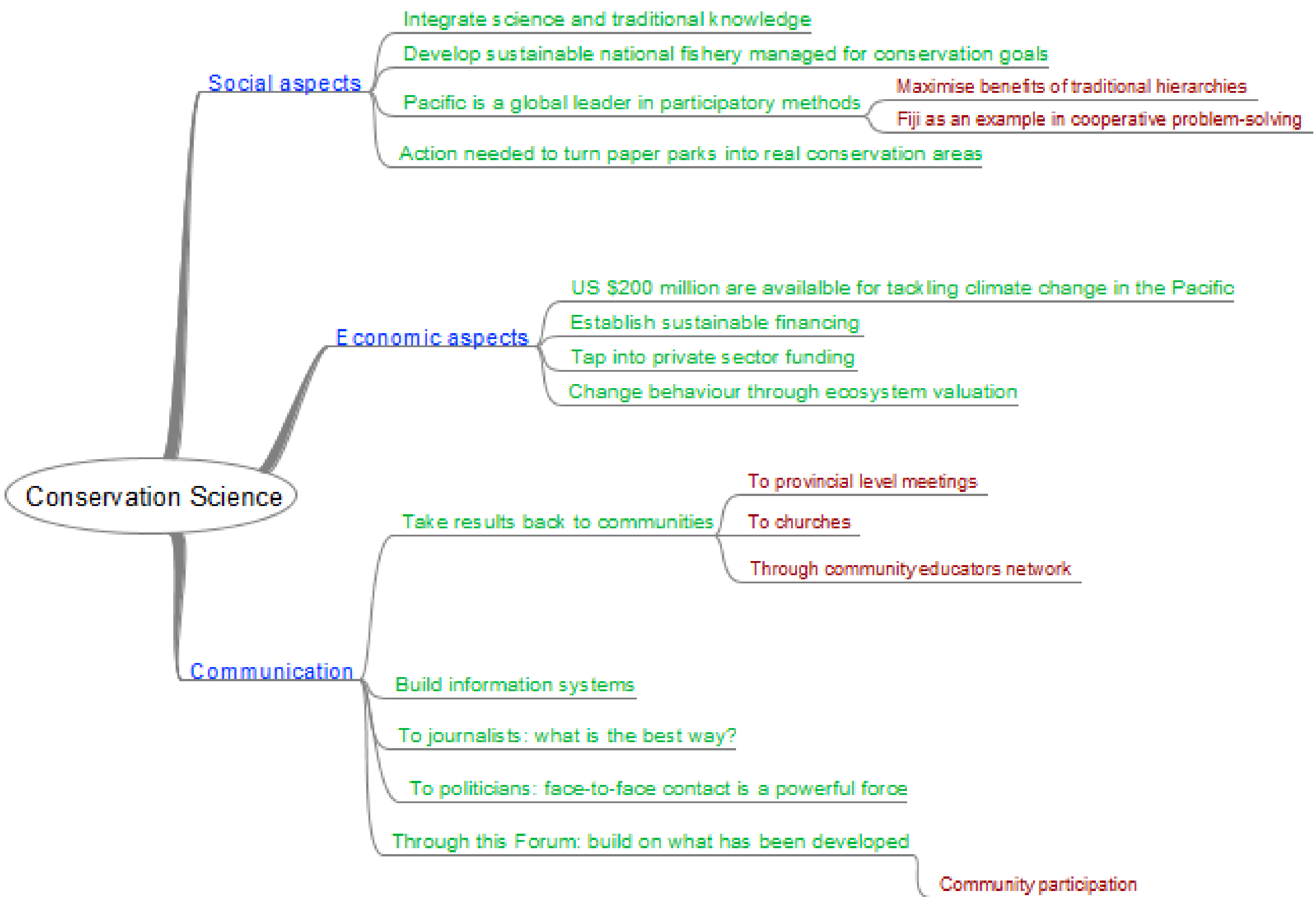
BA: Economics cannot be the sole factor we look at, nor can ecology. We can only solve problems by looking at things holistically; by looking at the ecological, social, cultural and the economic, and by having tools to address these aspects. And that may help convince some of the thinkers in policy and planning to bring all our possible tools into play when we deal with climate change.

