

Guam  
 Year  
 Of the  
 Reef  
 2008  
 Our Reefs, Our Future

Guam  
 Coral Reef  
 Symposium  
 April 19, 2008





## Guam Coral Reef Symposium Schedule

- 9:30-10:00**      **Welcome and Introduction**
- Introduction: Overview of Guam's Reef Resources and Threats
- 10:00 - 10:55**      **Land Based Source of Pollution**
- Developing a GIS-Based Soil Erosion Potential Model of the Ugum Watershed
  - The Impact of Ordot Dump on the Heavy Metal Status of Sediments and Biota in the Lonfit River and Pago Bay
  - An Evaluation of the Bioindicator Potential of the Soft Coral, *Sinularia polydactyla*, for Monitoring PCB Contaminants in Guam's Coastal Waters
  - Nutrient Fluxes Across Guam's Reef Flats
- 11:00 - Noon**      **Fisheries Management**
- Guam's Marine Preserves
  - Assessment of Algal Abundance, Composition and Chemical Defense on Guam's Reef Flats in Relation to Herbivore Stocks and Nutrients in the Marine Protected Areas (MPAs) of Guam
  - Resident Reef Fish Spawning Aggregation Dynamics
  - Monitoring of Guam's Coral Reefs
- Noon - 1pm**      **Lunch Break / Poster Session**
- 1:00-1:45**      **Recreational Misuse and Overuse**
- Impacts of Recreational Misuse
  - Management Actions to Address Recreational Impacts
  - Recreational Divers Can Help Reefs Too!
- 1:50-2:40**      **Coral Bleaching and Disease**
- Indo-Pacific Coral Disease
  - Guam Reefs Show a Link Between Disease Prevalence, the Dominant Genus *Porites* and Temperature
  - Monitoring of Crown-of-Thorns Seastars (*Acanthaster planci*) Around Guam and the Role of Chemical Signals in their Feeding Behavior
  - Effects of Recent Coral Bleaching Events
- 2:45 - 3:35**      **The Human Dimension**
- Guam Coral Reef Economic Valuation
  - Tackling the problem of Lack of Awareness: Education and Outreach Efforts on Guam
  - Conservation Action Planning for the Piti-Asan Watershed
- 3:40-4:00**      **Closing Remarks**
- Status of Guam's Reefs: Current Status and Steps Forward



## **Guam Coral Reef Symposium**

### **Panel 1: Land Based Sources of Pollution**

Presenters: Michael Park, John Jocson, Paulina Welch, and Ernie Matson

#### **Developing a GIS-Based Soil Erosion Potential Model of the Ugum Watershed**

**Dr. Shahram Khosrowpanah<sup>1</sup> and Michael Park<sup>2</sup>**

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WATER & ENVIRONMENTAL RESEARCH INSTITUTE OF THE WESTERN PACIFIC (WERI),  
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Soil erosion is defined as the natural degradation of the landscape over time. The process is initiated when soil particles are disrupted from original configuration by erosive agents such as rainfall and human activities. The soil particles are then transported towards nearby rivers and oceans and can negatively impact the local ecosystem. Current developments in geographic information systems (GIS) allow complex spatial information to be created and analyzed. Special data structures such as a digital elevation model (DEM) present the real world terrain. Hydrological phenomenon such as overland flow and rainfall can be simulated within the GIS. These capabilities make it possible to model a complex process such as soil erosion.

Through a research grant that was funded in part by National Oceanic and Atmospheric Administration (NOAA), the researchers at WERI developed a GIS based soil erosion potential model for the Ugum Watershed. The model combined the Universal Soil Loss Equation (USLE), the GIS, and the DEM for predicting potential soil erosion. The model is capable of identifying the areas of high erosion potential, evaluating the effectiveness of various soil erosion reduction practices, and estimating the sediment yield for an entire watershed. Model development and how it can be used for managing southern Guam watersheds will be presented at this symposium.

