

PACIFIC ISLANDS FISHERIES SCIENCE CENTER



A Summary of the Marianas Trench Marine
National Monument and Mariana Archipelago
Ecosystem Science Implementation Workshop
Saipan, CNMI
May 21-22, 2013

Eric Breuer
Samantha Brooke
Risa Oram
Eric Cruz
Michael Trianni

September 2014



Administrative Report H-15-03

doi:10.7289/V5GX48H9

About this report

Pacific Islands Fisheries Science Center Administrative Reports are issued to promptly disseminate scientific and technical information to marine resource managers, scientists, and the general public. Their contents cover a range of topics, including biological and economic research, stock assessment, trends in fisheries, and other subjects. Administrative Reports typically have not been reviewed outside the Center. As such, they are considered informal publications. The material presented in Administrative Reports may later be published in the formal scientific literature after more rigorous verification, editing, and peer review.

Other publications are free to cite Administrative Reports as they wish provided the informal nature of the contents is clearly indicated and proper credit is given to the author(s).

Administrative Reports may be cited as follows:

Breuer, E., Brooke, S., Oram, R., Cruz, E., and Trianni, M., 2015. A Summary of the Marianas Trench Marine National Monument and Mariana Archipelago Ecosystem Science Implementation Workshop Saipan, CNMI May 21-22, 2013. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96818-5007. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-15-03, 35 p. doi:10.7289/V5GX48H9

For further information direct inquiries to

Chief, Scientific Information Services
Pacific Islands Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
1845 Wasp Boulevard
Bldg 176
Honolulu, Hawaii 96818-5007

Phone: 808-725-5386
Fax: 808-725-5532

Pacific Islands Fisheries Science Center
Administrative Report H-15-03

doi:10.7289/V5GX48H9

A Summary of the Marianas Trench Marine
National Monument and Mariana Archipelago
Ecosystem Science Implementation Workshop
Saipan, CNMI
May 21-22, 2013

Eric Breuer¹, Samantha Brooke², Risa Oram¹, Eric Cruz³ Michael Trianni⁴

¹Pacific Islands Fisheries Science Center
National Marine Fisheries Service
1845 Wasp Boulevard
Bldg 176
Honolulu, Hawaii 96818

²Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Boulevard
Bldg 176
Honolulu, Hawaii 96818

³Pacific Islands Fisheries Science Center
National Marine Fisheries Service
Guam Field Office
P. O. Box 315488
Tamuning, Guam 96814

⁴Pacific Islands Fisheries Science Center
National Marine Fisheries Service
Saipan Field Office, Yoon Bldg
Saipan, MPU 69650

September 2014

CONTENTS

INTRODUCTION	1
MATERIALS AND METHODS.....	1
DISCUSSION.....	3
RESULTS	19
SUMMARY/CONCLUSION	21
APPENDIX A.....	A-1
APPENDIX B	B-1
APPENDIX C	C-1

INTRODUCTION

A 2-day workshop was held in Garapan, Saipan, to gain insight from the Commonwealth of the Northern Mariana Islands (CNMI) and Guam researchers and managers on marine research needs within the Marianas Archipelago for consideration as NOAA Fisheries develops its science and management plans. More than 30 individuals representing a broad spectrum of organizations attended. Following a series of presentations, participants identified key research topics that could be implemented in the next 3 to 5 years. NOAA Fisheries will incorporate this information into a Mariana Archipelago marine research action plan.

This report summarizes the outcomes of the 2-day workshop. Common themes include the need to conduct broad-scale studies of life history and connectivity to understand regional biodiversity; develop ways to conduct long-term monitoring; develop collaborative Geographical Information System (GIS) mapping products that include habitat types, human uses, species distributions, and other data; and to improve systems for storing and sharing information. Many topics highlighted the need to collect a broader array of data at an enhanced frequency in the Islands Unit Overall; an emphasis was placed on collaborative research activities and building capacity within the Marianas Archipelago, particularly through engagement with fishermen. Underlying notes were to examine and incorporate underutilized and volunteer data sources and to ensure that collected data are analyzed and shared.

MATERIALS AND METHODS

From May 21 to May 22, 2013, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) convened a 2-day workshop in Garapan, Saipan, CNMI. The workshop focused on formulating a 5-year research implementation strategy (2014–2019) to 1) address knowledge gaps identified in the Marianas Trench Marine National Monument (MTMNM) Ecosystem Science Plan, and 2) contribute to existing baseline data on the linkages between biological, geophysical, and human components of the Mariana Archipelago Ecosystem (including the Marianas Trench Marine National Monument).

NOAA Fisheries Pacific Islands Fisheries Science Center (PIFSC) and Pacific Islands Regional Office (PIRO) staff planned the workshop in consultation with a committee of scientists and resource managers from the Guam and CNMI government and academia. Eric Breuer (NOAA Fisheries PIFSC) served as the Workshop Chair.

Planning Committee members included:

- Jason Biggs, University of Guam
- Eric Breuer, NMFS, Pacific Islands Fisheries Science Center
- Samantha Brooke, NMFS, Pacific Island Regional Office
- Eric Cruz, NMFS Pacific Islands Fisheries Science Center (Guam office)
- Michael Gawel, National Park Service
- Steven Johnson, CNMI Department of Environmental Quality
- Todd Miller, CNMI Department of Fisheries and Wildlife
- Risa Oram, NMFS, Pacific Islands Fisheries Science Center
- Michael Tenorio, CNMI Department of Fisheries and Wildlife
- Michael Trianni, NMFS, Pacific Islands Fisheries Science Center (CNMI office)

The 2013 workshop aimed to identify research aligned with NOAA Fisheries core focus areas: 1) maximizing the sustainability of fisheries and fishing communities; 2) recovering and conserving protected species; and 3) habitat processes. With this in mind, the planning committee identified the following subtopics for discussion: mapping, historical and current human usage, trans-boundary species, fisheries resources, benthic environment, and latitudinal gradients. The planning committee identified subject matter experts and asked them to deliver brief (15-minute) presentations focused on the current state of knowledge, data gaps, and research needs (see Appendix A—Workshop Agenda).

This document is a report-out on the workshop itself, summarizing presentations, discussion, and potential research needs. Next, NOAA Fisheries will incorporate this information into a Mariana Archipelago marine research action plan for 2014–2019. These steps are being taken to fulfill NOAA’s mandates in the region, including the Magnuson-Stevens Act, Endangered Species Act, Marine Mammal Protection Act, and Presidential Proclamation 8335, which established the Marianas Trench Marine National Monument in 2009 and which calls for the establishment “of a program to assess and promote monument-related scientific research and exploration.”

The workshop included the following activities:

- Two plenary talks;
- Fourteen presentations by regional subject matter experts (http://www.pifsc.noaa.gov/media/news/mariana_archipelago_ecosystem_science_implementation_plan_workshop.php);
- Open discussion on research priorities and knowledge gaps;
- Identification of viable research strategies to address gaps and priorities; and
- Identification, discussion and evaluation of ecosystem monitoring and observation activities.

NOAA Fisheries would like to thank all of the participants who took time out of their schedules to attend and contribute to this meeting. More than 30 people representing Guam and CNMI natural resource agencies, the University of Guam and Northern Mariana College, the Western Pacific Fishery Management Council, the Mariana Trench Management Advisory Committee, the Guam Fishermen’s Cooperative, NOAA, and other scientists and stakeholders attended the meeting. Unfortunately, as a result of resource limitations, several key individuals who could have provided insight on their area of expertise were unable to attend. However, remote connections were made available to NOAA staff in Honolulu and interested parties elsewhere (via webinar and teleconferencing). Regrettably, the remote links were not optimal, and other options are being explored for future meetings. A full list of participants is provided in Appendix 2.

Following the 2-day workshop, a 1-day session was held to discuss proposed research projects to be conducted using the NOAA Ship *Oscar Elton Sette* (scheduled for a Mariana Archipelago Fisheries Insular Survey Research Trip late spring 2014).

DISCUSSION

DISCLAIMER: Summaries of presentations given at the workshop reflect the view of the presenter only; all presentations and discussions do not necessarily represent the opinions or positions of the Department of Commerce, NOAA or NOAA Fisheries.