SP: To conclude on the issue of climate change and biodiversity, on whether it is a catastrophe or an opportunity: from the comments from the panellists and the floor, we have a yes-yes situation here.

If you want to be an optimist, you've heard about how we need to make an effort costing the environment, maybe the current system of GDP and economic growth is not a realistic model for our finite world. We need to take more action instead of just discussing and negotiating. We need to plant mangroves and trees and get our hands dirty. And being an optimist, we can use availability of funding for climate change and to protect biodiversity.

But, on the other hand, if you are a pessimist, it's already too late. You can't do much with climate change and carbon emissions. We should make a revolution; get rid of capitalism! But the bottom line is: we need leaders in this country, not followers!

Plenary session: summary diagram of discussion points



List of Participants

Name	Ministry/Department/Organisation
Kathryn Baven	Australian National University
Francis Wise	Biosecurity Authority Fiji
Deborah Sue	BirdLife International
Nick Askew	BirdLife International
Miliana Ravuso	BirdLife International
Mere Tabudravu	BirdLife International
Tuvarea Tuamoto	BirdLife International
Sarojni Raj	BirdLife International
Elenoa Seniloli	BirdLife International
Tilaila Tanumi	Columban Fathers JPIC DEPT
Visenia Navelinikoro	Columban Fathers JPIC DEPT
Mareani Tanumi Mataika	Columban Fathers JPIC DEPT
Georgina Reeve	Community Centred Conservation C3
Maleli Qera	Community Centred Conservation C3
Isaac Rounds	Conservation International
Loraini Sivo	Conservation International
Davendra Nath	Consultant
Sunil Prasad	CORAL
Helen Sykes	CORAL Shark Conservation Campaign
Neema Nand	Department of Environment
Rahul Chand	Department of Environment
Kirti Chaya	Department of Environment
Aisake Batibasaga	Department of Fisheries
Saras Sharma	Department of Fisheries
Richard Veeran	Department of Fisheries
Aporosa Rabo	Department of Fisheries
Pretika Prasad	Department of Fisheries
Rajesh P	Department of Fisheries
Binesh Dayal	Department of Forestry
Salaseini Bureni	Department of Forestry
Craig Marlow	Environment Artists
Joe Taoi	Environment Artists
Nicola Thomson	Environment Consultants
Kiji Vukikomoala	Fiji Environmental Law Association
Usaia Gaunavou	Fiji Museum
Lepani Kolinisau	Fiji National University

Indrani Krishna	Fiji National University
Mele Vakaloloma	Fiji National University
Raijieli Kolinisau	Fiji National University
Rosalia keresoni	Fiji National University
Mereoni A. Radidi	Fiji National University
Katie Shaw	Fiji National University
Mesake Drawiatu	FLMMA
Jolame Sikolia	FLMMA
Apolosi Silaca	FLMMA
Kiniviliame R	FLMMA
Abdul Mufeez Shaheed	FNU/FSM
Kendall Benton	Freelance Environment
Simita Singh	FSPI
Tony M	FSTE /UST
Lusiana Ganilau	Ganilau's
Jemma Aitken	Greenforce
Scott Peaker	Greenforce
Claire Morrison	Griffith University
Dr Julien Grignon	ICER /Griffith University
Lizette Salmon	Independent
Samisoni Pareti	Islands Business Magazine
P Velitokaduadua	iTaukei Affairs
Bernard O'Callaghan	IUCN
Sanivalati Navuku	IUCN
Jan Steffen	IUCN
Etika Rupeni	IUCN
Morena Mills	James Cook University
Mr Kameyama	JICA
Bola Tubuna	Korolevu-i-wai environmetal committee
Apisai Tuisaya	Korolevu-i-wai environmetal committee
Peni Ware	Kubalau Business Development Committee
Luseane Ligabalavu	Ligabalavu Law firm
Helen Sykes	Marine Ecology Fiji
Unaisi Bera	Ministry of Health
Sheetal Singh	Ministry of Health
Kinijioji Rarayasarogo	Nageremal Foundation
Samuela Baleioneata	Nakorotubu Youth Rep
Corzzerrah Posala	Nakorotubu Youth Rep
Fiona Rodei	Nakorotubu Youth Rep
Laisiasa Waqavatu	Namada Qoliqoli Coomiittee

