Pohnpei Protected Areas Network Design Workshop

WORKSHOP REPORT

June 18-20 2014
Pohnpei, Federated State of Micronesia
Co-organized by The Nature Conservancy, the Conservation Society of Pohnpei and Pohnpei State Governor's Office

Table of Contents

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Pohnpei State Protected Area Background

The **Micronesia Challenge** (MC) is a commitment by the Republic of the Marshall Islands (RMI), the Federated States of Micronesia (FSM), and the Republic of Palau (RP), in collaboration with the United States (US) Territory of Guam and the US Commonwealth of the Northern Mariana Islands (CNMI), to conserve their natural resources by **"effectively conserving at least 30% of the near-shore marine and 20% of the terrestrial resources across Micronesia by 2020."**

The Federated States of Micronesia (FSM) is the largest and most diverse part of the MC sub-region. It is a federation of four semi-autonomous island States, in geographic sequence from west to east - Yap, Chuuk, Pohnpei and Kosrae - comprised of 607 islands with land elevation ranging from sea level to the highest elevation of about 760 m. FSM's total landmass is 702 km², with a declared Exclusive Economic Zone covering over 1.6 million km². Its marine and terrestrial biodiversity are the nation's living wealth and species endemism is high among the terrestrial biota. The high endemism within the nation is a direct result of the isolation of the islands to one another and to other landmasses in the greater Micronesian region. The conservation and preservation of FSM's natural heritage has high national importance and its endemic species have global significance. The marine and terrestrial resources are the foundation of the country's long term economic self-sufficiency as articulated in its National Biodiversity Strategic Plan (NBSAP) and subsequently its Strategic Development Plan 2004-2026 (SDP). Maintaining the habitats and ecosystems that nurture this diversity is crucial to sustaining the country's rich ethno-biological traditions while improving Micronesians' quality of life, since sixty percent (60%) of its population is dependent on subsistence livelihoods. Further inventory and monitoring of the FSM terrestrial and marine biodiversity are integral to a thorough understanding and appreciation of the island's biodiversity.

In FSM, the responsibility for environmental issues is shared between FSM National Government and the individual FSM State governments (i.e., Pohnpei, Chuuk, Kosrae and Yap). Each State, as owner of its surrounding natural resources out to 12 nautical miles, manages these resources through policies and plans (e.g., land use plans, coastal zone plans, legislation and regulations). The National Government, on the other hand, provides on request guidance and technical assistance to the States, and manages the resources from 12 to 200 nautical miles.

The sharing of stewardship responsibility has at times resulted in duplicate legislation at the State and National levels. Additionally, it has also led to gaps in legislation due to lack of clear delineation of respective roles and responsibilities at both government levels. Often the National government does not provide tangible (policy/legislative and funding) support to the states for their protect area (PA) and conservation laws. Recognizing these difficulties, FSM national and state leaders, as well as customary chiefs, have made an effort to streamline their work toward meeting their mutual goal of ensuring effective protection of natural resources.

Ownership of land and aquatic areas also varies between States. In Kosrae and Pohnpei, land is both privately and State owned, while aquatic areas are managed by the State as public trusts. In Chuuk, most land and aquatic areas are privately owned and are acquired through inheritance, gift or, more recently, by purchase. In Yap, almost all land and aquatic areas are owned or managed by individual

estates and usage is subject to traditional control. In all States, land cannot be sold to non-citizens of the FSM, although there are long term leasing options available for non-citizens. These land and aquatic ownership patterns greatly influence the strategies and actions required to sustainably manage the biodiversity of the nation.

Pohnpei has several marine protected areas (MPA,) the Watershed Forest Reserve and mangrove protected areas, which were established by state law in 1999 and 2001. The "Marine Sanctuary and Wildlife Refuge Act of 1999," recognized that certain areas of the terrestrial and marine environment possess conservation, cultural, recreational, ecological, historical, research, educational, or aesthetic qualities which give them special national and international significance, and that protection of these special areas is necessary for the social, cultural, and economic well-being of future generations.

In 2002, a "blueprint" of the FSM's biological resources was created to provide a clear picture of areas of biodiversity significance (ABS) that can be found within the FSM and a prioritization of conservation needs. The plan took over two years to create through a coordinated effort by individuals within the governments of the Federated States of Micronesia, the U.S. Forest Service, The Nature Conservancy, university scientists, and local experts. The "blueprint" contributes to the NBSAP. The major goal of NBSAP is to protect and sustainably manage a full representation of the FSM's marine, freshwater, and terrestrial ecosystems.

In 2005, the Conservation Society of Pohnpei (CSP) led a Rapid Ecological Assessment to assess the existing MPAs and identify potential new sites, based on habitat types and threat status. In 2011, two major conservation bills were signed into law in Pohnpei. The first bill amended the Marine Sanctuary and Wildlife Refuge Act, adding four additional protected sites (including over 1500 hectares of reefs and mangroves). This law significantly increased the biodiversity conservation coverage in Pohnpei.

In 2009, a "Gap Analysis" was completed for each state in FSM using information gathered from workshops held in each state. Participants at the workshops worked together to identify conservation features ("Class") within each state and then to define an initial set of goals for each Class. The Gap Analysis project was divided into three distinct phases where each one built on the previous. This allowed for a sequential learning process and ensured that all elements were considered. Phase 1 was designed to evaluate the status of each Class given the current configuration of Protected Areas (PAs). Summary statistics were then calculated to report on the total area of each Class captured within the PAs. Phase 2 built on these calculations by evaluating the Areas of Biological Significance (ABS). The ABS areas were defined based on expert knowledge during the FSM Blueprint project (~2002).

From the information gathered in Phase 1 and Phase 2 a report was developed on the status of all conservation features (Class) in relation to existing PAs, and illustrated how the ABS areas would complement the current PAs. Phase 3 of the Gap Analysis developed Marxan[1] models per State in order

[1] Marxan is a commonly used decision support tool for conservation planning, which identifies priority areas to achieve a specified conservation objective when provided with information about the spatial distribution of conservation features of interests and the socioeconomic cost of protecting different sites.

to provide guidance on achieving conservation Goals. The maps were developed digitally and passed onto the State Focal Points Agency – Kosrae Island Resource Management Authority (KIRMA), Pohnpei Department and Land and Natural Resource (DLNR), Chuuk Environmental Protection Agency (EPA) & Yap Department of Resource and Development (R&D) - and their respective Land Resource Agencies. Unfortunately many of those currently working in resource management at the state level are unaware that the gap analysis took place and have never seen the results. This has been attributed to clearly identifying a staff member at the state level to take over the project.

The previous Gap Analysis was not able to assess the management effectivness of the PAs. An MPA effectiveness assessment tool has been developed for Palau and Micronesia modelled after the MPAME tool developed in Indonesia. This will allow for enhanced understanding of management effectiveness of existing MPA sites to be taken into consideration of the PAN design, regarding whether sites are appropriate of state goals and objectives based on management level and conservation effectiveness level.

Additionally the previous Gap Analysis focused on biodiversity as the number one objective of designated protected areas and did not take into consideration other objectives especially those of the community. This new approach will build on the gap analysis by reevaluating the PA sites in each area using previous research efforts and appropriate community consultations to ensure the PANs meet the goals of both resource managers and community members (e.g. fisheries management), are representative of biologically significant areas and incorporate resiliency.

Workshop Purpose and Objectives

This workshop was the first step in refining the design of Pohnpei's Protected Area Network (PAN) to better meet Pohnpei state's goals using spatial planning. The purpose of this workshop was to agree on the goals of Pohnpei's PAN, understand the principles of protected area design and gather data and knowledge from community leaders to help assess and make recommendations on how to redesign Pohnpei's PAN.

Workshop Objectives

(1) Refine Goals for Network
(2) Clarify scope of study
(3) Agree on network design principles
(4) Assess data needs to complete design and available data layers

Workshop Report

Day 1

Opening address and Introductions

Ricky Carl, The Nature Conservancy, opened the workshop on behalf of John Ehsa, Pohnpei state governor. He welcomed everyone to the workshop and thanked them for taking the time to attend to

help with this important subject. He talked briefly about Pohnpei's PAN and how important participants' contributions will be over the next three days.