Opening Plenary Talk: Results of Human Dimensions Monument-related Research
Dawn Kotowicz (Senior Social Research Project Manager, Joint Institute of Marine and Atmospheric Research /NOAA Affiliate)

After a brief introduction to the MTMNM and the Human Dimensions Program, the results of the 2011–2012 NOAA Fisheries phone survey of Guam and CNMI on Monument awareness and management preferences were presented. In total, 100 residents living in Guam and CNMI were interviewed. Many participants had heard of the Monument, but knew little to nothing about its purpose. Most participants strongly supported the Monument after learning more about the Proclamation and potential activities. Fishing households expressed stronger opinions than non-fishing households on many Monument-related issues.

Results of the recent NOAA Fisheries assessment of traditional fishing patterns in the Northern Marianas Islands (Monument Islands Unit) were also presented. Note: throughout the report, the term “Northern Mariana Islands” is used to indicate the islands in CNMI north of Saipan, while the term “islands unit” is used to refer to the three northern islands that are part of the MTMNM. The assessment collected 32 oral histories from 40 people, including fishermen, individuals with personal/familial connections to the northern islands, boat owners, researchers, and government officials. Overall, trips to the northern islands were rare; when they occurred, they were multi-purpose in nature and almost always included fishing. Fish that were caught were sold, shared, and consumed – they were important culturally, socially, and commercially. Trips to the northern

islands were said to help maintain cultural connections, and the Islands have high existence value to interviewees.

Information from the two studies is being used to develop guidelines for traditional indigenous fishing, and to help inform Monument science and management. A short video is also being produced.

More information on these studies is available at: www.pifsc.noaa.gov/human_dimensions/index.php

Opening Plenary Talk: Discussion—This section captures the main points and questions raised during and immediately following the plenary presentation. Bullet points show comments/ideas by one or more participants and do not necessarily reflect group consensus.

- Audience members requested clarification on the methods used to determine how participants' attitudes towards the Monument changed after learning more information about it. It was clarified that the survey measured the participants' views during the course of the survey itself. Participants were asked if they had heard of the Monument at the beginning of the survey. If they had heard about it, they were asked for their level of support or opposition to it. Then they were asked a variety of questions, through which we learned a little about the types of management concerns that were being considered for the management plan. Then at the end of the survey, all respondents (those who had heard of it before and those who hadn't) were asked about their level of support or opposition. Survey methods are included in the PIFSC data report which is currently awaiting internal review.
- Audience members also noted that changing circumstances (e.g., a recent proposal by the U.S. military for use of Pagan Island for live-fire and training and exercises) might change the priorities of survey participants when asked about Monument activities.

Workshop Day 1

Welcome by Secretary Palacios

The workshop opened with a welcome from Arnold Palacios, Secretary of CNMI Department of Land and Natural Resources. First, Secretary Palacios recognized NOAA Pacific Islands Fisheries Science Center Director Samuel Pooley for his leadership. He expressed his appreciation that now NOAA off-island officials are now working to engage public participation in CNMI through workshops and meetings on the various islands. He acknowledged the goal of the workshop and emphasized the importance of cultural and human dimension of the indigenous people of the CNMI. Director Palacios also expressed his belief that the indigenous people have responsibly carried out good marine stewardship in the CNMI, and that the people of CNMI should be co-managers in regional science and decision making. To conclude, Director Palacios noted that CNMI is coordinating governmental agency communication toward the management and preservation of the CNMI's marine ecosystems, and emphasized his hope that the U.S. federal government be forthcoming, particularly, from the U.S. Department of Interior and the

U.S. Department of Defense with regards to major military and training for the islands of Tinian and Pagan.

Workshop Overview

Following this welcome, the workshop chair (Eric Breuer) provided an overview of the workshop. He assured the audience of NOAA Fisheries' commitment to partnership in the sciences between NOAA and the communities of the Marianas Archipelago, calling attention to discussions on scientific research and exploration of the Marianas Archipelago Ecosystem including the Marianas Trench Marine National Monument. Mr. Breuer requested that workshop participants think about research needs during the workshop presentations, and to share these ideas, either during the discussion session, writing on the post-it pads provided, or contacting him directly after the workshop.

Session 1

Setting the Stage

Mapping the Marianas

Rob O'Conner

NOAA Fisheries PIRO, Habitat Conservation Division (HCD))¹

A variety of GIS data products are available from NOAA Fisheries, including bathymetry, nautical charts, marine managed area boundaries, regulatory boundaries, Essential Fish Habitat (EFH) maps, and survey data from the Coral Reef Ecosystem Division (CRED). At this time, 63% of the MTMNM has been mapped at high resolution with boat-based sonar. GIS mapping products are developed to assist HCD work with the military (e.g., Guam and CNMI military relocation; relocating marines from Okinawa, Japan, to Guam – commonly referred to as the “Guam build-up”), protected species, reef resiliency (Saipan), and the Army Corps of Engineers permit applications. Map products are available at: www.fpir.noaa.gov/HCD/hcd_mapping.html.

What are All Those People doing in the Ecosystem?

Judy Amesbury

Micronesian Archeological Research Services

Humans have inhabited the Marianas Archipelago for at least 3,500 years (3,000 years before Magellan arrived in 1521). A history of the population changes and historic and current fishing activities on the various Northern Marianas Islands was provided; this information can be found in “CNMI as a Fishing Community.”² Archeological surveys in Guam and CNMI have uncovered jabbing hooks and gorges made of shell and bone, as well as spear tips made from human bone. However, little archeological research has occurred in the northern islands. In 1937, Ichiro Yawata documented latte sites on the islands of Pagan, Agrihan, and Alamagan. In 1972–1973, Egami and Saito excavated at one of Yawata's latte sites on Pagan. Their earliest radio carbon

¹ Note that speaker biographies are provided in Appendix C.

² www.pifsc.noaa.gov/library/pubs/tech/NOAA_Tech_Memo_PIFSC_36.pdf

(RC) date was about AD 1300. In 2008, Steve Athens found abundant latte features on Pagan and Surigan. His earliest RC date from Pagan was also about AD 1300.

Additional field and archival research is needed to improve our understanding of the islands' historic usages.

The Future of Fisheries

Manny Duenes

Guam Fishermen's Cooperative

Subsistence and recreational fisheries continue to decline in part due to commercial fishing and industrialization (loss of access to fishing grounds), increasing operational costs, demographics, new entrants into the fishery, loss of traditional strategies, and expansion of competing marine usages. Conflicts occur between marine resources user groups. Fishermen should be included by NOAA as part of a collaborative research process, from development of research strategies through analysis. Fishermen have local knowledge and experience, and are willing to share these with researchers. Additionally, the community should drive the research agenda and benefit from scientific research. Scientific research can benefit the community by increasing or enhancing productivity, determining sustainable fishing limits, and by identifying ecological threats and developing solutions to address them.

Discussion

This section captures the main points and questions raised during and immediately following Session 1 presentations. Bullet points show comments/ideas by or one more participants and do not necessarily reflect group consensus.

Mapping the Monuments

- Clarification was requested on what types of maps were available for the Monument (referencing the 63% of the Monument being mapped); it was explained that the maps are multi-beam, high-resolution bathymetric data maps (0–5 m resolution).
- Audience members asked whether NOAA Fisheries worked with anyone in CNMI when developing GIS products (e.g., were CNMI and Guam natural resource agencies involved). R. O'Conner replied that he responds to mapping requests primarily from within the NOAA Fisheries Pacific Region, but that he is willing and interested in working with CNMI and Guam resource agencies to develop mapping products.
- Interest was also expressed in the development of GIS maps that would include human uses (military activities, fishing, etc.). The group noted that adding additional human use information may require access to additional information sources (beyond what NOAA Fisheries currently has available, such as military or agricultural data sets³).

³ NOAA's Pacific Services Center produces *Coastal-Change Analysis Program* or C-CAP data, which classifies land use, including agricultural uses.

- One participant noted that “sometimes the unknown is better left unknown;” referring to a concern that when people learn about resources in an area, they will want to utilize them.

What are All Those People doing in the Ecosystem?

- Clarification on the source material for archival research was requested; J. Amesbury identified 20 volumes of material (compiled by Levesque) that could serve as a starting point.
- A participant noted that history repeated itself in respect to the northern islands’ habitations, removals, re-inhabitations, depopulation, etc.

The Future of Fisheries

- The need for two-way communication (between researchers and the community) was highlighted. However, achieving this communication can be difficult and sometimes requires extra efforts to reach out to individuals and gain their trust. The importance of being clear about planning/agenda in these conversations was noted.