Voni Rusa	Namada Qoliqoli Coomiittee
Om Chand Bhim	Nasinu Chamber of Commerce
Kasaqa Tora	National Trust for Fiji Islands
Avesaki Ravuvu	National Trust for Fiji Islands
Tamara Osborne	NatureFiji-MareqetiViti
Dan Orcherton	PACE-SD
Naushad Yakub	PACE-SD
Antoine de N'Yeurt	PACE-SD
Dr Morgan Wairiu	PACE-SD
Eric Katovai	Pacific Adventist University
Setefano Nauqe	PCDF
Lone vestergaurd	PCDF
Matilita Kedrayate	PCDF
Chinnamma Reddy	Projects Abroad
Victor Bonito	Reef Explorer Fiji
Madeleine Carse	Reef Safari
Stuart Gow	Resort Support
Thomas Boysen	Saskatchewan Environment Society
Alumeci Nakeke	SEAWEB
Mereoni Mataika	Shangri-la Fijian Resort & Spa
Federica Gerber	SOPAC Division SPC
Iva Bakaniceva	SOPAC Division SPC
Rodney Lui	SOPAC Division SPC
Miriama Kunawave	SPC
Georgina Pene	SPC/FACT
John Bennett	SPC/FACT
Karl P. Kirsch - Jung	SPC/GIZ
Valerie Tuia	SPC-CePaCT
Marita Manley	SPC-GIZ
Felix Ries	SPC-GIZ
Filomena Serenia	Suva Activist Group
Vonivate Damu	Tagaqe Environment committee
Luke Tabutakia	Tagaqe Environment committee
Iliki Tabika	Tagaqe Environment committee
Semi Bailau	Tagaqe Environment committee
Charlotte Catmur	University of Melbourne Australia
Vivitskaia Tulloch	University of Queensland
Azusa Makino	University of Queensland
Professor Ove Hoegh-Guldberg	University of Queensland
Timoly Carter	USP

Chelcia Gomese	USP
Linda Yuen	USP
Abitara Takinana	USP
Monal Lal	USP
Nicollette Goulding	USP
Viliame Waqalevu	USP
Marika Tuiwawa	USP
Visheshmi Chandra	USP
Varsha Mala	USP
Roneeta Sharma	USP
Eparama Kubunavanua	USP
Ed Lovell	USP
Jerome Taoi	USP
Litiana Loganimoce	USP
Ruci Yani Loganimoce	USP
Matereti Mateiwai	USP
Shaleen Lata	USP
Nishita Naicker	USP
Professor Bill Aalbersberg	USP
Lia Bogitini	USP Biology
Shingo Takeda	USP Geography
Salanieta Bukarau	USP Geography
Teddy Fong	USP Geography
Teddy Fong	USP Geography
Rusiate R	USP IAS
Fiona Heilala	USP IAS
James Comley	USP IAS
Ron Vave	USP IAS
James Comley	USP IAS
Leigh-Anne Buliruarua	USP IAS
Lekima Copeland	USP IAS
Alivereti Naikatini	USP IAS
Fulori Waqairagata	USP IAS
Isimeli Loganimoce	USP IAS
Ron Simpson	USP IAS
Patrina Dumaru	USP IAS
Hans Karl Wendt	USP IAS
Semisi Meo	USP IAS
Shirleen Bala	USP IMR
Prerna Chand	USP IMR