# **The Impact of Ordot Dump on the Heavy Metal Status of Sediments and Biota in the Lonfit River and Pago Bay**

**Gary R.W. Denton**

Water and Environmental Research Institute  
University of Guam, Mangilao, Guam 96913

Guam's only civilian landfill has been in continuous use for over 50 years and has been operating at over capacity for the last 20. The western borders of the landfill encroach on wetlands that drain into the Lonfit River. This rather picturesque stream converges with the Sigua River further downstream to form the Pago River, which in turn drains into Pago Bay on the eastern side of the island. Local residents fish all three rivers and the bay for food, and the adjacent lands support a variety of agricultural activities including subsistence farming. The landfill is unlined and does not have a leachate retention system in place. As a result, streams of brown, foul smelling leachate flow intermittently from the dump's perimeter during wet weather conditions and course their way down gradient into the Lonfit River valley below. Past chemical characterization of the leachate indicates that heavy metals are the contaminants of primary concern both from an ecological and human health perspective. This fact has promoted speculation that fisheries resources from these waters are heavy metal enriched to the point of being unfit for human consumption. In light of this, recent chemical analyses of abiotic and biotic components from the rivers and bay were surprising and indicate that local topographic and climatic conditions continually conspire to produce natural cleansing processes that prevent heavy metal accumulation from occurring within the watershed.

## **An Evaluation of the Bioindicator Potential of the Soft Coral, *Sinularia polydactyla*, for Monitoring PCB Contamination in Guam's Coastal Waters**

**Paulina Welch<sup>a</sup>, Gary R.W. Denton<sup>a</sup> and Peter Schupp<sup>b</sup>**

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University of Guam, Mangilao, Guam 96913

Biological indicator organisms are powerful tools that have been used extensively to measure pollutant abundance and bio-availability since the 1970s. They are used to monitor pollution trends, pinpoint sources, and provide early warnings of ecosystem and resource degradation. However, there exists little information about biomonitors suitable for tropical locations. The primary objective of this project was to evaluate the soft coral, *Sinularia polydactyla*, as a bioindicator of PCBs in tropical coastal zones. The qualities of *S. polydactyla* determined in this evaluation were: variation in contaminant accumulation within and among organisms; age, gender and seasonal influences; uptake and loss kinetics; regulation of PCBs; and tolerance to handling and relocation. Sampling and analysis techniques were defined to facilitate consistent and valid monitoring. *S. polydactyla* can potentially be added to PCB monitoring programs in the tropics. The potential gain is a tropical counterpart to the Mussel Watch Project. This project is an exciting pioneer in the little researched area of tropical bioindicators.

## **Nutrient Flux Across Guam's Reef Flats**

**Matson, E. A. and Ngirchechol, M.K.**

University of Guam Marine Laboratory, Mangilao, Guam

Coral reefs are active centers of the fixation of C and N and nutrient transformation, with dissolved nutrients being actively recycled among the water, biomass and sediments. This study analyzes the dynamics of water-borne nitrate, phosphate and silica over several coral reef flats on Guam. The nutrient flux estimates were done with drifting floats, measuring the nutrient content of a parcel of water as it flowed (Lagrangian) across a coral reef flat. Tidal nutrient studies were done at several sites to compare the signal from tides with that from benthic community uptake/release of nutrients. Two types of sites were included in this study: one type with allochthonous aquifer nitrate (northern reefs) and the other with oceanic/riverine nutrient levels (southern reefs). On reefs directly impacted by Guam's northern carbonate aquifer there was net uptake of nitrate while there was net production of phosphate and silica. Interestingly, nutrient levels at sites with oceanic nutrient levels also showed net production rather than uptake. Phosphate (and perhaps Fe) supplies potentially limited net biomass production. Regardless of the levels in and fluxes due to water flow, nutrient levels in the underlying sediments were several orders of magnitude higher and serve as buffer against nutrient depletion in the overlying waters.

For more Information About the Land Based Sources of Pollution Local Action Strategy :

### **Guam Point of Contact**

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### **The Guam Coral Reef Initiative**

<http://www.guamcri.com>

### **Guam Year of the Reef**

<http://www.guamiyor08.com>



## Guam Coral Reef Symposium

### Panel 2: Fisheries Management

Presenters: Jay Gutierrez, Terry Donaldson, Peter Schupp, and Valerie Brown

### Guam's Marine Preserves

#### Jay Gutierrez

Guam Department of Agriculture, Division of Aquatic and Wildlife Resources, Mangilao, Guam

Guam's Marine Preserves have been successful on many levels. Biologists have observed increased fish abundance and diversity in the preserves, residents have commented on the noticeable improvement in the preserves, and local government and business entities have realized the value of these areas.

Guam's marine preserves were created to restore declining fish stocks. Research conducted by the Guam Division of Aquatic and Wildlife Resources (DAWR) has confirmed that limiting fishing in these areas has had a significant effect on species abundance and diversity. The data indicate that after only two years of enforcement, the number of fish along transects in the Piti Bomb Holes and the Achang Reef Flat Preserves increased by over 100% (Gutierrez, 2003). The diversity in the Piti preserve also increased significantly during this time.