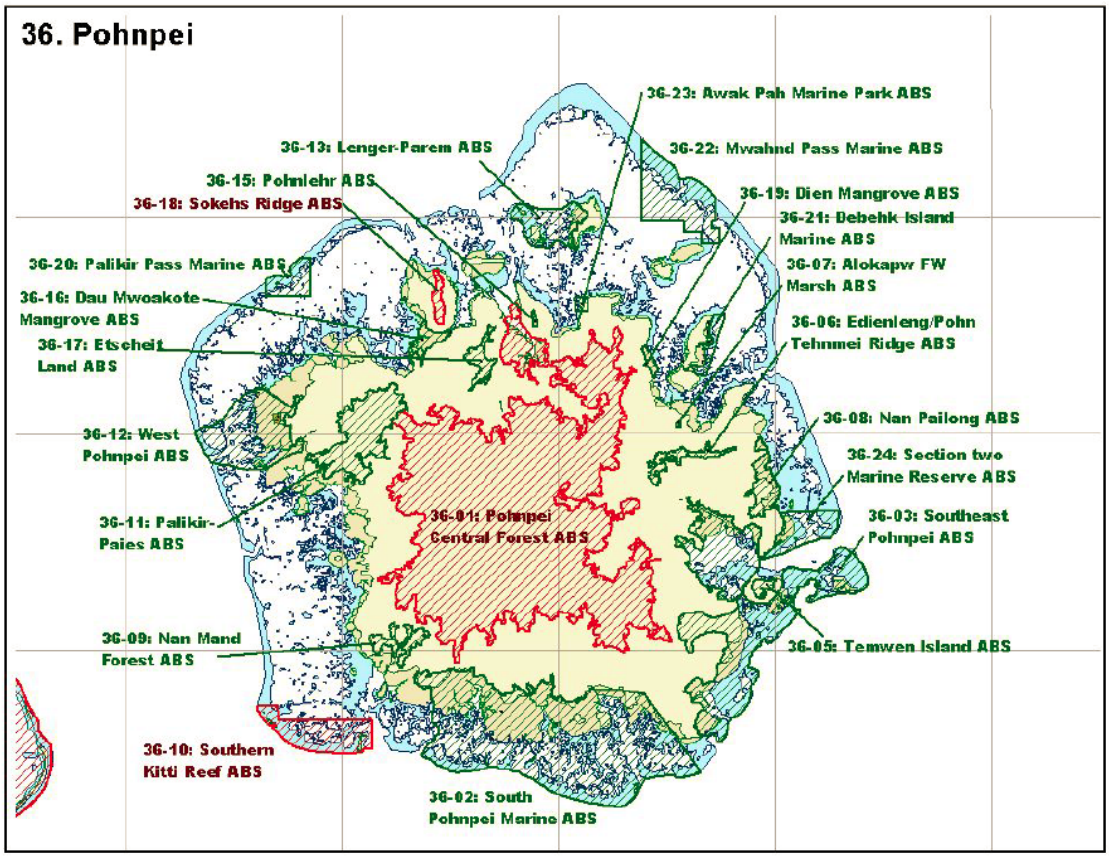
Workshop coordinator, Elizabeth Terk, asked participants (Appendix 1) to introduce themselves. She then went through the objectives and the agenda for the first day of the workshop, calling for any input or requests for clarification.

Presentation: Brief History of Conservation Planning in the FSM

By Nate Peterson, TNC

Nate Peterson presented on previous conservation planning done in in Pohnpei, FSM. He highlighted the Blueprint for Conserving the Biodiversity of the FSM, identified areas of biological significance, the rapid ecological assessment conducted in 2005 and coral reef and fish surveys. He also shared the results of the Gap Analysis (as describe above) conducted in all four FSM states in 2009 lessons learned from that process.

Areas of Biological Significance



Questions and Comments from Participants on Presentation

Question: Is this workshop going to answer questions we have regarding status of MPAs or are our MPAs working like we anticipate them to be?

Response: This workshop will assist the participants in determining whether current MPAs are effective or changes or adjustments need to be made.

Question: Does ABS map include the current MPAs in Pohnpei?

Response: Red areas are of biological significance needs that needs immediate attention/ we are gathered to look at our current PAs and to determine whether they are working or not.

Question: Are there any data available on the actual changes in fish/corals/forest etc? Are they effective or are there any improvements in biodiversity?

Response: MC initiative that helped push for the current monitoring protocols that are in place since 2003 only focusing on MPA now there is some data. Terrestrial measures group is still working on a monitoring protocol.

Response: Vegetation map from 1975/ 1995 turning a little brown along the side/ 2002 continues to turn brown which means more and more native forest is lost.

Question: Are MPAs the only solution to our fisheries issues?

Response: MPAs are a powerful tool to replenish fish, but there is also a need for additional management measures. Information of fish that we are fishing will be available.

Question: Is the problem commercial catching or fishing for food?

Comment: MPA is a powerful tool but we also need to consider fish size limits.

Comment: Enforcement of MPA is a huge issue because MPA don't work if you don't do enforcement.

Comment: The changes that were made to the Division of Fish and Wildlife did not lead to the expected improvement. Currently protected areas need to be legally declared by the legislature. This makes the process difficult. If changes were made to the law do that the director of the Department of Land and Natural Resources can legally designate protected areas this would make the process much more efficient.

Presentation: How Marine Reserves Work

By: Eugene Joseph, Director, Conservation Society of Pohnpei

Eugene Joseph gave in overview of how MPAs work. He explained that MPAs in Pohnpei were designed to take care of the marine ecosystem both fish and corals and that people in Pohnpei expect fish from the MPAs. He then facilitated a discussion on the vision and goal for Pohnpei's PAN.

Discussion on Vision and Goals of Pohnpei PAN

Comment: Around the island there are existing MPAs. Can there be any legal recognition for MPAs to be established in Sokehs? This committee can also look into the offloading areas near Sokehs. This is a traditional fishing site.

Comment: Lack of enforcement towards existing MPAs.

Comment: Changing the mechanics of the law is not enough. Joint law enforcement agreement all municipalities have the right to take to trial anyone breaking any laws within the MPA.

Comment: Last Marine Advisory Council (MAC) meeting in U, the Chief of Police was concerned about what is going to happen if they were to catch people from other municipalities in their waters.

Comment: That it is the reason why we have the joint law enforcement.

Comment: We need to focus on the things that we the people of Pohnpei survive on.

Comment: Not aware of the joint law that is in existence

Comment: Net and U have existing ordinances

Comment: Strengthen collaboration between communities and government (Resource/funding and man power/awareness-spawning aggregation-ecology)

Question: Is there enough information on the background of the existing MPAs?

Comment: Challenge is that people think it's the worst possible thing to create but we need effective awareness to be able to help people understand the importance of MPAs.

Comment: There is poaching because people now know that there are more fish in the MPAs.

Comment: People in my community know that they have CCO's and forest rangers and when discussions take place people only care about their survival. Need to find solution of how to decrease that mentality.

Comment: Thinking about the bigger picture, where we can learn from other examples of how successful these places are and to stress out the unique situation we have here in Pohnpei? We have an intact reef and forest so have to make people proud of what we have.

Comment: Need to apply what is Yap is doing is to have license fee on fishing in other municipalities. Need to improve fishing management turf.

Comment: We can also focus on Terrestrial side of things.

Comment: Is it possible to have the coordinates in the existing MPAs corrected? Most of the people in Madolenihmw survive on fisheries. Ensure everyone has access to fishing spots.

Comment: People feel deprived of their rights. Redefining MPA is not the only solution; we need to make sure that there is enough investment. When we do conservation we need to keep in suitable alternatives.

Comments: Put up designations of allowable fishing sites.

Comment: People are now fishing for tuna. OFA has been putting FADS in place. We need to mix the kinds of fish we catch-reef and pelagic. Put in mooring buoys.

Comment: They have also put in place some FADS but not sure if these FADS are effective.

Comment: There are plans to deploy FADS in Pakin. We are planning to deploy 12 within the reef.

Comment: Shift to more pelagic fish species to take pressure off of the reef.

*Land Based

Comment: Clean abundant water supply. There is also a problem of sedimentation

Comment: There is a wide range of farming done according to the maps what kind of crops are being planted and the answer is sakau.

Comment: If we can look into the law which mentions spawning areas. If we can open up the spawning sites so that it can be fished once since its part of our culture to do so. Nan Wap has seen improvement and so can there be any changes made so that it can be open once during the spawning season.

Comment: Recommended that we don't need to create another law and it is very dangerous to open up fishing during spawning for it may get out of hand.

Comment: If we can look into spawning sites and ease off on the MPA sites.

Comment: Tie the law with the culture.

Comment: Combine MPAs and fisheries management work. It may be a problem when we open up the spawning sites because there can be excuses to have it open when we let these sites open for one time. If we were to do so then there needs to be careful management established.