Kelly T Brown	USP/CORAL
Mausio Mafai	Uto ni Yalo
Mosese Tuiloruma	Vatu-o-lalai Qoliqoli committee
Akuila Kaitabu	Vatu-o-lalai Qoliqoli committee
Sireli Nauka	Vatu-o-lalai Qoliqoli committee
Josua Kiloni	Vatu-o-lalai Qoliqoli committee
Jale Bola	Vatu-o-lalai Qoliqoli committee
Rex Thomas	VECA
Elia Gasaiwai	Waitabu Marine Park
Stacy Jupiter	WCS
Yashika Nand	WCS
Akanisi Caginitoba	WCS
Margaret Fox	WCS
Rebecca Weeks	WCS
Janette Kaipio	WCS
Natalie Askew	WCS
Ingrid Qauqau	WCS
Waisea Naisilisili	WCS
Sirilo Dulanuqio	WCS
Akuila Cakacaka	WCS
Nischal Narain	WCS
Liz Matthews	WCS
Kinikoto Mailautoka	WCS/Wetlands International
Akei Sarasau	Webmedia
Aaron Jenkins	Wetlands International
Cara Miller	Whale and Dolphin Conservation Society International
Jyotishma Naicker	WHO
Ryan collins	WWF
Seini Tawakelevu	WWF
Merewalesi Laveti	WWF
Unaisi Malani	WWF
Jale O. Baba	
Davidd Ephraim	
Marvin Baelaisapa	
Mrs Jung	
Kristy Barnby	
Simon Finlay	
Kameli Kororvulavula	
Salome Tuwaci	

Programme

Time	*Activity*	*Lead*	*Title*	*Presentation Authorship*
Day 1 - Wednesday 14th September				
08:30-09:00	Registration of Participants	Natalie Askew and Janette Kaipio		
09:00-09:05	Opening Prayer	TBC		
09:05-09:10	Welcome Address	TBC		
09:10-10:10	Keynote Speech	Professor Ove Hoegh-Guldberg	Climate change: the conservation challenge for Pacific marine resources and people.	
10:10-10:30	MORNING TEA			
10:30-12:15	Theme 1: Ecology and Management of Fiji's Watersheds (6 talks)	**Chairs:** Sanivalati Navuku (IUCN) and Aaron Jenkins (Independent)		
10:30-10:45		Aaron Jenkins (Wetlands International)	Fishes of Nadi Basin & Bay. Conservation ecology & habitat mobility	Jenkins, A. and Mailautoka, K.
10:45-11:00		Dan Orcherton (PACE-SD)	A Social and Biophysical Reconnaissance of the six upper Ba Watershed communities	Orcherton, D. and Veitata, S.
11:00-11:15		Leigh-Anne Buliruarua (USP IAS)	Lessons learned in community based watershed management and rehabilitation	Buliruarua, L.
11:15-11:30		Mr Kameyama (JICA)	Strengthening Community-Based Disaster Risk Management Project in the Pacific Region	TBC
11:30-11:45		Kinikoto Mailautoka	Human and climate impacts on decline of Fiji's	Mailautoka, K., Jupiter, S. and

		(WCS/Wetlands International)	freshwater fishes	Jenkins, A.
11:45-12:00		Lekima Copeland (USP IAS)	Factors Affecting Fish Assemblages in Wade-able Streams of Nakorotubu	Copeland, L.
12:15-13:15	LUNCH			
13:15-15:00	Theme 2: Terrestrial Species (6 talks)	**Chairs:** Miliana Ravuso (BirdLife) and Sunil Prasad (CORAL)		
13:15-13:30		Lia Bogitini (USP Biology)	Conservation of Fiji's Placostylid Land Snails	Bogitini, L., Brodie, G. and Barker, G.
13:30-13:45		Eric Katovai (Pacific Adventist University)	Plant species and functional diversity in the degraded wet tropical forests of Kolombangara, Solomon Islands	Katovai, E., Burley, A.L. and Mayfield, M.M.
13:45-14:00		Mere Tabudravu (BirdLife International)	Threat of Climate Change to Fiji's endemic forest birds	Tabudravu, M., O'Brien, M. and Ravuso, M.
14:00-14:15		Shingo Takeda (USP Geography)	Revealing the silent invasion: A GIS approach to analysis of plant invasion in the Sigatoka Sand Dunes National Park, Fiji Islands	Takeda, S.
14:15-14:30		Alivereti Naikatini (USP IAS)	Assessing different tree species and planting techniques for grassland reforestation	Naikatini, A. and Dayal, B.
14:30-14:45		Tuvarea Tuamoto (BirdLife International)	Monitoring seabirds in Fiji: Responses to rodent eradication and climate change	Tuamoto, T., Cranwell, S., Bird, J., Seniloli, E. and Rasalato, S.
15:00-15:30	AFTERNOON TEA			
15:30-17:30	Theme 3: Marine Species (7 talks)	**Chairs:** Jan Steffen (IUCN) and Merewalesi Laveti (WWF)		
15:30-15:45		Merewalesi Laveti (WWF)	Critical habitats of sea turtles in Fiji	Laveti, M.