Research conducted by Mark Tupper formerly of the University of Guam Marine Lab indicates that the mean densities of four focal species were at least 20% higher (in many cases much higher) in the preserves versus control sites. The four species studied were: *Mulloidichthys flavolineatus*, *Chlorurus sordidus*, *Naso lituratus*, and *Naso unicornis*. In addition to increased density, the researcher documented a shift in the population structure towards larger individuals in the preserve populations of *C. sordidus* and *M. flavolineatus*, suggesting that the preserves are indeed working as an egg bank with higher levels of reproductive potential than nearby control sites (Tupper, in prep). In mark-recapture studies, orangespine surgeonfish (*Naso lituratus*) showed a net spillover of biomass from all three marine preserves studied. The researchers found that the patterns of spillover were strongly influenced by the physical habitat, including headlands, channels, and other topographic features. The researchers also suggested that spillover rates are influenced by the species size and mobility. The findings suggest that MPAs that are physically connected by contiguous reef structures will likely provide more spillover than areas with habitat barriers (Tupper 2007).

The preserves have been recognized not only for their biological success, but also for the social benefits they provide. But it's not just the residents who have noticed these changes, the Guam Visitor's Bureau and local tourism industry have also recognized the benefits of marine preserves and are supporting education and outreach activities. While interest from the tourism industry is important, the Guam Legislature and DAWR realized that it may become necessary to limit recreational uses within the preserve areas. Public Law 27-87 authorized the Department of Agriculture to regulate non-fishing activities within the five marine preserves. This "eco-permitting" will allow DAWR to keep recreational uses within limits compatible with the goal of fisheries restoration. The regulations are currently awaiting final approval.

Guam's Marine Preserves have demonstrated the value of protected areas. They have witnessed not only biological success, but are also valued for their social benefits both to local residents and the tourism industry.

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## **Assessment of algal abundance, composition and chemical defense on Guam reef flats in relation to herbivore stocks and nutrients in marine protected areas (MPAs) of Guam**

**Nick Pioppi<sup>1</sup>, Peter Schupp<sup>1</sup>, Jenny McIlwain<sup>1</sup>, Tom Schils<sup>1</sup>**

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The role of herbivores as the primary regulator of algal communities within the coral reef ecosystem is well documented (Carpenter 1986, Lewis 1986, McClanahan et al. 1999). In areas where herbivore biomass is high, macroalgal cover is typically low (Williams and Polunin 2001). Conversely, reductions in herbivory by fishing or herbivore exclusion often lead to the proliferation of algae (McManus et al. 2000). The aim of this study was to investigate whether increased herbivore stocks in Guam's Marine Protected Areas (MPAs), as previously reported by Tupper (unpublished data), alter the species composition in algal assemblages by increasing the proportion of chemically defended algae. Two models were considered in this study: 1) Direct control of algae by herbivores, which is known as the "top-down" model where herbivores structure the abundance and diversity of algae. 2) The "bottom-up" model, in which nutrient input and availability prove to be the determining factors in algal community structure. From January to December of 2006, ten sites around Guam were surveyed on a monthly basis. Five of these sites have no fishing restrictions. The other five sites represent the MPAs, in which fishing is regulated. Five pairs of sites were chosen based on proximity and similarity in environmental factors (wave exposure, orientation to open ocean), and members of pairs were

surveyed on consecutive days. The pairs are as follows, with the MPA sites listed first: Piti – Asan, Tumon South – Agana, Tumon North – Tanguisson, Ritidian Closed (East Side) – Ritidian Open (West Side), and Achang – Chubic Beach. At each site, two permanent 50 meter transects were installed on the reef flat parallel to the shoreline. Permanent transects were established in algal assemblages that are submerged during mean low tide. Coral cover was low at all transect sites. At the onset of each survey, fish counts with size estimations for target species in the families Acanthuridae, Scaridae, and Siganidae were performed along belt transects of 50 m x 5 m. These families were deemed to include the most ecologically and commercially important herbivores on Guam (creel surveys of the Division of Aquatic and Wildlife Resources in 1999-2003). Next, percentage cover of algae within a 0.25 m<sup>2</sup> quadrat was estimated using a 16-point quadrat count method. Benthic categories included macroalgae (identified to species level where possible), functional groups (coral, cyanobacteria, crustose coralline algae, turf algae), and substrate types (sand, rubble, rock). In addition, environmental data such as temperature and water height were also recorded. Fish and algal data were stored in a relational database, being the interface between data management and further statistical analyses. Preliminary results suggest that fish abundance is higher in the MPAs, especially after removal of the erratic effect of rabbitfish runs on fish populations. Further statistical analyses will focus on the seasonal productivity of algae and the effect of grazing on the species composition and biomass of algal assemblages. The results of this study will evaluate the effectiveness of MPAs in Guam and will result in management recommendations. If low algal abundances are correlated with high herbivore abundances, MPAs might be a tool to control dense algal stands on reef flats and possibly to improve coral survivorship. It is important to discover any and all processes at work in relation to Guam's MPAs, as their value will be important in maintaining the overall health of Guam's marine resources.