Trans-boundary Species

Highly Migratory Species

Eric Breuer, NOAA Fisheries PIFSC

“Highly Migratory Species” (HMS) was defined to include tunas and tuna-like species, billfish, and sharks. A presenter on highly migratory species was not available to attend the workshop and discuss the state of knowledge. Instead, the group engaged in a conversation on research gaps summarized in the Session 2 discussion section.

Cetacean Research in the Mariana Archipelago

Erin Oleson, NOAA Fisheries PIFSC

The goal of NOAA Fisheries’ cetacean program’s research is to understand what species are present, where, and when. Twenty-eight species of cetaceans are known to occur in the western Pacific. Of these, 20 are known to occur in the Mariana Archipelago. To date, NOAA Fisheries cetacean survey efforts have focused on the southern Mariana Islands and have been primarily coastal due to weather and boat-size constraints. The most commonly encountered species has been the Spinner dolphin, which does not appear to have resident island populations as occurs in Hawai’i. NOAA Fisheries has also placed two acoustic recorders in the Marianas Archipelago, which have recorded several beaked whale species. Potential threats to cetaceans in the region include increasing naval activities (e.g., sonar, island and near-shore bombing, beach landings, etc.), contaminants (from military use, former garment factories, etc.), and entanglement and hooking in fishing gear. NOAA Fisheries will conduct its next cetacean survey of the Mariana Archipelago in summer 2014.

Monitoring of Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata*) Sea Turtles in the Commonwealth of the Northern Marianas Islands

Tammy Summers, NOAA Contractor

From 2006 to 2013, the DLNR sea turtle program monitoring efforts have focused on the near-shore waters and beaches of Saipan, but rapid assessments were also accomplished on the neighboring islands of Tinian and Rota. To date, the bulk of DLNR data concerning turtles has been collected from the southern arc islands, while that for the northern arc islands has been negligible. Historically, throughout the region, tow or transect, cliff-side, and beach rapid assessments were used to estimate numbers, species, and size classes. Since 2006, however, DLNR has maintained a long-term capture-mark-recapture program for turtles in CNMI near-shore waters and beaches to assess the basic ecology of their foraging and nesting populations. Additionally in 2011, DLNR was able to monitor the migratory routes of their nesting population with the donation of 3 satellite transmitters from NOAA Fisheries PIFSC. Size distribution, growth rate, diet, habitat utilization, behavior, and site fidelity of the green and hawksbill turtles in the study suggest near-shore waters of CNMI provide important developmental habitat for immature turtles. Preliminary satellite telemetry results suggest that CNMI's nesting turtle population are not resident but instead migrate from/to distant foraging grounds. From data collected during morning, night, and nearshore surveys and from stranded turtles, the program has found that the greatest current threat to CNMI foraging and nesting populations is direct harvest of turtles and eggs.

Discussion

This section captures the main points and questions raised during and immediately following Session 2 presentations. Bullet points show comments/ideas by one or more participants and do not necessarily reflect group consensus.

Highly Migratory Species

- Participants agreed that tagging studies that focus on more than one species are needed.
- Concern over the impacts of Fish Aggregating Devices (FADs) on reefs (e.g., FADs snagging on the reef) and creating artificial environments affecting local fishing spots was expressed; it was stated that no recovery plan for the FADs exists.
- Increasing coastal shark populations resulting from the removal of prey species and the discarding of live sharks was cited as a concern. This was linked to the need to examine marine ecosystems as a whole rather than just study a single commercially important species.
- A suggestion was made to mirror the tagging study on species of Hawaiian jacks.

Cetaceans Research in the Marianas Archipelago

- Collaborative research opportunities with the cetacean research program were discussed: previously, the program has invited CNMI and Guam scientists and managers to participate. Requests were made to provide opportunities for fishermen and teachers to

join the cetacean researchers; E. Oleson agreed to follow-up. She also noted that talks are given at the local schools when the researchers are in the region.

- It was noted that the NOAA Fisheries hopes to deploy satellite tags during its 2014 research trip, which may provide insight as to movement patterns in the northern islands.
- It was also noted that the University of Hawai'i (UH) has 4 acoustic recorders in the area, but that the data has not been analyzed for cetaceans.
- Voluntary/other data collection programs (Guam Fishermen's Co-op, Guam Division of Aquatic and Wildlife Resources, DAWR, lists interactions with cetaceans in their data and the Guam aerial survey inshore since 1989 records marine mammal strandings) were identified that may be an additional source of information for the cetacean program. The cetacean program will meet with representatives from these programs to discuss their utility to NOAA (likely while in region for 2014 summer survey).
- Usage of the data was also a concern; some participants felt that the data could be used to justify setting aside more area for protection, which might interfere with resident's access. It was highlighted that establishing protected areas was not the intent of the program, however, researchers cannot control how their data are used (government data are public). E. Oleson also noted that the data is used to develop mitigation measures to address potential threats.

Monitoring of Green and Hawksbill Sea Turtles in the Commonwealth of the Northern Marianas Islands Turtles

- Participants discussed traditional harvest. The speaker highlighted the small number of nesting turtles the research team has observed in the CNMI and stated that given these low levels, they believed any take would not be sustainable. Sea turtles remain listed and protected under the Endangered Species Act (ESA), which prohibits harvest.
- Concerns that the human dimensions were not being considered in research and management of sea turtles were expressed by some audience members (e.g., traditional practices). Some research in this area has been completed by M. McCoy and others and includes suggestions in how the traditional navigational culture could be drawn on to also integrate turtles and communities. The WPFMC also held a 2011 Saipan Turtle Management Meeting that discussed these issues; however, no final report is available.
- Comparisons with Hawaii's green turtle population were made; although care must be given between drawing direct comparisons as sea turtle ecology, relative threats, and management capacity are different between these two areas. A global green turtle status review is currently ongoing that may likely consider application of the Distinct Population Segment policy.
- More information on habitat usage and migration patterns of different age classes of turtles in NMI is needed. Workshop participants reported seeing many turtles in the water, although current genetic research indicates that NMI supports a mixed stock of foraging turtles that originate from rookeries that do not nest in the MNI.
- Some workshop participants felt that the data collection was too limited, focusing only on the more accessible areas —e.g., islands of Tinian, Rota, and Saipan (although some

work was done by Kolinski on island farther north in the chain). These areas are also where some of the greatest threats to turtles exist (i.e., coastal development and harvest).

- Differences between the CNMI population migration patterns and the Hawai'i population's migration patterns were noted; particularly that post-nesting turtles traverse the high seas to international areas, through and potentially into regions where they are not protected via the U.S. ESA.

Session 3

Fishery Resources

Reef Fishes in the Mariana Islands

Terry Donaldson, University of Guam Marine Laboratory

Currently, more than 1048 species of inshore marine, estuarine and freshwater species have been identified in the Marianas Islands. Data sources include the University of Guam Marine Laboratory collections (late 1960s to present), CNMI Division of Fish & Wildlife, NOAA Fisheries PIFSC CRED, Bar Code of Life fish sampling project in Guam, and CNMI (University of Guam and other collaborators, funded by NOAA Fisheries). Threats to reef fish include over-exploitation, natural habitat destruction and loss, volcanic eruptions, earthquakes, typhoons, crown-of-thorns, disease, anthropogenic habitat destruction or loss, ocean warming and acidification through anthropogenic climate change, pollution, poor land-use practices, and destructive fishing. Several Marine Protected Areas (MPAs) have been put in place to protect reef fish (CNMI/Guam and federal); however, these MPAs will only be effective if they protect areas of importance to the life cycles of reef fishes and/or help mitigate threats.

CNMI commercial bottomfish fishery

Trey Dunn, CNMI Division of Fish and Wildlife (DFW)

Ninety percent of the CNMI fisheries data collected comes from Saipan, the most populous island with the greatest level of both nearshore and offshore (bottomfish and pelagic) fishing activity. Overall, bottomfishing is a small proportion of the total fishing activities for CNMI. Onaga and mafute are the most common species landed. Data sources include the CNMI's DFW northern islands bottomfish data and the DFW-WPacFIN commercial purchase receipt system. The DFW has been collecting commercial fishing data since the mid-1970s. From 1995 to 2002, the DFW sampled bottomfish vessels returning from the northern islands. Over time, participation in the bottomfish fishery "pulsed"; currently, participation is low. The number of trips was high from 1983 through 1989 as a result of consistent fishing activity centered on the island of Farallon de Medinilla (FDM). This fishery subsequently largely ceased, resulting in a drop in bottomfish trips in the early 1990s. Vessels capable of landing large amounts of onaga are usually larger, fishing the northern islands. The difficulty of maintaining the equipment, vessel, and crew to consistently and routinely conduct these trips successfully appears to be difficult in the long term for fishermen in the CNMI. Bottomfishes are not commanding the high prices they once did, and local buyers seem to increasingly prefer reef fishes.