15:45-16:00		Aisake Batibasaga (Department of Fisheries)	Conservation and Management of Sea Turtles in Fiji	Batibasaga, A.
16:00-16:15		Saras Sharma-Gounder (Department of Fisheries)	Current Assessment of Cetacean diversity in the Lomaiviti Channel	Sharma-Gounder, S. and Miller, C.
16:15-16:30		Helen Sykes (CORAL Shark Conservation Campaign)	Status of shark fishing and conservation efforts in the Fiji Islands	Sykes, H.R., Chapman, D.D., Villagomez, A. and Brown, K.T.
16:30-16:45		Salanieta Bukarau (USP Geography)	The Conservation Status and the Return of Crabs in Vanua Navakavu	Bukarau, S.
16:45-17:00		Teddy Fong (USP Geography)	Ecological Importance and Ethnobiodiversity of Parrotfishes (Scaridae): A Kia Island Perspective	Fong, T.
17:00-17:15		Helen Sykes (Marine Ecology Fiji)	Fiji Coral Reef Monitoring Network: an overview of a current partial coral bleaching event as related to sea water temperature recordings	Sykes, H.R.
17:30-18:00	WELCOME COCKTAIL			
18:00	Panel Discussion	**Moderator:** Samisoni Pareti (Islands Business Magazine)	*Climate Change and Biodiversity: Catastrophe or Opportunity?* **Panel:** Professor Ove Hoegh-Guldberg (University of Queensland) Dr Morgan Wairiu (PACE-SD) Professor Bill Aalbersberg (USP IAS) Kirti Chaya (Department of Environment)	
Time	*Activity*	*Lead*	*Title*	*Presentation Authorship*
Day 2 – Thursday 15th September				
09:00-10:15	Theme 4: Results from Fiji's Marine Managed Areas	**Chairs:** Helen Sykes (Marine Ecology Fiji) and Semisi Meo (USP IAS)		

	(4 talks)			
09:00-09:15		Fulori Waqairagata (USP IAS)	The role of marine protected areas in the protection of herbivorous fishes and their ability to control brown macroalgae	Waqairagata, F., Simpson, R., Ratuniata, R. and Comley, J.
09:15-09:30		Victor Bonito (Reef Explorer Fiji)	Small Community-Based Marine Protected Areas in Fiji Offer Measureable Fisheries Benefits	Cody Clements, C., Bonito, V., Grober-Dunsmore, R. and Sobey, M.
09:30-09:45		Isimeli Loganimoce (USP IAS)	Assessing spillover of commonly caught adult fish from Navakavu no-take marine protected area using Catch Per Unit Effort (CPUE) survey and Underwater Visual Census (UVC)	Loganimoce, I.
09:45-10:00		Ron Simpson (USP IAS)	Assessing MPA effectiveness using fin fish biological indicators – a case study of Korolevui-wai Qoliqoli	Simpson, R.
10:15-10:45	MORNING TEA			
10:45-12:15	Theme 5: Scaling up Local Management to meet National Priorities (5 talks)	**Chairs:** Rebecca Weeks (WCS) and James Comley (USP IAS)		
10:45-11:00		Victor Bonito (Reef Explorer Fiji)	Lessons Learned From Two Co-Managed Fijian Fishing Grounds	Bonito, V., Comley, J. Simpson, R. and Waqairagata, F.
11:00-11:15		Vivitskaia Tulloch (University of Queensland)	Designing marine protected areas using uncertain habitat information	Tulloch, V., Klein C., Roelfsema, C., Jupiter, S. and Possingham, H.
11:15-11:30		Stacy Jupiter (WCS)	Prioritizing Land and Sea Conservation Investments to Protect Coral Reefs	Klein, C., Jupiter, S., Selig, E., Watts, M. and Possingham, H.