Comment: Mangrove areas are nursery sites.

Question: Is mangrove important for the island of Pohnpei? What can we do to care for our mangroves?

Response: Dredging can be banned and there needs to be laws created to protect mangroves.

Response: There are existing laws for mangroves and one needs a permit to cut down mangrove trees. Dredging is a serious problem.

Response: Municipalities have control of the permits for mangrove cutting. Need to look into the existing laws to cut down mangrove trees.

Response: Can PRMC be involved in the meetings we have?

Response: Regarding mangroves, what can we do with mangroves?

Comment: Very small scaled tourism it contributes to the economy has people have shifted from fishing and other things (Germany).

Comment: Concerned about Watershed Forest Reserve and the mangrove protected areas. EPA conducted 41 water analysis and 13 are safe for recreation and the rest are not. The plan for our community is to further conduct community clean ups so that we can have good quality water. Work alongside with CCO's so that they can make community members aware of the damage will be seen if we don't take care of our WFR. Need to have a wide island community clean up and to find solutions to

move away from watershed reserves. No more new roads move pig pens and toliets that are close to rivers.

Comment: EPA needs to share their water assessment report to all communities of Pohnpei.

Comment: Water coming from the forest is not the problem, it's where people are situated is the problem.

Comment: To have a clear and catchy vision. For instance to have 20% of the water we have drinkable.

Comment: Watershed provides water but when it comes to urban areas then there is a problem with water quality.

Visions and Goals for the Pohnpei PAN

This is a brainstorm of the visions and goals for the Pohnpei PAN. Participants of the workshop will work together to refining the vision of the PAN prior to conducting community visits on the PAN redesign.

Vision: Healthy and abundant natural resources which sustains Pohnpei…

Goals

Ecological

- Clean abundant water supply
- Maintain healthy ecosystems

Socio-economic

- Natural resources provide for sustainable livelihood

Food Security

- Reduce dependence on reef fisheries by providing alternative livelihoods

Cultural

- Preserve Pohnpeian cultural values
- Combine elements of traditional management practices and culture with science

Governance

- Effective management through improved enforcement and compliance
- Communities empowered to manage their resources
- Strengthen links between government and communities
- Community participation at every stage of the PAN process

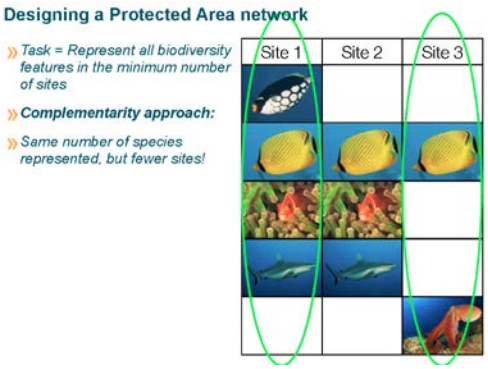
Presentation: Systematic Conservation Planning for Protected Area Networks

By: Dr. Rebecca Weeks, James Cook University

Dr. Weeks has participated in PAN design projects in several countries in the Pacific including Palau. Her presentation covered how protected areas were designed in the past, using systematic conservation planning to better design PANs and examples of how systematic conservation planning was used in other places. Below is a summary of the main points of her presentation.

In the past protected areas were placed in certain places because they were scenic places, remote areas, areas near research institutions or culturally important/traditional protected areas. This approach is proving to not be effective because we protect areas that are not needed for anything else and areas of high conservation importance may not be protected.

Systematic Conservation Planning is the integration of biological assessment, stakeholder engagement and socio-economics in cost-effect conservation action. The process is based on clear statements about stakeholder objectives and expected results. It is a scientific, data driven approach, which is transparent. It supports decision making, but does not make decisions. There are 11 stages in the conservation planning process.



In the past sites with greatest species richness were selected when trying to represent all biodiversity feature in the minimum number of sites. Using the complementarity approach the same number of species can be represented, but fewer sites are designated as PAs. In this approach sites complement each other if they contain different biodiversity features and each time a site is added what is already protected is considered. This approach also allows for flexibility because there may be more than one way to achieve the objectives of the PAN design.

Stages in the conservation planning process

1	Scoping & costing the planning process
2	Identifying & involving stakeholders
3	Describing the context for conservation areas
4	Identifying conservation goals
5	Collecting data on biodiversity & other natural features
6	Collecting data on socioeconomic variables & threats
7	Setting conservation objectives
8	Reviewing current achievement of objectives (gap analysis)
9	**Selecting additional conservation areas**
10	Applying conservation actions to conservation areas
11	Maintaining & monitoring areas

Once you start considering additional conservation features and scope of the project the problem can quickly become too difficult to solve by hand. This is why decision-support tools are useful. Computer programs like Marxan can do the calculations faster than we can do.

Social and economic "costs" in conservation planning are not $$ values. "Costs" indicated the opportunities that different stakeholders give up to establish a PA. e.g. fishing, agriculture. Tourists or recreational sites can have positive values or "costs". Conservation planning allows us to balance trade-off between biodiversity and human uses.

Discussion and Questions on Presentation

Question: How is the government in Fiji involved?

Response: Government is hands off but established goals like that of the Micronesia Challenge/ Locally Marine Managed Area.

Response: Fiji ministry of fisheries transferred all management powers to Locally Managed Marine Area (LMMA) network.

Comment: We have a hard time finding the balance between government and traditional leadership.

Question: The approach is pretty costly. Do we have an exact number of how much external support we would need?

Answer: The most expensive part is going out to collect data.

Comment: There are new tools coming out soon.

Comment: For the long term work we are about to do we need capacity building/ without capacity building we cannot change what government is doing towards conservation.

Comment: In the Solomon Islands we spent time in the communities mapping things out.

Comment: TNC has chosen TNC Micronesia a site for it Ocean Wealth Mapping project and we are hoping that Pohnpei might be the site for the new project.

Comment: There are GIZ projects in line with this work and can provide funding for certain projects

Presentation: PAN Redesign in Palau

By Steven Victor, The Nature Conservancy

Steven Victor presented on the PAN redesign process in Palau. He gave a background of the Palau PAN and relevant legislature. Palau's objectives for their redesign were biodiversity, climate change and fisheries. He presented the lesson's learned from the Palau process highlighting the important of understanding everyone's roles in the process and understanding which data layers are to be used and why.

Questions

Comment: Cost data have been done in FSM used in Pohnpei 2009.

Comment: Marxan is basically a calculator. So we need to ask what we need exactly with the PAN. If we don't know what we want then we won't be able to get the answer we need.

Comment: I suggest that Rudy Andreas from CSP learn about the program.

Comment: I Need to know what kind of data is available so will be discussing throughout the duration of the workshop.

Comment: We can have spatial data on existing maps.

Comment: GIS information is available but it's all over the place/US agency doing one thing and colleges doing one thing.

Comment: Put out data sets online/TNC has a system where information can be shared.

Discussion: Biodiversity Features (Targets) and Threats

Participants were split into marine and terrestrial groups to identify conservation feature targets and threats to those features. Outcomes from the discussion are summarized below.

Terrestrial

Target		**THREATS**
Palm Forest in Nett (Kedeu)	endemic	Clearing for sakau planting

Pohnpei Partula (Snails)	endemic	Clearing (deforestation) / Competition from introduce species
Ivory Tree (Oahs)	endemic / water indicator	Clearing for sakau, making houses
Pohnpei Mountain Starling (Siei)	endemic	Habitat changes
Soun Dau River/Stream in Sokehs	one of the cleanest rivers on island	Clearing too much mangrove, farming, agriculture waste
Mangrove Forest	indicates clean flowing water	Cutting, waste, dredging, filling, sedimentation
Sokehs Ridge (Bird diversity)	bird diversity and tourism	Hunting
Mushroom	for medicinal use	Over harvesting for selling
Medicinal Plants		Forest Clearing
Parem	rare palm found in mangrove	
Coconut Crab	only on outer islands	
Lehpwel (Wet Land)		

Marine Targets

- Kioak -Randall's rabbitfish (Siganus randalli)
- Palapal -Gold-spotted rabbitfish (Siganus punctatus)
- Pwoarin Mwomw -Pencil-streaked rabbitfish (Siganus doliatus)
- Arong -Jacks and Travallies
- Mwomw Mei -Pacific longnose parrotfish (Hipposcarus longiceps)
- Ah -Mullet