Fishery Resources of Guam

Brent Tibbatts, Guam Department of Agriculture, Division of Aquatic and Wildlife Resources

Data from the 2007 economic evaluation of Guam's coral reef resources showed that 35% of Guam's residents consider themselves to be fishermen. Guam fishery data has been collected since the 1960s and has been collected in a standardized format since 1982 (for the boat-based fisheries targeting pelagic, reef, and deep-water species) and 1985 (for the shore-based fisheries targeting reef species and freshwater species). More than 400 species are listed in the DAWR catch database. The accessibility of Guam's reefs increases the potential for human impact.

Invertebrate Fisheries in the CNMI

Mike Tenorio, CNMI Division of Fish and Wildlife (DFW)

Invertebrate species commonly harvested for the markets include lobster, octopus, and squid. Lobster is the primary crustacean fishery; however, data are not captured accurately by market surveys. Harvest occurs mainly at night (via spears). Several sporadic invertebrate fisheries have occurred for sea cucumbers, deep-water shrimp, and trochus. In general, information on invertebrate fisheries in the CNMI is limited with much of the data having been collected from collaborations, with a particular focus on commercial fisheries. Subsistence harvest also occurs for these and other species, but it is not captured in current data collection efforts.

Discussion

This section captures the main points and questions raised during and immediately following Session 3 presentations. Bullet points show comments/ideas by one or more participants and do not necessarily reflect group consensus.

Reef Fishes in the Mariana Islands

- Participants agreed there is an overall lack of information on spawning aggregation sites and biodiversity (especially in the deeper habitats and offshore reefs). A better understanding of spawning areas, distribution, as well as connectivity for reef fish, is needed.
- Identification of habitats used by multiple species was recommended.
- Collaboration at an international level, such as research previously conducted with the Chiba Institute (Japan) was encouraged by several participants.

CNMI Commercial Bottomfish Fishery

- The (current) primary area of fishing activity for bottomfish was clarified to be nearshore (for mafute), and also around FDM.
- It was noted that all data shared during the presentation are available at: <http://www.pifsc.noaa.gov/wpacfin/>

Commercial Fishery Resources of Guam

- It was noted that the challenges to fishery participation (e.g., weather) affect catch statistics. During the past year, many more weather/small craft advisories were issued for Guam. This could be an important socioeconomic indicator to track.
- The data sources referenced during the presentation were identified as being available on the above WPacFIN website; in addition, it was confirmed that the data came primarily from creel surveys.

Invertebrate Fisheries in the CNMI

- Participants asked where the deep-water shrimp fishery occurred; an area was not provided because the fishery depends on “secret spots” – smooth-bottom habitat (it is a trap fishery). While the fishery ended in the mid-1990s, DFW representatives believed it would likely start up again if prices are good.
- It was noted that limited data are collected on fisheries that are not commercially important, and that data collection often ceases if participation in a fishery is low.

General Discussion

- The group discussed whether regional fisheries would be affected by climate change. One participant noted that the season for some species is already different from some participants’ previous experiences (although whether this was a temporary or permanent shift was unknown). Studies of temperature shifts are being done by Guam DAWR; the El Niño phenomenon is particularly well-documented. T. Donaldson mentioned ongoing research with Dr. Patrick Colin of Palau regarding changes in spawning aggregations as ocean temperatures changes.
- The aquarium trade was also mentioned; participants agreed that it is not a large industry, although it is difficult to monitor individuals. Companies’ harvests are documented and inspected.

Workshop Day 2

The workshop opened with a summary of the research needs shared during the previous day and then moved directly into Session 4. The workshop chair highlighted the previous’ days suggestions to be culturally sensitive, increase data sets, develop collaborative, multilayer GIS maps, promote international collaboration and sharing of data, and to tap into voluntary data collection programs.

Session 4

Benthic Environment

NOAA Fisheries PIFSC CRED Reef Assessment and Monitoring Activities in the Marianas Archipelago

Roberto Venegas, Research Oceanographer/Data Analyst, Joint Institute of Marine and Atmospheric Research / NOAA Affiliate

The NOAA Fisheries PIFSC Coral Reef Ecosystem Division’s (CRED) mission is to provide scientific information about the status of coral reef ecosystems of the U.S. Pacific islands to the public, resource managers, and policy-makers on archipelago, regional, national, and international levels. CRED conducts benthic habitat mapping, oceanography, benthic assessment, fish assessment, and marine debris assessment & removal. CRED has conducted research in the Mariana Archipelago since 2003, on a biannual basis (although it is likely to

occur on a triennial schedule in the future, due to resource limitations). CRED's sixth cruise of the Marianas Islands is scheduled for 2014. Results of CRED research in the Mariana Archipelago are documented in a report available from: www.pifsc.noaa.gov/library/pubs/SP-10-002.pdf.

Non-target Invertebrates

John Furey, Ecologist, Asia Pacific Academy of Science, Education and Environmental Management

Over the past 10 years, research work on intertidal and subtidal invertebrate biodiversity studies has been carried out by Mr. Furey and a team of scientists and senior college students of Brigham Young University, Hawai'i, led by Biology Department Chair Dr. Roger Goodwill, Mr. Furey's main science co-researcher and project lead. The studies have all occurred under proper permits and results are regularly reported to DFW and DLNR, including an annually growing photographic binder. Images of identified species are also posted on the www.apaseem.org website. The reason for initiating the work came from discussions held with DFW Fisheries staff wherein it was learned that DFW staff were prohibited from working on non-sportfish species based on their federal grant requirements. The talk also shared research on a species of sea anemone unusual in its symbiotic association with living gastropods. The anemone species, *Neoaipiasia morbilla*, was later determined to be new to science. The team published their findings and methods in the regional University of Guam scientific publication *Micronesica*. The sea anemone was first found and documented to occur in the waters off Managaha Island, before the area was designated a Marine Protected Area.

Discussion

This section captures the main points and questions raised during and immediately following Session 4 presentations. Bullet points show comments/ideas by one or more participants and do not necessarily reflect group consensus.

NOAA Fisheries PIFSC CRED Reef Assessment and Monitoring Activities in the Marianas Archipelago

- Participants asked whether marine mammal or turtle observations were recorded during CRED towboard surveys. R. Venegas clarified that these used to be recorded but are no longer.
- Concern was raised over the lack of resources for marine debris removal in the Marianas Islands. University of Guam representatives stated that they had applied for this funding from NOAA, but never received an award.
- Ship groundings are also a concern; a clear mechanism for removal is not always in place.

- Availability of and coordination with PacIOOS data sets was mentioned; CRED is looking to collaborate and load their data into the PacIOOS system⁴, which is available online.
- The depth of temperature recorders planned for deployment on the 2014 CRED cruise was requested: they will be placed at intervals 1–30 m.
- The methodology of the REAs was discussed.
- The development of Essential Fish Habitat (EFH) if corals are listed was raised as a concern, particularly when primary stressors are not well understood.

Non-Target Invertebrates

- Participants recommended continuation of biodiversity studies; the lack of information on invertebrates was highlighted.
- Recommendations were made to further study coral as a habitat.
- Support/coordination with Dr. Richard Randall's upcoming seminal publication on corals and reef ecosystems of the Mariana Islands was recommended.
- It was noted that the research needed to identify many invertebrates primarily occurs at night. NOAA has a dive policy that does not allow for night diving, which restricts their ability to conduct this type of research.
- Research is needed for all the islands in the Marianas Archipelago—research so far has been limited to nearshore waters of Saipan, Tinian, Rota, and Guam.
- It was noted that sea anemones are consumed as food traditionally.
- An invitation was made to participate in APASEEM's annual November conference (Call for presentations sent out in July each year).

General

- Precious corals were discussed; harvest of deep-water/precious corals in the CNMI is prohibited by CNMI law. However, some participants felt that they are extracted from within CNMI waters, despite these regulations.
- Some discussion on algae also occurred. Algae were initially included as an agenda item, but the regional expert was unavailable to attend the meeting. The need to better understand nutrient cycles, patterns of algae blooms, and the relationship to land usages was highlighted.