11:30-11:45		Cara Miller (Whale and Dolphin Conservation Society International)	Use of science and local stakeholder engagement to progress a Marine Protected Area designation and management plan for resting spinner dolphins in Moon Reef, Viti Levu	Miller, C., Bau, J., Foster, H., Koroi, I., Tokairavua, J., Cribb, N., Hunt, T. and Williams A.
11:45-12:00		Kasaqa Tora (National Trust for Fiji Islands)	Protected Areas in Fiji (TBC)	Erasito, E. and Tora, K.
12:15-13:15	LUNCH			
13:15-14:15	Theme 5: Scaling up Local Management to meet National Priorities (3 talks)	**Chairs:** Rebecca Weeks (WCS) and James Comley (USP IAS)		
13:15-13:30		Victor Bonito (Reef Explorer Fiji)	The Importance of Herbivory in Maintaining Coral Community Resilience	Bonito, V., Rasher, D.B., Engel, S., Fraser, G.J., Montoya, J.P. and Hay, M.E.
13:30-13:45		Morena Mills (James Cook University)	Where do national and local conservation actions meet? Modelling the differences between local implementation and national conservation planning in Fiji	Mills, M., Adams, V.M., Pressey, R.L., Ban, N.C. and Jupiter, S.
13:45-14:00		Azusa Makino (University of Queensland)	Marine zoning of the Vatu-i-Ra ecoscape incorporating marine zone effectiveness and socioeconomics	Makino, A., Klein, C., Beger, M., Jupiter, S., Selig, E., Watts, M. and Possingham, H.
14:15-14:45	AFTERNOON TEA			
14:45-17:00	Theme 6: Socio-ecological Tools for Climate	**Chairs:** Ron Vave (USP IAS) and Kirti Chaya (Department of		

	Change Adaptation (7 talks)	Environment)		
14:45-15:00		Bernard O'Callaghan (IUCN)	Working towards Fiji's national biodiversity targets in order to meet international commitments under the Convention on Biological Diversity (TBC)	O'Callaghan, B.
15:00-15:15		Rahul Chand (Department of Environment)	Enhancing climate change resilience using the national strategy and action plan on biodiversity in Fiji	Chand, R.A.
15:15-15:30		Stacy Jupiter (WCS)	Building Social-Ecological Resilience as a Strategy to Protect Biodiversity and Adapt to Environmental Change	Jupiter, S.
15:30-15:45		Yashika Nand (WCS)	Reef Resilience: A tool to protect coral reefs against climate change crisis	Nand, Y. and Weeks, R.
15:45-16:00		Unaisi Malani (WWF)	Protection of Mangroves for Coastal Resilience	Malani, U and Fiu, M.
16:00-16:15		Mary Taylor (SPC-CePaCT)	Using agro-biodiversity for climate change adaptation (TBC)	Taylor, M. and Tuia, V.
Day 3 - Friday 16th September				
09:00-11:15	Theme 6: Socio-ecological Tools for Climate Change Adaptation (8 talks)	**Chairs:** Ron Vave (USP IAS) and Kirti Chaya (Department of Environment)		
09:00-09:15		Federica Gerber (SOPAC Division SPC)	Assessing the Social and Economic Value of Climate Change Adaptation in the Pacific Region	Gerber, F.