- Umwule -Forktail rabbitfish (Siganus argenteus)
- Kemeik -Bumphead parrotfish (Bolbometopon muricatum)
- Merer -Humphead wrasse (Cheilinus undulatus)
- Sopwou -Sleeper gobies (Ophiocara porocephala)
- Pehwehwe -Manta ray
- Pako –Shark
- Wehi -Turtle
- Kihs -Octopus
- Kioak → mangrove / reef
- Palapal → mangrove / reef
- Pwoaron mwomw → mangrove / reef
- Arong → mangrove / reef / outside barrier reef
- Mwomw mei → reef / mangrove
- Ah → mangrove / reef
- Umuleh → mangrove / reef
- Kemeik → reef
- Merer → reef
- Sopwou → mangrove
- Manta ray → reef
- Pako- shark → reef / outside barrier reef / mangrove
- Wehi -turtle → reef
- Kihs-octopus → reef / mangrove
- Lipwei - Bivalve sp.→ pohn mad (reef)
- Kopil -Bivalve sp.→ naniak (mangrove)
- Pahsu –giant clam→ pohn paina (reef)
- Elimoang –Mangrove crab→ naniak (mangrove)
- Masaht -land crab→ naniak (mangrove)
- Sile -Tri. Maxima → pohn mad (reef)
- Loangon-Elephant trunk fish → mangrove
- Penpen st. species→ pohn paina (reef)
- Werer – Sea cucumber.→mesen lam / pohn mad (reef)
- Sumwumw - trochus→ pohn paina / mas liki (reef)
- Uronna - lobster→ mas likin paina (outer reef)
- Oaloahd - seagrass → pahn iak / pohn mad (reef / sandy areas)
- Wasahn neitik en wehi – spawning ground for turtles

Marine Threats

1. Population Increase
2. Coral dredging
3. Human and animal waste
4. Harvesting of invertebrates
5. Reckless fishing methods
    a. Nets (size)
    b. Fishing using poison
    c. Kioar –Hawaiian sling
    d. Fishing at night
6. Road construction, deforestation and poor land management practices as leading to sedimentation

Presentation: Designing Resilient Networks of Marine Protected Areas to Achieve Fisheries, Biodiversity and Climate Change Objectives

By Dr. Alison Green, The Nature Conservancy

Dr. Green gave a presentation on MPA design principles that can be used to achieve fisheries, biodiversity and climate change objectives. She presented new science which is being used to design MPAs. She also highlighted how connectivity based on this new science can be used to improve marine reserve design. Below is her presentation. Information for the presentation came from the following sources:

Green, A., White, A., Kilarski, S. (Eds.) 2013. Designing marine protected area networks to achieve fisheries, biodiversity, and climate change objectives in tropical ecosystems: A practitioner guide. The Nature Conservancy, and the USAID Coral Triangle Support Partnership, Cebu City, Philippines. viii + 35 pp.

http://www.uscti.org/uscti/Resources/MPA%20Practitioner%20Guide%20Final%207Mar13.pdf

Green et al 2013 *Designing Marine Reserves for Fisheries Management, Biodiversity Conservation, and Climate Change Adaptation*) that provides the scientific basis for this approach which is available online at:
http://www.tandfonline.com.elibrary.jcu.edu.au/doi/full/10.1080/08920753.2014.877763#.Uyd_j02KDrc

Over five years, the Coral Triangle Support Partnership (CTSP: supported by USAID and the American people) has supported a project, led by The Nature Conservancy, focused on improving our ability to design marine protected area (MPA) networks to achieve multiple objectives regarding fisheries management, biodiversity conservation and climate change adaptation in the Coral Triangle. This

presentation focuses on some of the latest science that was done in support of this. While this work was developed in the Coral Triangle, the results are applicable to any tropical marine ecosystem.

If well designed and implemented, MPAs can contribute to achieving multiple objectives including: protecting biodiversity, climate change adaptation, fisheries production and management and other resource management (e.g. Tourism). MPAs often don't achieve these objectives because they are either not well designed or effectively managed. Furthermore, the way in which we design MPAs for different objectives are slightly different (particularly for biodiversity and fisheries). So we needed to come up with a way of combining this advice for people who wish to design their MPAs to achieve all of these objectives at the same time.

In recent years, there has also been some new and exciting science emerging which will help design MPAs to maximize their contribution to these objectives. Based on this new science, we developed 15 biophysical principles or guidelines for field practitioners for designing resilient networks of MPAs to achieve fisheries, biodiversity and climate change outcomes simultaneously. This presentation covers some of these principles and the rationale for each. The principles should be used with a similar set to address social, economic and cultural considerations.

First, it is important to create large multiple use areas that include but are not limited to marine reserves (no-take areas). This is because while marine reserves are the most powerful tool in our MPA toolbox for achieving our objectives, they cannot be effective on their own, and need to be integrated with other zones to be successful.

The next principle is the need to represent 20-40% of each habitat in marine reserves. This is because different species use different habitats, so it's important to protect representative examples of each habitat in no-take areas to protect all biodiversity and key fisheries species. How much depends on fishing pressure and other fisheries management outside.

Another principle is the need spread the risk by protecting at least 3 widely separated replicates of each habitat type in marine reserves. This minimizes the risk that all examples of a habitat will adversely impacted by the same disturbance. Protected habitats that survive the disturbance can act as a source of larvae to help recovery in other areas. Replication also helps manage the uncertainty associated with biological heterogeneity within habitats. Since variations in communities and species within habitats are often poorly understood, habitat replication increases the likelihood that examples of each are represented within the network of protected areas.

It is also important to make sure that critical, special and unique areas are protected in marine reserves. For fisheries management we need to protect critical habitats for key fisheries species at critical stages in their life histories, including important aggregation sites (e.g. for spawning and feeding) and juvenile fish habitat. For biodiversity protection we need to protect special or unique sites in no-take areas, including important sites for rare or threatened species (e.g. turtle nesting sites) or habitats, endemic species or areas of high biodiversity.

It is also important to identify and protect areas that may be more resistant or resilient to climate change in marine reserves. For example mangroves that have space to move inland with rising sea levels or ecosystems that have resisted or recovered from damage (e.g. coral bleaching) in the past and have characteristics that indicate they are more likely to survive impacts in the future (e.g. heat-tolerant corals that may be more resistant to coral bleaching.) Resilient sites (refugia) for key habitats and species should be included in MPAs, preferably marine reserves, because they are likely to be important for maintaining biodiversity in the face of climate change.

The rest of this presentation focuses on some of the science done in support of this regarding the connectivity of reef and coastal pelagic species, and how it can be used to improve MPA network design (based on Green et al. in review).

Most reef fishes have two life history phases. For example, we have two adult coral trout, a male and female, living on the reef. When they reproduce, hundreds of thousands to millions of tiny larvae are released into the waters above the reef. The larvae spend about 30 days out in the blue growing, and for the vast majority, dying – we estimate that as many as 99% of them die during this period, most of them eaten by other animals. How far they travel away from their parents is a real mystery and could be hundreds of kilometers. For the lucky few who survive the voyage they find a reef and settle down, and will generally stay on that reef for the rest of their lives.

Reef fish move different distances in these two life history phases. Most species don't move very far (a few meters, 100s of meters, or a few kms) as adults and juveniles, while larvae have the potential to move much further (10s, 100s or 1000s of kms). Scientists (e.g. Palumbi et al. 2004) recommend that since adults and juveniles are most vulnerable to fishing outside of marine reserves, we should set the size of NTAs size according to movement patterns of adult/juvenile fishes.

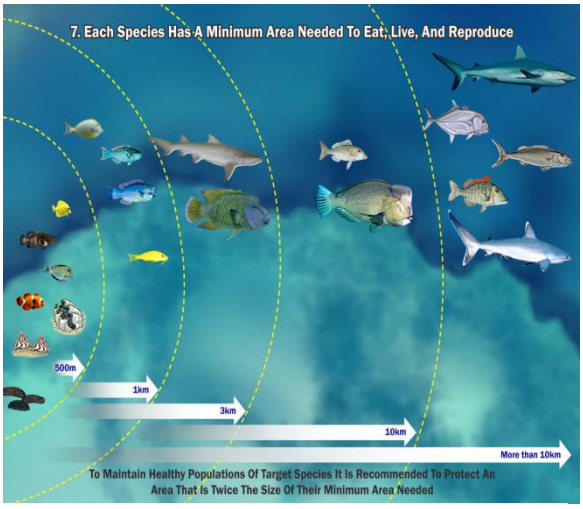


Image © Green et al 2013, Gombos et al 2013 (modified from Maypa 2012)

Why do we want the MPA size to be bigger than the home range of key species? Because size matters! A 40cm coral trout will produce around 350,000 larvae but a 50cm trout will produce 1 million larvae and a 60cm trout will produce 3 million larvae. So, big fish produce a lot more babies than small fish, which they can export to fished areas. So we aim to protect individuals so they can reach large sizes, where they will produce more larvae to export to other areas.