⁴ PacIOOS is 1 of 11 regional observing programs in the United States that is supporting the emergence of the U.S. Integrated Ocean Observing System (IOOS®) under the National Oceanographic Partnership Program (NOPP). See <http://oos.soest.hawaii.edu/pacioos/about/> for more information.

Session 5

Latitudinal Gradients

Latitudinal Gradients in Physical and Biological Characteristics along the Mariana Archipelago
Todd Miller, CNMI Department of Land and Natural Resources, Division of Fisheries and Wildlife

Latitudinal gradients are found in both the ocean's physical (climate, currents, sea surface temperature) and biological (primary productivity, community structure) realms. They also occur in patterns of species richness, herbivory and food web structure, fish growth, and life history strategies. For example, there is a greater variation in precipitation with latitude along the NMI Archipelago; primary productivity (e.g., chlorophyll-*a*) also increases with latitude. Seasonal and spatial dynamics and inter-annual variability also play a role. The Marianas Islands also has the potential for a "mid-domain" effect of increased species richness due to their position in the middle of the latitude extremes. However, when apparent latitudinal gradients are observed, it is difficult to determine the cause due to autocorrelations of latitude, temperature, area, energy/production and mid-point distance (mid-domain).

UOG Experimental Program to Stimulate Competitive Research (EPSCoR) Grant
Jason Biggs, University of Guam

Information on the EPSCoR grant program can be found on the National Science Foundation website <http://www.nsf.gov/od/iaa/programs/epscor/about.jsp>. The University of Guam is in the process of applying for an EPSCoR grant to establish a Micronesian Center for Biodiversity, Ecosystem Sustainability, and Technology (MACBEST). The facility would serve as a world-class physical and cyber warehouse of Micronesian biodiversity. The focus of this EPSCoR research would be to define what types of aquatic ecosystems exist in Micronesia and the ecological services they provide in an effort to truly ascertain their economic value, as well as to predict the sustainability of these systems. The EPSCoR grant provides financial support for research and salaries, in addition to funding to build new facilities and acquire research tools (e.g., vessels). This project is necessary to emphasize and preserve local knowledge; to address the underestimation of Micronesian biodiversity; and to analyze marine organisms for potential medicinal uses.

Discussion

This section captures the main points and questions raised during and immediately following Session 5 presentations. Bullet points show comments/ideas by one or more participants and do not necessarily reflect group consensus.

Latitudinal Gradients in Physical and Biological Characteristics along the Mariana Archipelago

- When scientists go to the northern islands, they are able to gather only a snapshot of information. Longer- term data sets of classical fisheries science information are needed.

- There are fishermen coming in with catch from the northern islands; working with them would provide an additional data stream, although there may be some adaptations to sampling methods necessary so that catch remains in a saleable condition.
- A concern over whether latitudinal gradients in diversity were masked by the overall high biodiversity of the region was expressed. A suggestion was made to develop a consistent variable/measure to address this (such as land area or age of island).
- Surface patterns may not match deep-ocean or vent patterns; it was noted that deep-water environments are more stable as far as temperature, although studies have demonstrated some changes.
- The need to study human impacts on the marine environment was raised, including the potential for climate change impacts; it is unclear how climate change would affect diversity in the region.
- The group agreed that the Archipelago provided an excellent system to conduct studies on latitudinal gradients.
- A study by T. Donaldson was highlighted; it indicated that fish diversity decreases as you travel north in the Archipelago, and the habitat types available also change. However, fish in higher trophic levels that are present in the northern islands are larger in average size in comparison to the southern islands, although this had not been established for fish in lower trophic levels.
- The need for a PacIOOS buoy in the region was highlighted.

UOG EPSCoR Grant

- The status of the EPSCoR grant was clarified: it has not been finalized; regional partnerships are being explored, especially between Guam and CNMI scientists on archipelago-wide studies.
- The need to understand what is currently present in the region, to evaluate the impacts of climate change, species invasion, etc. was noted. This is also important in order to communicate the value of these ecosystems to the world.
- There was discussion on the lack of acceptance/trust of local knowledge in the outside world. Videos were identified as a good means of establishing credibility.
- The ability of cultural resiliency to increase sustainability was noted (e.g., response to 1997 typhoon, where Guam community came together).
- The need to include indigenous students in research was identified.
- It was noted that more work needs to be done to document pre-contact Chamorro fishing technologies.
- Finer-scale habitat studies were identified as a research need, as were studies of genetic connectivity (e.g., which islands are sources/sinks).

- A recent study on algae was highlighted as a reason to support research on genetics; what was initially believed to be just a few species was determined to be nearly 20 species based on genetic work.

RESULTS

Table 1.—Session 1 Research Needs.

Session 1: Research Needs
<ul style="list-style-type: none">• GIS maps that include layers of human usages (including DOD information if available) and habitats.• Additional archaeology in the northern islands to better understand the timing and nature of human habitation.• Conduct research on the Pre-historic Period occupation of the northern islands (what did they eat? When did people arrive?)• Archival research to improve understanding about the use of the northern islands during the Historic Period.• Increased opportunities for collaborative research with the fishing community (such as by including individuals from Guam, CNMI and northern islands in research so they in turn can share with the community).• Benthic habitat mapping.• Research to benefit the community; asking for cooperation (including enhancing fishery productivity, determining sustainable catch levels based on recruitment, and taking steps to address ecological threats).• Identify any underutilized or unutilized data sources.

Table 2.—Session 2 Research Needs.

Session 2: Research Needs
<ul style="list-style-type: none"> • Improve understanding of the impact of FADS on Mariana Archipelago pelagic ecosystems. • Tagging studies that include both commercially targeted and non-targeted HMS species, including a study to track incidents of shark predation on fishermen’s boats; this information could then be used to develop an expanded tagging study that would use fishermen to catch and tag the sharks. • Studies of cetacean and sea turtle occurrence in the northern islands, including the Monument Islands Unit. • Studies of cetacean and sea turtle habitat associations. • Large-scale cetacean abundance surveys in good weather. • Information on the impact of naval activities (current activities and formerly used site, including potential contaminants) to cetaceans and sea turtles. • Collaborative research opportunities that include fishermen. • Evaluation of potential marine mammal and sea turtle entanglement/interaction threats from fishing gear in the region. • A review of existing voluntary/other data collection programs for useful information on cetaceans. • Rapid nearshore capture-mark-recapture assessments of sea turtles at the northern end of the NMI chain to obtain genetic samples and information on size compositions, growth rates, diet, threats, etc. • Deployment of satellite transmitters equipped with time/depth recorders on northern NMI arc island turtles (> 70 cm SCL) to track dive behavior and movements (potential collaborations with Kyle Van Houtan (NOAA Fisheries PIFSC). • Mapping of benthic habitat use (immature population) and migratory pathways (adult population) for northern NMI arc island sea turtles. • Human dimension studies of the CNMI population’s understanding of basic sea turtle biology and laws governing their protection to guide education outreach efforts for adults. • Support/increase research and management partnerships at an international level for sea turtle populations that use both CNMI waters and the waters of other countries.

Table 3.—Session 3 Research Needs.

Session 3: Research Needs
<ul style="list-style-type: none"> • Continue support of the Bar Code of (Fish) Life. • Studies of cryptic species, deep reef, shallow sea mount, and nearshore pelagic fish species diversity. • Conduct more shallow-water sampling (16-30 ft). • An elasmobranch survey and network analysis of behavior. • Development of GIS maps of habitat and microhabitat distribution and utilization. • Fine-scale diversity inventories of offshore reefs. • Studies that consider the geography of rarity vs. commonality in relation to biodiversity conservation. • Identification of spawning aggregations, distribution, characterization, and function. • Examination of the reproductive dynamics of spawning aggregation species. • Studies on connectivity at local and archipelago-wide scales. • Collection of more information on the life history of reef fish species. • CNMI and Guam have biosampling projects that could be expanded to other areas. • Predictions of extinction vulnerabilities in relation to threats. • Studies examining the impacts to local and regional fishery resources from commercial fisheries and increased fishing pressure. • Conduct stable isotope analysis (to improve understanding of latitudinal gradient understanding and the impact of land-based impact/contaminants). • Develop biomarkers for Napoleon wrasse. • Examination of potential impacts to fisheries from climate change and other meteorological phenomena. • Fisheries valuation study (socioeconomic, CPUE). • Development of monitoring program with companies involved in the invertebrate fishery. • Initiation of a program to assess status of invertebrate resources due to overall lack of information. • Assessments of prevalent invertebrate species being sold in the markets and studies of subsistence harvests (including species that are lesser known traditional food sources, such as anemones). <p>Methodologies: Participants suggested taking advantage of opportunistic sampling opportunities and coordinating sample collection between CNMI and Guam.</p>

Table 4.—Session 4 Research Needs.