09:15-09:30		Patrina Dumaru (USP IAS)	Studying adaptive capacity in the Pacific	Aalbersberg, W. and Dumarau, P.
09:30-09:45		Naushad Yakub (PACE-SD)	Community-based Climate Change Adaptation: An overview of Pacific Center for Sustainable Development (PACE-SD) Projects in Fiji	Yakub, N., Jacot des Combes, H., Orcherton, D., Limalevu, L. and McNamara, K.
09:45-10:00		Jyotishma Naicker (WHO) and Sheetal Singh (WHO)	Climate-sensitive diseases in Fiji – what do we know, and what do we need to know, to protect human health in Fiji from the worst impacts of climate change?	Naicker, J., McIver, L., Singh, S. and Hales, S.
10:00-10:15		Iva Bakaniceva (SOPAC Division SPC)	Effective Handwashing Campaign in Schools	Bakaniceva, I.
10:15-10:30		Tamara Osborne (NatureFiji-MareqetiViti)	Community Conservation and Climate-Change Mitigation	NatureFiji-MareqetiViti
10:30-10:45		Akanisi Caginitoba (WCS)	Using Digital Education to teach coral reef biology and engage youth in marine conservation	Drew, J., Sanzenbacher, B. and Caginitoba, A.
10:45-11:00		Thomas Tui (SEAWEB)	Community Educators Network: Strengthening Community Leadership and Conservation through Effective Communications	Tui, T., Nakeke, A., Williams, H., Dulunaqio, S., Jupiter, S., Radway, S., Tokota'a, M. and Kolikata, P.
11:15-11:45	MORNING TEA			
11:45-13:15	Theme 7: Adaptive Management (5 talks)	**Chairs:** Etika Rupeni (IUCN) and Loraini Sivo (CI)		
11:45-12:00		Margaret Fox (WCS)	Using local knowledge of traditional management practices from Kubulau District (Fiji) to inform current actions to maintain sustainable livelihood practices through future uncertain	Fox, M., Tokota'a, M., Dulunaqio, S., Williams, H. & Jupiter, S.

			climate change	
12:00-12:15		Teddy Fong (USP Geography)	Interrogating the Changing Baseline: A Retrospective Assessment of the Recovery of a Managed Fijian Fishery based on the Marriage of Modern and Indigenous Taxonomic Expertise	Thaman, R.R., Balawa, A., Fong, T., Bakalevu, S., Lalabalavu, J., Gwilliam, M., Biu, K., Mudunasolevu, M. and Taoka S.
12:15-12:30		Katie Shaw (FNU)	The use of local resource knowledge and customary fisheries management to assist marine spatial planning in Fiji, using Namata River Estuary as a case study: the journey so far	Shaw-Brown, K. and Bollard-Breen, B.
12:30-12:45		AD Rokomate-Nakoro (Community Centred Conservation C3)	Cakau Bula - Managing the marine resources of the Great Sea Reef, Fiji	Rokomate-Nakoro, A.D., Poonian, C.N.S. and Qera, M.
12:45-13:00		Antoine de N'Yeurt (PACE-SD)	Conservation issues for marine plant biodiversity in Fiji	de N'Yeurt, A.
13:15-14:15	LUNCH			
14:15-15:15	Theme 7: Adaptive Management (3 talks)	**Chairs:** Etika Rupeni (IUCN) and Loraini Sivo (CI)		
14:15-14:30		Rebecca Weeks (WCS)	Adaptive marine protected area management to improve reef resilience	Weeks, R. and Jupiter, S.
14:30-14:45		Hans Karl Wendt (USP IAS)	Applying marine spatial planning tools to strengthen the design of a community based network of no-take protected areas in Kadavu	Wendt, H. and Comley, J.

14:45-15:00		Semisi Meo (USP IAS)	Community-Based Adaptive Marine Co-Management in the South Pacific: A Fiji experience	Tawake, A., Meo, S., Bogiva, A., Fong, P., Tawake, L., Vave, R., Comley, J. and Aalbersberg, W.
15:15-15:45	AFTERNOON TEA			
15:45-16:45	Discussion and Feedback	Bernard O'Callaghan (IUCN)	**Topic:** *Does conservation science in Fiji represent good value-for-money?*	
16:45-17:00	Forum closing	TBC		
17:00	CLOSING COCKTAIL			