Latest science suggests that the size should depend on key species (and how far they move) and if other effective protection is in place. While we've known this for a while, how do we apply it to MPA network design? The key is to consider the key species the communities want to manage, and how far they move. Unfortunately we haven't been able to able to apply this information in any detail before because we didn't have the information on movement patterns of key species available.

Over the last few years, we've reviewed the best available science regarding movement patterns of adult/juvenile coral reef and coastal pelagic fish species (Green et al in review). We can now use this info to have informed discussions with communities regarding how large NTAs should be based on key species they are interested in and how far they move and there is other effective protection in place.

Most species don't move very far as adults/juveniles (most <1-3km^2), although some move longer distances (5 to >20km). So if possible, it is better to have large MPAs (10-20kms) because they protect larger populations of more species. But if this is not feasible (e.g. for most community managed areas in inshore areas), then we need to think clearly about what species communities want to protect, how far they move, and how to protect them (i.e. NTAs of the appropriate size, or by some other means e.g. regulations to protect wide ranging species).

How we can use information on larval dispersal in MPA design? Scientists (e.g. Palumbi et al. 2004) recommend that we set the spacing of marine reserves according to larval dispersal distance (since they are less vulnerable to the fishery when they move outside of NTAs, and they are important for replenishment of areas after disturbance). Biophysical models predict that the scale of coral reef fish larval dispersal is likely to be in the 10's of kms (3-50km or more). However recent direct measurements of larval dispersal (e.g. using DNA parentage analysis) of a range of coral reef species shows that self-recruitment is more common than we thought, and in fact 20-60% actually stay in the local area where they were spawned (most within 15km). Therefore, we recommend that marine reserves be separated by <15kms (Green et al in review). We also recommend that marine reserves are close to fishing grounds, to maximize the benefits to local fisheries.

Another thing to consider is the location of no-take areas (ie the need to locate NTAs where the primary habitat of key species is located) and connectivity among habitat types i.e. where key species use different habitats throughout their lives.

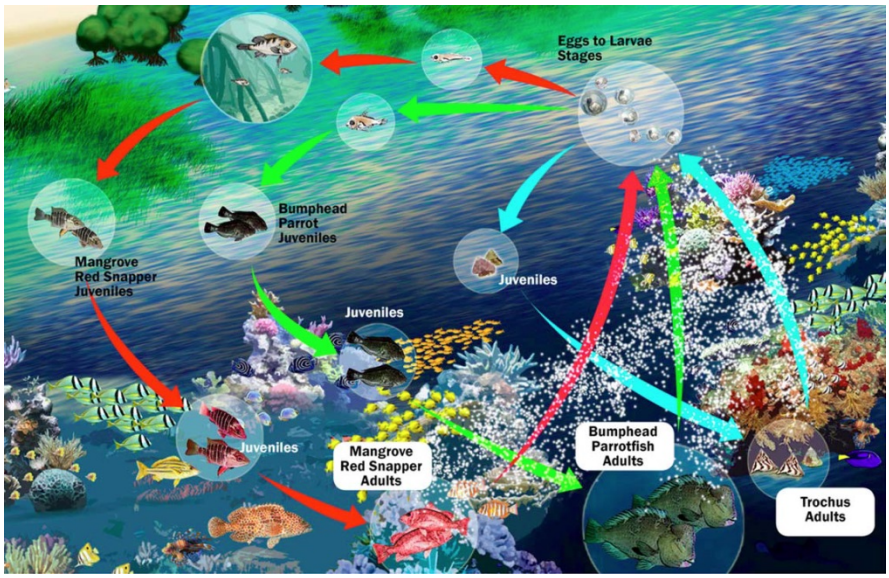


Image © Green et al 2013, Gombos et al 2013

This image shows how some species (e.g. the mangrove red snapper, also called mangrove jack) use different habitat types throughout its life. Therefore, to protect this species, it is necessary to protect all of the habitat types it uses throughout its life (and to make sure these areas are close enough together to allow for movement among them).

Another ecological concept that we need to consider is vulnerability and recovery times of fishes and implications for duration of marine reserves. Many factors affect vulnerability and recovery rates of reef fishes (based on Abesamis et al in review) including life history characteristics (maximum size, growth rate, life span, age/length at maturity) and trophic level (Rate of natural mortality, Recruitment rates, Species interactions and Population size due to fishing intensity)

Life history and trophic characteristics are useful but not perfect indicators of vulnerability and recover times, which we can use in data poor situations. Some species (e.g. herbivores such as most parrotfishes), are less vulnerable to fishing pressure and take less time to recover after protection because they have smaller maximum sizes, shorter life spans, and grow and mature more quickly. Others (eg. large carnivores like groupers) are more vulnerable to fishing and take longer to recover after protection because they have larger maximum sizes, longer life spans, and grow and mature more slowly. Therefore NTAs (for 20-40% habitat representation) need to be long term/permanent to allow time for all species to recover, including key fisheries species such as groupers. Short term areas can provide short term fisheries benefits for some species (e.g. to stockpile resources for feasts/school fees), but are no substitute for long term areas for biodiversity protection and fisheries production for all species. So short term areas should be used in addition to, and not instead of, long term areas.

It is also important to prohibit destructive activities and minimize or avoid local threats. If these threats cannot be managed effectively, it is important to protect areas with lower levels of threats in no-take areas.

This is great news for MPA network design, particularly small community managed marine areas because now we can demonstrate benefits to local people more clearly. The latest scientific evidence suggests that local fisheries management through marine reserves, even small ones, can result in local benefits for communities because NTAs protect spawning stock that provides recruitment to local fisheries since most coral reef and coastal pelagic fishes don't move very far as adults or juveniles (most <1-3km^2), although there are some wide ranging species that move longer distances (5 to >20km); and the scale of larval dispersal is much smaller than previously thought (20-50% of recruits stay in the local area, most within 5km).

This information covered in Dr. Alison Green's presentation is available in several formats for different audiences.

Designing Marine Protected Area Networks to Achieve Fisheries, Biodiversity and Climate Change Objectives in Tropical Ecosystems

- A scientific paper (Green et al 2013 *Designing Marine Reserves for Fisheries Management, Biodiversity Conservation, and Climate Change Adaptation*) that provides the scientific basis for this approach which is available online at: http://www.tandfonline.com/doi/full/10.1080/08920753.2014.877768

- A guide for field practitioners (Green et al 2013 *Designing marine protected area networks to achieve fisheries, biodiversity and climate change objectives in tropical ecosystems - a Practitioner's Guide*), which provides a succinct, graphic and user-friendly synthesis of the best available scientific information

for practitioners who may not have access to, or the time to review, the increasing amount of research literature regarding this issue. This is available online at: http://www.coraltriangleinitiative.org/library/guide-designing-marine-protected-area-networks-achieve-fisheries-biodiversity-and-climate

- A guide for community based managers (Gombos et al 2013 *Designing Effective Locally Managed Areas in Tropical Marine Environments*), where we provide a series of flip charts and speaking notes for facilitators to discuss important considerations regarding MPA network design with local communities who may own and manage these resources. This is available at: http://www.coraltriangleinitiative.org/library/training-material-designing-effective-locally-managed-areas-tropical-marine-environments-3

- A policy brief (Green and White 2013 *Using Marine Protected Area Networks to Achieve Fisheries, Biodiversity and Climate Change Objectives*), which is designed for use by government departments and senior government officials and is online at: http://www.uscti.org/uscti/Resources/MPANetworkDesignPolicyBriefFinal4.pdf

Discussion

Question: Climate Change will increase in the future regarding the scientific bases would need to change the MPA's since resources are going to change. How are we going to apply PAN? Are there examples?

Response: Choose sites which can move. Ensure legislation is open for continued review. Coral reef fisheries suggested that the biggest impact is habitat loss because the corals are going to be effected. Alternative livelihood can be considered which will address climate change.

Question: Short term and long term MPA's are there species specifically for short and long term sites?

Response: More permanent long terms and then short terms can be opened. The best is to have long term.

Comment: From the presentation we have determined that we need to move MPA's because they are not of any importance.