Session 4: Research Needs
<ul style="list-style-type: none"> • Confirm presence/absence of potential listed species (endangered proposal). • Understand Maug (photo/chemo synthetic communities). • Coral diversity studies (distribution of potentially listed species?). • Information on diurnal, seasonal, and interannual variability on coral reef biodiversity. • Evaluation of habitat to determine EFH for potential coral listings. • Assessment of deep coral ecosystems (30-100 m). • Improved understanding of reef genetics. • Improved understanding of oceanographic processes and climate-related changes. • Estimates of local nutrients and carbon cycles. • Expanded range of research work on non-target invertebrates to Northern Mariana Islands. • Studies on human land use and its impacts on nutrient cycles.

Table 5.—Session 5 Research Needs.

Session 5: Research Needs
<ul style="list-style-type: none"> • Research focused on potential gradients, including studies of parameters that are temporally integrated measures of some characteristic or processes or measures that do not exhibit high levels of seasonal variation. • Long-term measurements for remote areas (e.g., northern islands) focusing on classical life history data collection (growth aging). • LIDAR for nearshore habitats. • Assessment of the diversity of aquatic organisms of Micronesia, through exhaustive sampling to discover, characterize, and DNA barcode new species. • Habitat surveys to record the physical and chemical demographics influencing community structure (i.e., GPS coordinates, depth, slope, substrate type, temperature, and video transects). • Integrated diversity and habitat information with a repository of biological materials (tissues, genomes, and proteomes) cross-referenced to a virtual library of high-resolution digital photographs, behavioral videos, biometric specimen data, and habitat demographics to maximize scientific and educational impact for the world. • NIST—planning bio-repository to Pacific (collaboration). • Establish a research lab on one of the northern islands (Pagan) to facilitate studies.

SUMMARY/CONCLUSION

Open Discussion

During the open-discussion section, participants were asked to work in small groups to identify in a short bulleted list of what they felt were the most important research needs, based on workshop presentations and discussion. Groups were asked to consider especially those activities that should be conducted in the next 3-5 years. Outputs from each group are shown below.

Several common research themes emerged from the small group exercise, particularly the need to conduct broad-scale studies of life history and connectivity to understand regional biodiversity; develop ways to conduct long-term monitoring (for example, by using advance technology to collect information between research trips), the need to develop collaborative GIS mapping products that include habitat types, human uses, species distributions, and other data; and the need to improve systems for storing and sharing information. For many topics, the fact that limited-to-no data exists for Islands Unit ecosystems (and northern islands), and the need to include these areas in research activities, was highlighted.

A few research topics were raised that had not been included in any presentations or earlier discussions. Overall, an emphasis was placed on collaborative research activities and building capacity within CNMI and Guam, particularly through engagement with fishermen. Underlying notes were to examine and incorporate underutilized and volunteer data sources, and to ensure that data collected are analyzed and shared.

Group 1

- Collection of life-history (age, length) information from all islands throughout the Archipelago to compare to existing data from Saipan and Guam, particularly of reef fish (e.g. mafuti/goatfish, *Lethrinus atkinsoni*) and shallow water bottomfish. When going to other areas, collect data on species that have already been studied in Saipan and Guam, as well as on species of interest for potential future studies.
- Use of the Baited Remote Underwater Video Stations (BRUVS) suggested as one tool to aid in research.
- Conduct tagging studies for multiple species (sharks in particular⁵) and other pelagic species.
- Study shark depredation bottomfish fishing activities: there is a need to understand how often it is happening and how often fishermen come across sharks during fishing activities. Additionally, fishermen could potentially identify shark species. Researchers could accompany the fishermen to get length data and tag with spaghetti tags in order to understand rates of recapture. This research could help to identify areas where additional tagging studies are needed (such as acoustic-tagging studies).

⁵ Note: Northern Marianas College is seeking funding to conduct shark-tagging research.

Group 2

The relationship between these three activities was highlighted: e.g. spawning aggregations and larval dispersal feed the genetic connectivity; habitat species mapping important for understanding why sites are selected for spawning aggregation, as well as potential threats.

- Studies on genetic connectivity, focused on culturally and economically important species (lists of these species to be provided by CNMI and and Guam experts)
- Habitat/species mapping (development of GIS maps)
- Identification of spawning aggregations (areas/times, and species)
- Biodiversity assessment
- Studies of the Maug system, because of the chemosynthetic and photosynthetic organisms coexist there.
- Opportunistic sampling was identified as one potential methodology to conduct these studies; sampling platforms are needed.

Group 3

- Fisheries valuation studies – examining actual economic value to households, protein intake value, and Catch Per Unit Effort (CPUE).
- Data management – sharing cumulative CNMI data from all agencies in a single place.
 - The group highlighted data management as an important focus for the Monument and CNMI/Guam natural resource agencies. Currently, work done in the Monument is shared by PIFSC with CNMI and Guam; however, given the remote nature of the Monument, NOAA Fisheries is not always aware of who is conducting work there. PIFSC is working with the State Department, University-National Oceanographic Laboratory System (UNOLS), and the National Science Foundation (NSF) to understand these activities. It is part of the University of Guam’s mission (and part of the EPSCOR project proposal) to collect and house this data, and there is a movement toward housing data and samples locally, rather than in traditional repositories, such as the Bishop Museum or the Smithsonian. A repository for samples/data collected from the Monument is also needed.
- The use of advanced technology is important, especially given the difficulty in conducting research in the northern islands (e.g., distance, cost). NOAA Fisheries PIFSC CRED currently has a wave buoy at each island and is partnering with PacIOOS to distribute this information; this is currently a CRED activity. Partnerships with Northern Marianas College and University of Guam are also needed (grant writing, collaborative research). NOAA’s Office of Atmospheric Research (OAR) is planning to place smart buoys in the region, and this data should be accessible to regional partners. As discussed previously, other organizations, such as Woods Hole Oceanographic Institute and Scripps, are also placing instrumentation in the area. Overall, those conducting research in the region should be identified and encouraged to share data.

- Improved coordination between PIFSC scientists, NOAA Fisheries contractors, and other scientists in the Guam DAWR and CNMI DLNR/DAFW on research and management (such as sea turtle satellite tagging projects), including allowing permitted researchers on NOAA vessels to catch turtles to conduct in-water sampling of turtles. Expanded DNA sampling and flipper tagging projects are also recommended.⁶
- Coral diversity studies
- Human dimensions surveys, specifically surveying people about topics such as the role of sea turtles in CNMI/Guam cultural and general historical knowledge of the northern islands uses.

Group 4

- Collection of fish life-history data (e.g., length, weight, age) from reef fish to determine growth rates across different areas. Needs include more shallow water sampling (30-60 ft using scuba and spear).
- Analytical studies (genetics and stable isotopes):
 - Using molecular methods such as microsatellites of target fish species, examine the connectivity of island populations along the Mariana Archipelago. Particular focus on those species that already have microsatellite probes developed (these can be the same species used for life history studies)⁷.
 - Examine persistent organic pollutants (POPs) in fish.
 - Conduct nutrient pollution studies of nearshore reefs (CNMI DFW continue/expand deployment of sediment traps on CNMI; many years of data available for Guam from University of Guam).
 - Communicate with potentially interested research partners to facilitate sample collection.
- LiDAR mapping
- Macro-invertebrate inventories (both conspicuous and cryptic), especially in the rocky intertidal areas, nearshore shallows, and in the black sand beaches.
- Confirm the occurrence of potentially listed coral species in the northern islands, and better understand their distribution.
- Development of a Monument Visitor's Center which includes research facilities.

⁶ Note that while funding is provided for these projects by NOAA, the research is carried out by the respective wildlife agencies.

⁷ The Napoleon or humphead wrasse was identified as one fish species that lacked genetic markers. This species is being reviewed for listing under the ESA (see http://www.fpir.noaa.gov/PRD/prd_humpheadwrasse.html for more information). Several individuals expressed interest in a project that would develop these markers. It was noted that obtaining a distribution of ages is important. Between 30 and 100 individual samples would be needed from each site. These samples would not need to be lethal (fin clips).

Group 5

- Building capacity within the Archipelago through each research project and program by including children, adults, and researchers. Fishermen should be included in planning and conducting research, where applicable, as they have experience that can improve projects.
- Archeology and archival work for the northern islands. Steve Athens worked in the northern islands of Pagan and Surigan in 2008. For his next study, the islands of Asunción, Agrehan, and Alamagan are targeted. The length of time needed on land is flexible. While on island, the goals would be to locate middens, which would help researchers understand which fish were targeted as food species. Additionally, there is a need to date human occupation. To date, only artifacts from the Latte period (approximately CE 800 – CE 1700) have been found, but evidence is still needed to reveal whether occupation began earlier.
- Multi-species tagging program targeting primarily species of concern—not just potentially listed or listed ESA species (e.g., Napoleon wrasse and sea turtles), but also sharks, reef, bottomfish and pelagics) (prioritized in that order), so that patterns of movement can be understood. Working with the fishers to catch and tag these species is recommended.
- Connectivity of fish from offshore banks to main islands. An example provided was the area between the Galves Bank seamount that drops to 1000 ft and serves as a “highway” for fish between southern Guam and the bank.
- Continue bio-sampling and complete analysis (e.g. size frequency, aging of otoliths) on collected samples.
- Include the Western and Central Pacific Fisheries Management Council’s (WCPFMC) 5-year cooperative research plan into NOAA Fisheries PIFSC’s science planning, as it has already been vetted with the community and WCPFMC working groups.
- Provide solutions for addressing ecological threats. One example was given from American Samoa where cold water was pumped onto bleached coral, and the coral recovered in 24 hours. As second example were sediment trap studies in Guam, and the need to use this data to address a known problem.

Closing Plenary: First Voyage to the Marianas Trench Marine National Monument (*Ken Kramer, President, APASEEM*)—Ken Kramer provided an introduction to the recently released video “First Voyage to the Marianas Trench Marine National Monument.” The video was produced by the Asian Pacific Academy of Science, Education, and Environmental Management (www.apaseem.org). It documents the trip of a group of scientists, managers, and students aboard the *Lady Carolina*, as they travel to the Islands Unit of the MTMNM shortly after its designation. The video also features interviews with Robert Ballard, Ph.D., Laura Bush, Jim Quick, Ph.D., Barry Stieglitz, Peter Houk, Ph.D., Heidi Hirsh, and Genevieve S. Cabrera. This video can be viewed at: www.youtube.com/watch?v=kU_XeCMBNCE

ACKNOWLEDGMENTS

We would like to thank the following people for their support in helping to make sure this workshop happened. DLNR Director Arnold Palacios, CRM Director Rita Chong-De La Cruz, DEQ Director Frank Rabauliman, members of the planning committee (Jason Biggs, Mike Gawel, Michael Tenorio, Todd Miller and Steven Johnson), the Pacific Islands Regional Office for providing funding, John and Eloise Furey and the plenary speakers Dawn Kotowicz and Ken Kramer.

APPENDIX A—WORKSHOP AGENDA



NOAA FISHERIES
Pacific Islands Fisheries Science Center

AGENDA

Mariana Archipelago Ecosystem Science Implementation Planning Workshop 2013

TUESDAY, MAY 21 – WORKSHOP DAY 1 – FIESTA RESORT, AZUCENA 2

8:00 – 8:15 am	Welcome and introduction	Arnold Palacios
8:15 – 8:30 am	Overview of workshop process	Eric Breuer
8:30 – 10:30 am	SESSION 1: Setting the Stage	
8:30 – 8:45 am	Mapping the Marianas	Rob O’Conner
8:45 – 9:00 am	Human Dimensions: Current and Historical	Judy Amesbury
9:00 – 9:15 am	The Future of Fisheries	Manny Duenes
9:15 – 10:30 am	PANEL 1 Q&A	Panel Members
10:30 – 10:45 am	Break	
10:45 – 12:30 am	SESSION 2: Transboundary Species	
10:45 – 11:00 am	Highly Migratory Species	Eric Breuer
11:00 – 11:15 am	Cetaceans	Erin Oleson
11:15 – 11:30 pm	Turtles	Tammy Summers
11:30 – 12:30 am	PANEL 2 Q&A	Panel Members
12:30 – 1:30 pm	Lunch (on your own-local area)	
1:30 – 3:30 pm	SESSION 3: Fishery Resources	
1:30 – 1:45 pm	Reef Fish	Terry Donaldson
1:45 – 2:00 pm	CNMI Commercial Bottomfish Fisheries	Trey Dunn
2:00 – 2:15 pm	Fisheries Resources around Guam	Brent Tiabbats
2:15 – 2:30 pm	Invertebrates	Mike Tenorio
2:30 – 3:30 pm	PANEL 3 Q&A	Panel Members
3:30 – 3:45 pm	Break	
3:45 – 4:30 pm	Public questions and comments	
4:30 – 5:00 pm	Summary and discussion	Eric Breuer
5:00 pm	Adjourn	



Mariana Archipelago Ecosystem Science Implementation Planning Workshop 2013

WEDNESDAY, MAY 22 – WORKSHOP DAY 2 – FIESTA RESORT, AZUCENA 2

8:00 – 8:30 am	Overview of Day 1 outcomes	Eric Breuer
8:30 – 10:30 am	SESSION 4: Benthic Environment	
8:30 – 8:45 am	Coral	Roberto Venegas
8:45 – 9:00 am	Other invertebrates	John Furey
9:00 – 10:30 am	PANEL 4 Q&A	Panel Members
10:30 – 10:45 pm	Break	
10:45 – 12:30 pm	SESSION 5: Latitudinal Gradients	
10:45 – 11:05 am	Latitudinal Gradients: Ecology, Climate, and Oceanography	Todd Miller
11:05 – 11:20 am	Experimental Program to Stimulate Competitive Research (EPSCoR) Grant	Jason Biggs
11:20 – 12:30 pm	PANEL 5 Q&A	Panel Members
12:30 – 1:30 pm	Lunch (on your own-local area)	
1:30 – 3:30 pm	Open Discussion and Priorities	Eric Breuer
3:30 – 3:45 pm	Break	
3:45 – 4:30 pm	Public questions and comments	
4:30 – 4:45 pm	Summary and discussion	Eric Breuer
4:45 – 5:00 pm	Next steps	Eric Breuer
5:00 pm	Adjourn	

APPENDIX B—LIST OF PARTICIPANTS

Name	Affiliation	Role
Jerome Alda	NIMO	Participant
Midori Akamine	NOAA Fisheries PIRO Manager, Marine National Monument Program	Participant (HNL)
Judith Amesbury	Micronesian Archeological Research Services, WCPFMC	Presenter, participant
Britta Bacchler	NOAA/DFW	Participant
Jason Biggs	University of Guam	Presenter, participant
Eric Breuer	NOAA Fisheries PIFSC	Workshop Chair
Samantha Brooke	NOAA Fisheries PIRO, Marine National Monuments Program	Workshop support staff
Rita Chong	Administrator, CNMI Coastal Resource Management Office	Participant
Matthew Crane	Northern Mariana College	Participant
Eric Cruz	NOAA Fisheries PIFSC, Guam liaison	
Carl DelaCruz	WCPFMC	Participant
Terry Donaldson	University of Guam	Presenter, participant
Manny Duenes	Guam Fisherman’s Cooperative	Presenter, participant
Trey Dunn	CNMI DFW	Presenter, participant
John Fraser	CNMI DEQ	Participant
John Furey	APASEEM	Presenter, participant
Eloise Furey	Furey and Associates	Note taking
Elizabeth Furey	Furey and Associates	Note taking
John Gourley	Micronesian Environmental Services	Participant
Siri Hakala	NOAA Fisheries PIFSC	Participant (HNL)
Avra Heller	CNMI DEQ	Participant
Marie Hill	NOAA Fisheries PIFSC	Participant (HNL)