Comment: Will get more detailed information about whether Pohnpei's MPAs are in the right place through this workshop. For example we will take a list of species and will think of habitats they live in and how far they move and then look at the size of the MPAs and see if Pohnpei's MPAs are large enough.

Breakout Groups: Developing Specific Design Criteria and Targets for Pohnpei PAN

Participants returned to their marine and terrestrial groups to select which design criteria they would like to use for the redesign of Pohnpei's PAN.

Marine Group:

PRINCIPLE	FEATURE	TARGET	DATA
Representatives of each habitat	Each type of coral, mangrove, seagrass habitat	30% by 2020 / 20% effectively managed	yes
Critical Area/ Special Species	Kehpara (Spags)	100% (keep protected , no take year round)	yes
	Palikir Pass (Spags)	100% seasonal management	yes
	Mwand Pass (reminant spags site)	100% keep protected, no take, better enforcement	yes
	Nanwap (rabbit fish, spags, parrot fish)	100% keep protected	need to add
	Nanwap Nearshore (rabbit fish, spags)	3 days seasonal protection	more spags need to be added
	Napali, Madolenimw (turtle nesting)	lost beach due to coastal	need to correct data

	Pakin (turtle nesting)	100% keep protected, Note: part is nt in PA seasonal protect turtles - enforcement, need to check labs	need to add
Special Species	Mantas	No additional requirements	
Size of PA based on fish movement	Invertebrates	ensure their respective habitats are protected by habitat reps.	
		crabs: seasonal protection	
		Lobster: catch limitation / no eggs	

Terrestrial Group

CATEGORY		**TARGET**	**THREATS**	**DATA**
Palm Forest in Nett (Kedeu)	endemic	100%	Clearing for sakau planting	Survey needed
Pohnpei Partula (Snails)	endemic	100%	Clearing (deforestation) / Competition from introduce species	Survey needed / Not enough data
Ivory Tree (Oahs)	endemic / water indicator	100%	Clearing for sakau, making houses	Watershed Forest Reserve
Pohnpei Mountain Starling (Siei)	endemic	100%	Habitat changes	Legislation to enforce no hunting in the PA

Soun Dau River/Stream in Sokehs	one of the cleanest rivers on island	100%	Clearing too much mangrove, farming, agriculture waste	Nett watershed reserve (Soun Dau)
Mangrove Forest	indicates clean flowing water	30%	Cutting, waste, dredging, filling, sedimentation	Need more data
Sokehs Ridge (Bird diversity)	bird diversity and tourism	25%	Hunting	Data available
Mushroom	for medicinal use		Over harvesting for selling	Need to get clarification from source
Medicinal Plants		20%	Forest Clearing	Not focusing specifically on medicinal plants but also include forest types
Parem	rare palm found in mangrove			Included in the Forest Reserve
Coconut Crab	only on outter islands			Need survey on the outer islands
Lehpwel (Wet Land)		20%		

Discussion following presentation of design principles and targets

Comment: We need to protect the coconut crab and their habitat
Comment: Wetland is also important to be protected for it is where most of the islanders get their food.
Question: 20% enough?
Respond: Yes

Comment: some of the targets have no data, no spatial data, continued survey; vegetation map is what we have. Most of the island is characterized as upland forest, data to represent wetlands and marshes are also available. Vegetation changes as we go higher in the mountain?
Comment: Who has information of soil? (NRCS) Do we know how we would care for our soil in different areas? Is the soil different in different parts of the island?
Comment: As we go up the slope vegetation changes. Maps of potential land slide areas. When we reach the top we find the watershed.
Comment: Combine elevation and slope to find out soil types.
Comment: Main cash crop for Pohnpeians is Sakau. People are planting in the upland forest. The sakau that are grown in the lower parts has a slow growing rate but is stronger than the ones found in the upland forest.
Comment: connection of mangrove and marine environment. 8 additional proposed areas on the island. (Marine)
Comment: break up features by habitat type

- Corals/Reef, Mangrove Forest, Sea Grass (Habitats) 30% in compliance with the Micronesia Challenge goal of preserving 30%. There is data found for these specific areas
- Critical Areas: Spawning areas. Spags three sites are chosen which are Kehpara (Legislation), Mwand (Legislation) , Palikir Pass (No Legislation) 100% but proposed seasonal management. Mwahng is one site where unicorn fish is found 100% Mwand Pass a site where spawning takes place. Fishermen from U stated that groupers can be found but less then Palikir Pass and Kehpara. Monitoring and research have been done on Kehpara and Palikir Pass 100%. Since its already an MPA we can move forward but need to work on enforcement. Nan Wap is also mentioned since it is one of the sites that there is abundance in rabbit fish. The team agreed that during rabbit fish spawning and not to focus solely in Nan Wap and to protect the whole island. Need to have seasonal bans during spawning season of Rabbit Fish. Turtle nesting sites are depleting due to climate change. Pakein is also highlighted for its nesting ground for turtle.

Coomment: Need to consider areas Kepdauhn Sokehs to the ship port. Bumphead and a certain type of indigenous sponge are found there. Kehlou, Dawahk needs to be considered for biological diversity both on land and sea.

Activity: Designing MPA Networks for Important Fish Species in Pohnpei

Participants were broken up into smaller groups and participated in an exercise that compared fish movement patterns to the size of Pohnpei's existing MPAs. Below is a summary of the conclusions and main points learned from the exercise.

Review of Existing MPAs based on Movement Patterns of Key Species

Key considerations

- No-take marine reserves (NTAs) should be designed to take movement patterns of the key species they are aiming to protect into account. In particular, NTAs should be larger than the home range of key species.

- Only 3 of the existing 18 MPAs (Appendix 1) are large enough (>5km maximum linear distance) to protect most of the key fish and invertebrate species identified in Appendix 2 (except sharks and manta rays): And Biosphere Reserve, Minto Reef Marine Sanctuary and Oroluk Marine Sanctuary.
- The other 15 MPAs are currently too small to protect most key fish species. However they are likely to have benefits for other species that don't move as far e.g. small grouper, surgeonfishes and parrotfish species, and most key species of invertebrates (e.g. sea cucumbers, trochus, giant clams that don't move or move very far, except mangrove crabs and lobsters that may move further).

Some recommendations for consideration regarding MPA design

- Maintain 3 large MPAs at And Biosphere Reserve, Minto Reef Marine Sanctuary and Oroluk Marine Sanctuary.
- Consider options for expanding existing NTAs to at least 3-5km across (or surrounding them with wider areas that limit the take of wide ranging species).
- Consider redesigning the MPA network to have few, larger NTAs.
- Consider establishing MPAs that include mangroves, seagrasses and coral reefs to allow for movement patterns of some species.
- Species that are not protected within MPAs will need to be protected using other fisheries management approaches e.g. State-wide legislation to protect wide ranging species such as sharks, manta rays, humphead wrasses and bumphead wrasses; and seasonal closures at spawning times for relevant key fishes and invertebrates.
- For the 3 grouper species that are currently protected during the spawning season in NTAs (e.g. in Kehpara Marine Sanctuary) and by seasonal closures, consider expanding other NTAs to protect them in their home ranges also.

Recommendations to refine supporting information:

- Work with fishermen to understand local knowledge regarding key ecological information for key species and their habitats.
- Change kms to miles on Figures and Tables, and compare distances that fish move and proposed MPA sizes to known distances e.g. the runway or existing MPAs.
- Use posters and supporting documents (Appendix 3) to discuss key ecological issues for consideration regarding MPA design with key stakeholders (governments, fishermen and communities).

Presentation: PAN Design Case studies from the Philippines

By Dr. Rebecca Weeks, JCU

Dr. Rebecca Weeks presented a case study from the Philippines as an example of how socioeconomic design principles and ecological design principles could be used together to redesign or create a PAN system. In the MPA design they wanted to minimize costs to local fishers and spread costs equitably across communities. She recommended setting targets for socioeconomic activities, rather than

treating them as costs to be avoided which may better engage stakeholders. In this example, when minimizing cost to small-scale fishers as a single stakeholder group some communities would have lost 80% of their fishing grounds. Instead they set fishery targets for each community, so that no community lost more than 13% of their fishing grounds. New MPAs were established in locations where community science-based priorities aligned.