Name	Affiliation	Role
Andre Kozij	APASEEM	Participant
Dawn Kotowicz	JIMAR/NOAA Fisheries PIFSC contractor	Presenter
Jared Makaiau	NOAA Fisheries PIRO, Sustainable Fisheries Division	Participant (HNL)
Todd Miller	CNMI DFW	Presenter, participant
Rob O'Connor	NOAA Fisheries PIRO, Habitat Conservation Division	Presenter (HNL)
Jack Ogumoro	WCPFMC	Participant
Erin Oleson	NOAA Fisheries PIFSC	Presenter (HNL)
Dana Okano	NOAA NOS, OCRM	Participant
Risa Oram	NOAA Fisheries PIFSC	Workshop support staff
Arnold Palacios	Director, CNMI DLRN	Presenter, participant
Frank Parrish	NOAA Fisheries PIFSC	Participant (HNL)
Frank Rabauliman	Director, CNMI Division of Environmental Quality	Participant
Ben Sablan	Marianas Trench Monument Advisory Council	Participant
Nori Shoji	NOAA Fisheries PIFSC	Participant (HNL)
Tammy Summers	Contractor/ NOAA Fisheries PIRO (Stationed in Saipan, assisting CNMI DLNR)	Presenter, participant
Tita Taitague	Director of Agriculture, Government of Guam	Participant
Brent Tibbatts	Guam DAWR	Presenter, participant
Mike Trianni	NOAA Fisheries PIFSC, CNMI Liaison	Workshop support staff
Andrew Torres	NOAA Fisheries PIRO, Sustainable Fisheries Division	Participant (HNL)
Roberto Venegas	JIMAR/NOAA Fisheries PIFSC contractor	Presenter

APPENDIX C—SPEAKER BIOGRAPHIES

Eric Breuer (Workshop Coordinator, Facilitator)

After retiring from the U.S. Navy, Eric Breuer obtained a BS in Chemical Oceanography from the University of Washington. This was followed by a MSc in Marine Environmental Science from MSRC SUNY Stony Brook, where he conducted field and laboratory work on diagenetic processes in both deep sea environments. Subsequently, Eric accepted a 3-year position with the Scottish Association for Marine Science (SAMS; <http://www.sams.ac.uk>), where he investigated environmental impact of oil and gas exploration and production on the North Sea seabed and taught marine environmental science for the University of the Highlands and Islands (<http://www.uhi.ac.uk/home/uhi-campuses/sams1>). Eric also conducted research on natural and anthropogenic disturbances in the Arctic, Indian Ocean, Northern Atlantic, North Sea, and Scottish coastal waters. After leaving SAMS, Eric joined NOAA in 2007 as the Program Coordinator for the Ecosystem Observations Program and now as the Pacific Island Fisheries Science Center Science Coordinator for Rose Atoll, Mariana Trench and Pacific Remote Island Marine National Monuments.

Plenary

Dawn Kotowicz

Dawn Kotowicz is a social scientist with NOAA Fisheries' Pacific Islands Fisheries Science Center in Honolulu, Hawai'i. She has recently conducted research in Guam and Saipan documenting trips to the area now known as the Islands Unit of the Marianas Trench Marine National Monument and managed a project to assess public perceptions about Monument management preferences. She has a PhD in Marine Affairs from the University of Rhode Island and, in addition to the Pacific Islands Region, has worked with communities on coastal and marine issues internationally, in Thailand, the Philippines, the Caribbean and domestically, in the northeastern United States.

Session 1

Robert O'Conner

Robert O'Conner earned his undergraduate degree in Geography with an emphasis on GIS at the University of Hawai'i at Mānoa in 2002. He has worked at the NOAA Fisheries Pacific Island Regional Office as a Fishery Information Specialist and GIS

Coordinator since 2003. Robert deals with a wide variety of GIS data sets including Essential Fish Habitat, Critical Habitat, Marine Managed Areas, International Fishing Boundaries as well as Bathymetry Data Collection and Processing.

Judy Amesbury

Judith R. Amesbury is an archaeologist with Micronesian Archaeological Research Services, Guam. She has been doing archaeology on Guam, Saipan, Tinian, and Rota for 25 years. Her area of expertise is the analysis of shell artifacts and faunal remains, particularly fish bones and invertebrate remains. She is the author of numerous papers and reports on marine resource use from the prehistoric period to the present in the Mariana Islands.

Manny Duenes

Manny is the president of the Guam Fishermen's Cooperative Association for nearly 20 years. The Cooperative is made up of all facets of the fishing community from Fishing Charters to Subsistence Fishers. From 2003 to 2012, he served on the Western Pacific Fishery Management Council as Vice-Chair, including serving 2 years as Council Chair.

Session 2

Erin Olsen

Erin Oleson is the Leader of the Cetacean Research Program at the Pacific Islands Fisheries Science Center. Erin received her Ph.D. from Scripps Institution of Oceanography and now oversees cetacean population assessment research at the Science Center. The CRP has been conducting visual surveys and long-term acoustic monitoring for whales and dolphins in the southern portion of the Marianas Archipelago since 2010.

Tammy Summers

Tammy Summers is currently contracted through NOAA/PIRO and has worked to build capacity within the CNMI DLNR-DFW Sea Turtle Program since 2008. She has studied sea turtles in other National Monuments such as the Papahānaumokuākea and Buck Island Reef, U.S. Virgin Islands.

Session 3

Terry Donaldson

Dr. Terry Donaldson is Associate Professor of Ichthyology at the University of Guam Marine Laboratory. He earned a PhD in Systematics and Evolutionary Biology with a specialization in Ichthyology from the Louisiana State University Museum of Natural Science. His career has included service in government fisheries agencies, conservation NGOs and academia. For more than 30 years he has conducted research on the taxonomy, behavioral ecology, biodiversity and biogeography, and conservation biology of marine, estuarine and insular freshwater fishes in the Indo-Pacific region. His current studies include work on reef-fish spawning aggregations, assemblage diversity and distribution patterns, habitat associations, and extinction risks. He is also collecting samples from the Marianas Archipelago in collaboration with the Fish Barcode of Life project with partial support from NOAA's National Marine Fisheries Service. He is a section editor for the journal *Ichthyological Research* and chairs the Pacific Science Association Coral Reef Working Group.

Trey Dunn

Trey Dunn is a fisheries biologist at the CNMI Division of Fish and Wildlife. He is originally from Georgia and is in his third year in the CNMI. He has been working on underwater visual surveys and the CNMI life history program. He is currently starting an ultrasonic tagging program to monitor habitat use and movement of the Thumbprint Emperor. In his spare time he enjoys fishing on his boat.

Brent Tibbatts

Brent Tibbatts is a fisheries biologist with the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources.

Mike Tenario

Mike Tenario is a fisheries biologist with the CNMI Division of Fish and Wildlife, Fisheries Research Section.

Session 4

Roberto Venegas

Roberto Venegas is an Oceanographer with NOAA Coral Reef Ecosystem Division in Honolulu. He earned a MS in Oceanography from Oregon State University in 2005. His career has included Marine Biology, Ecology, Fisheries and Oceanographic research around the world. His current working is associated to Climate Ocean Change forecasting and the studying of the role of remote sensed physical and biological parameters on coral reef ecosystems at the U.S. Pacific Island region.

John Furey

John Furey is a general ecologist studying tropical island biodiversity and species interactions for both terrestrial and marine habitats with 35 years of field science experience, the vast majority within tropical Pacific Islands. An experienced science educator, environmental planner, and grants manager. Lead author and editor of the textbook *Island Ecology and Resource Management: Commonwealth of the Northern Mariana Islands*. John is a founding member of APASEEM—the CNMI’s principal nonprofit/non-advocacy professional science organization. Current interests span from planning for a marine mammals' skeletal display; monitoring international migratory shorebirds; and documenting potentially new-to-science cryptic marine invertebrates.

Session 5

Todd Miller

Since August 2012, Todd has been the Supervisor of the Fisheries Research Section for the Division of Fish and Wildlife, Commonwealth of the Northern Mariana Islands. He received PhD in Fisheries Oceanography at Oregon State University in 2006. Prior to his current position he was a Visiting Professor in Japan from 2008 to 2012 where he worked on marine food webs in Japan, the Philippines, Vietnam, South Africa, and Namibia.

Jason Biggs

Jason Biggs, *Familian Pedan*, earned his PhD in Pharmacology & Toxicology from the University of Utah in 2005, and joined the University of Guam as the first Chamorro tenure-track faculty at the University of Guam Marine Laboratory in 2008. Jason now uses his training in “drugs and poisons” not only to discover new medicines from our unique ocean resources, but also to study the how pollution and climate change affect coral reef organisms by treating them as the patients. Jason has had a variety of experiences after earning his PhD, including Molluscan DNA-Barcoder and Cone Snail Chemical Ecologist for the Museum of Natural History in Paris; Forensics consultant for the New Jersey State Police Department; Scientific Advisor for the Governor of Guam; UOG Sea Grant Facilitator; and has co-authored a book to develop Marianas-

centric educational programs designed to foster student interest in marine science and environmental studies.