Discussion Socioeconomic targets

Participants split into terrestrial and marine to discuss socioeconomic targets. Below is summary of main points from each group's discussion

Marine Group

- Comment: Identifying fishing spots and how to ensure everyone has access. An example would be the Nett resource management through the guidance of a CAP, whereby fishing sites that are pressured by fishermen are recognized and management measures are set up to address such issues.
- Most fishermen already understand that fish populations are declining. For fishing methods, the mentality behind them not shifting to other methods is that they don't want to shift or stop using current methods if other fishing families or communities are going not going to do the same.
- Night time spear fishing was recognized as an unsustainable method of fishing.
- Fishing pressures are so high, according to findings of Dr. Rhodes, Pohnpeians fish above the bio-capacity level of reef ecosystems.
- Given that some people rely only on night time fishing as their only fish method that serve to provide income, how can we help those people?
- We should explore alternative sources of income. How?
- In regards to alternative sources of income generation, we can explore ways to align efforts with agencies such as SPC's efforts in other areas that are working.
- Livelihood is very important; we do this work because of people. So it's important to improve the effectiveness of our efforts in a way that recognizes the need of the people.
- It's important to review lessons learned from the past and utilize these lessons as ways forward.
- A good way to address night time fishing is to allow all types of fishing methods and only ban night time spear fishing; this means hook and lines and other methods can still be used.

- The Marine Advisory Council a.k.a. Meninketengensed suggested that this new effort and approach to be brought into the communities. It is important for communities to have a sense of ownership when it comes to resource management.
- There are available information i.e. posters/brochures/etc. that can be made available for outreach programs to be taken out into the communities.
- There's a need for TNC/CSP/Other agencies to make awareness materials ready to be taken into the communities.
- It's also important to learn from the communities first before taking to awareness into their communities.
- It must be realized that nighttime fishing is one of the major factors behind fish population decline.
- Fish price in Pohnpei since 20 years ago has remained the same at about $1.00/lb but gas prices have changed or increased in recent decade. So there's an imbalance between the two.
- Communities have different attitudes towards MPAs and fisheries management, some are not supportive, and of those that are supportive, some favor MPAs whilst others prefer different management strategies.

Terrestrial Group

<u>What:</u>

- Veggie gardens pretty much everywhere there are people. But lots of veggies are also imported!
- Sakau
- Chickens run free and everyone has pigs
- Coconut trees are harvested for soap and oils, but no one mentioned that there were large scale coconut plantations
- Mangroves are harvested for building materials
- No commercial timber
- Deer, wild pigs, and birds are hunted

<u>Where</u>

- Sakau is planted and harvested at all altitudes
- "Sei Pepper" farm down on south side of island
- New coffee plantation

- There is a push to get pig farms/pens to use “dry litter”

Disputes

- Land disputes near Watershed Forest Reserve boundary
- Watershed boundary is only complete in U, Madolenhmw and Sokehs municipalities
- There is some interest to Zone the Watershed with more restrictive rules for sub-watersheds
- Permits are required to utilize and harvest from watershed, but sounds like this is not respected as well as it should be

Cultural and historic sites are scattered throughout the island with mixed levels of significance

Bottom line was that everyone agreed there is a need for best management practices on public lands and rivers. It’s not so much about more protected areas, but rather just better management

Wrap up, Next Steps and Closing of Workshop

Eugene Joseph, Executive Director of CSP, gave a final wrap up of the conference. Then the group discussed next steps. They agreed to create a presentation summarizing the workshop to present back to the Marine Advisory Council, the Locally Managed Marine Area Committee and the Watershed Alliance. Participants plan to form a committee and get trained in how do better provide communities with the information regarding PA design. The committee will then work with the communities to get their support for refining the Pohnpei state PAN.

Appendix 1. Participant List

NAME	AGENCY
Yuper Soram	Community Conservation Officer Nanwap
Motoichy Hebel	Community member
Angel Jonathan	Conservation Society of Pohnpei
Angel Jonathen	Conservation Society of Pohnpei
Eugene Joseph	Conservation Society of Pohnpei
Francisca S. Obispo	Conservation Society of Pohnpei
Hectory Victor II	Conservation Society of Pohnpei
Kesdy-Ray Ladore	Conservation Society of Pohnpei
Kirino Olpet	Conservation Society of Pohnpei
Mary Linda Salvador	Conservation Society of Pohnpei
Rudy Andreas	Conservation Society of Pohnpei
Selino Maxin	Conservation Society of Pohnpei
Banly Lucios	Department of Land and Natural Resources
Delma Henry	Department of Land and Natural Resources
Douglas Nelber	Department of Land and Natural Resources
Wallet Elias	Department of Land and Natural Resources
Valentine Santiago	Division of Forestry
Dave Mathias	FSM R&D
Francisca T. Sohl	Marine Advisory Council
Gabriel Spencer	Marine Advisory Council
Pedrus Primo	Marine Advisory Council
Romeo P. Walter	OEA - Nanwap Chairman
Rommy Rapo Walter	OEA Nan Wap
Mike Helgenberger	Office of Fisheries and Aquaculture
Chris LaFranchi	One Reef
John E. Brody	One Reef
Surech Hideyos	One Reef Micronesia Program
Mike Chipen	PNI LMMA Executive Committee
Fenno Brunken	SPC-GIZ CCCPIR
Nate Peterson	The Nature Conservancy
Alison Green	The Nature Conservancy
Bill Raynor	The Nature Conservancy
Mike Aulerio	The Nature Conservancy
Nate Peterson	The Nature Conservancy
Rebecca Weeks	The Nature Conservancy
Arlene Rosencrans	USDA - NRCS
Emilio Eperiam	WKSNC Inc. (community group)

Appendix 2. Agenda

Agenda

Pohnpei Protected Areas Network Design Workshop

June 18-20 2014

Venue: AG's Conference Room

Workshop Objectives

(1) Refine Goals for Network
(2) Clarify scope of study
(3) Agree on network design principles
(4) Assess data needs to complete design and available data layers

Wednesday, June 18 (Context) Objectives: All participants understand purpose of workshop and objectives of PAN redesign process, and to learn from experiences elsewhere in Micronesia, the Pacific and beyond.			
9:00 – 9:30 am	Workshop purpose and participants introductions	Eugene, Governor Ehsa, Liz Terk	
9:30 – 10:15	History of PAN and previous GAP analysis	Nate Peterson	Previous plans that have been developed for FSM and Pohnpei State, and the strengths and weaknesses of those processes/products.
10:15-10:30	Break		
10:30 – 12:00	Why invest in protected area design	Eugene Joseph	Discussion about why we need a PAN design, to make sure everyone is on the same page, and for people to start thinking about the goals for the Pohnpei PAN
12:00 – 1:00	Lunch		
1:00 – 2:00	PAN goals	Liz Terk	Deciding what the *general* goals are for the PAN. What do you want your PAN to do for you?
2:00 – 3:00	Systematic conservation planning – approaches to PAN design	Rebecca Weeks	Key concepts in systematic conservation planning, stages in the process
3:00 -3:15	Break		

3:15-4:00	PAN redesign in Palau process in Palau	Steven Victor	
Thursday, June 19 Objectives: Define broad ecological goals, features, threats and biophysical design principles for the PAN; and identify key data layers			
9:00 -9:15	Recap of Day 1	Eugene	Summary of goal statements
9:15 – 10:30	Biodiversity features and threats	Rebecca Facilitated plenary discussion	List specific features that need to be considered and identify threats to them
10:30 – 10:45	Break		
10:45-12:00	Latest scientific advice for designing MPAs	Alison	Presentation and open discussion: Refine biophysical design principles to achieve goals/objectives biophysical design principles for MPAs
12:00 – 1:00	Lunch		
1:00 – 2:30	Developing specific design criteria and targets for Pohnpei PAN	Breakout groups based on marine / terrestrial / species / habitats or whatever natural divisions arise from features identified and no. participants Alison Green	For each feature, discuss how best to specify objective (% target, design criteria or other), discuss data available (Nate & Mike roam) and potential surrogates. Marine groups to consider zones
2.30 – 2.45	Break		Notes prepared for next session
2.45 – 4:45	Ecological objectives, targets and design criteria review	Plenary feedback / agreement	Identify data gaps and process to fill data gaps
4:45-5:00	Wrap up		
Friday, June 20th Objectives: Define broad socioeconomic goals, features, threats and design principles for the PAN; and identify key data layers			
9:00 -9:15	Recap of DAY 2		
9:15-10.00	PAN Design Case studies from Fiji and Philippines	Rebecca Weeks	Examples of other PA network design processes
10:00 – 10:15	Break		
10:15 -11:00	Refining socioeconomic and cultural goals	Liz	Facilitated discussion
11.00 – 12:00	Develop specific design and process criteria for Pohnpei	Rebecca (break out marine and terrestrial?)	

12:00 -1:00	Lunch		
1:00 – 2:30	Socioeconomic and cultural data	Nate and Mike	Discussion on what are negative and positive cost layers for analysis, how to consider socioeconomic factors, sites to lock in and out.
2:30 – 2:45	Break	Alison Green	
2:45 -3:45	Designing MPA networks for important fish species in Pohnpei		Example of how MPA design criteria can be determined for particular species.
3:45	Review/ Wrap up	Eugene/ Liz	Next steps/ plan

Appendix 3. Summary of Principles to be used in PAN redesign

ECOLOGICAL DESIGN PRINCIPLES	RATIONALE	APPLICATION
1. Representation:		
Including 30% of each nearshore marine habitat [1] and 20% of each terrestrial habitat type [2] in protected areas	Since different species use different habitats, protection of all plants and animals and the maintenance of ecosystem health, integrity and resilience can only be achieved if adequate examples of each habitat are protected. Ensuring that all habitat types are represented in the PAN will also provide protection for species for which spatial data are not available	30% representation target for all marine habitat features [1] Minimum 20% representation target for terrestrial habitat features [2]
2. Risk Spreading:		
Include examples of each habitat type within each municipality	This minimizes the risk that all examples of a habitat will be adversely impacted by the same disturbance. Including examples from each municipality will also capture any differences in habitat or species composition in different parts of the main island, and on atolls.	Stratify habitat features by municipal boundaries
3. Protecting Critical, Special and Unique Areas:		

Fish spawning aggregation sites	When animals aggregate they are particularly vulnerable and often, the reasons they aggregate are crucial to the maintenance of their populations. Therefore the main sites where they aggregate must be protected to help maintain and restore populations	Include in PAN as:
Kehpara Palikir Pass Mwand Pass Nanwap Nanwap nearshore		Year-round no take Seasonal protection Year-round no take 100% keep protected Seasonal protection
Nursery areas for key fisheries species	It is important to protect the range of habitats that species use throughout their lives, particularly areas that they use during critical life history phases (nursery areas, fish spawning aggregations and migration corridors among them)	30% representation target for mangroves (critical nursery habitat for fish species)
Important fishery species [3]	Key objective of PAN is to ensure sustainability of key fishery species, and livelihoods dependent upon those species. Therefore the PAN must be designed to incorporate critical habitats for these species.	Representation targets for key habitats [3]; where MPAs are not large enough, supplement with other fisheries management approaches
Key habitats for endemic and locally important species: Wetlands Mangroves Palm forest	Identified as critical habitats that play an important role in ecosystem functioning or are unique to Pohnpei.	20% representation of palm forest habitat; 30% representation target for mangroves; 20% representation of palm forest habitat, with 100% within WFR
Special, unique, endemic and locally important	Key objective of PAN to protect special and unique species of local	Feature specific targets

species [4]	and cultural value	
4. Adapting to Changes in Climate:		
Prioritising for protection mangrove areas that have room for landward expansion / range shift	This will minimise the risk of mangrove loss due to sea level rise, associated with climate change and already observed in Pohnpei.	Use Digital Elevation Model to identify mangroves with room to move, and preferentially include these when meeting representation targets

5. Incorporating Connectivity:		
Using best available information on movement patterns of important fishery species [3] to determine the size, spacing and location of no-take marine protected areas.	To be effective, marine reserves must be large enough to sustain target species within their boundaries. Spacing reserves to allow for connectivity among populations helps maintain fish stocks, diversity and builds ecosystem resilience by ensuring that marine reserves are mutually replenishing to facilitate recovery after disturbance.	Use information on movement patterns of important fishery species [3] to set design criteria for minimum MPA sizes
Protect key habitats used by focal species throughout their lives (e.g. mangroves, coral reefs and seagrass) and ensure PAs are spaced to allow for movements among them	Some species use different habitats for foraging and resting, or during different life history stages. To protect thes especies effectively, all habitats that they use much be included in the PAN.	Included in habitat representation targets above.
Prioritise for protection wetlands, mangroves and marine habitats that are downstream of rivers with good water quality	Poor water quality may have adverse impacts on the ecological quality of ecosystems downstream. Ideally, high quality habitats should be protected, as these are more likely to support healthy and diverse ecological communities	Identify habitats that are downstream of watershed with water quality rated as "safe for recreation", and preferentially include these when meeting representation targets
6. Allowing Time for Recovery:		
Implement year-round MPAs, except where identified as seasonal closures to protect vulnerable life history stages (e.g. spawning) of key fishery	Benefits of improved ecosystem function and fisheries productivity can be quickly lost when marine reserves revert back to open access	Include in management plans for MPAs

species.		
RECOMMENDATION (not discussed) Ensure protected areas are in place for the long-term (20-40 years), preferably permanently	Long-term protection allows the entire range of species and habitats to recover, then maintain, ecosystem health and associated benefits.	Include in management plans for MPAs
7. Minimizing and Avoiding Local Threats:		
Include examples of marine habitats distant from river mouths, as these are less likely to be impacted by local threats (e.g., land based runoff)	Areas that have not been impacted by stressors such as land based runoff, pollution, and other damaging human uses are likely to be more resilient to climate change and contribute more, and more quickly, to ecosystem health	Identify habitats that are likely to be free from terrestrial influence and preferentially include these when meeting representation targets
Watersheds with intact primary vegetation and good water quality	These areas are likely to have fewer local threats, and are more likely to support healthy ecological communities that include special and unique species (e.g. endemics)	Identify habitats that are downstream of watershed with water quality rated as "safe for recreation", and preferentially include these when meeting representation targets
Include proposed and existing protected areas (where these are well designed and effectively managed)	Since it takes time for MPAs to improve ecosystem health, it is usually advantageous to include existing effective MPAs within a network. Existing terrestrial areas are	Use existing and proposed PAs as the basis for future planning and prioritization

	likely to have fewer local threats.	
Integrate PAs with complementary management strategies outside of protected areas	PAs are most likely to be effective when embedded within a broader management framework which considers the entire ecosystem	Integrate spatial planning recommendations into broader policy

[1] Marine habitat types: (modified Millennium Reefs data)

- Oceanic atoll
  - forereef
  - inner slope
  - lagoon pinnacle
  - pass
  - reef flat
  - ridge and fossil crest
  - subtidal reef flat
- Oceanic island
  - bay exposed fringing
  - diffuse fringing
  - enclosed basin
  - forereef
  - pass
  - pinnacle

[2] Terrestrial habitat types (modified USFS land cover data, stratified by municipality)

- Mangroves
- Palm Forest
- Upland Forest*
- Wetlands
- Atoll islands

[3] Important fishery species

- Rabbitfishes, e.g. Pwoarin Mwomw S. doliatus
- Arong - Jacks and Trevallies
- Mwomw Mei - Hipposcarus longiceps
- Kemeik - Bolbometopon muricatum
- Ah -Mullet
- Merer - Cheilinus undulatus
- Sopwou - Ophiocara porocephala
- Kihs - Octopus
- Lipwei - bivalve sp.
- Kopil - bivalve sp.
- Pahsu - giant clam
- Masaht - land crab
- Loangon - elephant trunk fish
- Penpen - st. species (sea cucumber)
- Werer - Pohnpei Speg (sea cucumber)
- Sumwumw – trochus

[4] Special, unique, endemic and locally important species	**Target**
Kedei palm	100% target for known location, 20% representation of palm forest habitat (including 100% of palm forest within WFR)
Parem palm	30% representation target for mangrove habitat
Ivory tree (oahs)	20% representation of palm forest habitat (including 100% of palm forest within WFR)
Pohnpei partula snails	100% target for known location
Plants with cultural significance / medicinal uses	Representation target for 20% terrestrial habitat types
Siei - Pohnpei mountain starling	100%, enforce WFR, clarify no hunting
Seabirds	100% target for important nesting islands
Wehi - Turtle	Include nesting sites at Ant Atoll and Pakin in PAN; seasonal protection for turtles
Pehwehwe - Manta ray	State-wide legislation, consider known manta ray sites as opportunities for tourism
Pako - Shark	Representation targets for key habitats (reef, mangrove), State-wide legislation
Elimoang - mangrove crab	30% representation target for mangrove habitat
Coconut Crabs	
Uronna – lobster	Catch limits, no take of berried
Sting rays	Protect nursery grounds / aggregation sites

Appendix 4. References

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