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## **Resident Reef Fish Spawning Aggregation Dynamics**

**T.J. Donaldson and K.A. Chop<sup>1</sup>**

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Two types of reef fish spawning aggregations, transient and resident, have been described previously. Transient spawning aggregations are formed by species that migrate periodically from relatively distant home ranges to specific sites where they persist for days or weeks during a spawning cycle before returning home. Resident spawning aggregations, the subject of this paper, are formed by species that travel relatively short distances to court and spawn over a matter of minutes or hours during a spawning cycle before leaving the aggregation site. Various hypotheses have been proposed to account for the occurrence of either form of spawning aggregation, and it is possible that multiple benefits are conferred that are specific to

each species employing one or the other. The dynamics of either form of spawning aggregation may be the same or similar in a number of respects, as well. For example, the form and function of a number of spawning aggregations display behavioral characteristics resembling those seen in leks. Lekking or lek-like behavior has been defined as a temporary aggregation of sexually active males for reproduction. This behavior is observed commonly in a number of resident spawning aggregation species including parrotfishes (Scaridae). In this talk, we examine resident spawning aggregation dynamics in relation to lek-like behavior and provide examples from our recent studies at reefs off of Asan and Piti, Guam in an attempt to support the hypothesis that lek-like behavior is a central component of resident spawning aggregation formation and function. This behavior has important implications for the management of reef fishes.

## **Monitoring to Improve the Management of Guam's Coral Reef Resources**

**Valerie Brown**

National Marine Fisheries Service Pacific Islands Regional Office  
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While Guam's reefs have been the subject of numerous studies, there has never been a continuous monitoring program that addressed water quality, benthic habitat, and associated biological communities. This lack of baseline information has decreased managers' ability to evaluate natural and anthropogenic impacts to Guam's reefs. In response, the resource agencies, with the assistance of the University of Guam Marine Laboratory and NOAA, have developed a long term monitoring strategy that will combine the resources of the resource agencies to address the reef related management questions of local resource agencies. The new strategy is expected to be finalized in the summer of 2008. It is designed to look at all three monitoring targets: water quality, benthic habitat, and associated biological communities. This information will be used to improve reef management. One of the earliest efforts began in 2003, when the National Oceanic and Atmospheric Administration's Coral Reef Ecosystem Division initiated the first Marianas Archipelago Rapid Assessment and Monitoring Program survey. This project combined the expertise of the local agencies, the University of Guam Marine Laboratory, and NOAA scientists to survey reefs along the entire archipelago from Santa Rosa Bank to Uracus. This project was repeated in 2005 and 2007. The data from these surveys are now being analyzed and the initial analysis of fish data suggests that fish stocks in the Southern Marianas, particularly Guam are much lower than the Northern Islands, particularly for large fish.

For more Information About the Fisheries Management Local Action Strategy :  
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## Guam Coral Reef Symposium

### Poster Session

#### **Monitoring of *Enhalus* Seagrass in Two Marine Preserves on the Island of Guam from August 2005 to June 2007.**

**VC Vuki, S. Wilkins and Walter Kelly**

University of Guam Marine Laboratory, Mangilao, Guam 96923

Although the role of seagrasses is not well understood in many parts of the world, seagrass stands are recognized as some of the most productive and dynamic ecosystems in the marine environments. On Guam, seagrass meadows are one of the major habitats associated with coral reefs. Knowledge of seasonal changes, distribution, abundance and general health is too limited to effectively formulate a management plan. Challenges to seagrass ecosystems on Guam are numerous ranging from human population increase, inappropriate coastal land use and fishing practices, pollution, uncontrolled activities and development, sea level rise and global warming. Two seagrass meadows were selected, Achang Bay on the southern coast and Piti Bomb Hole on the leeward coast of Guam, both are marine preserves and have large stands of *Enhalus acoroides*. The sites were established as long-term permanent seagrass monitoring sites for Guam. Environmental changes were assessed by measuring physical parameters such as temperature, light intensity, and salinity of water at each location. Modified methods used by the SeagrassNet and SeagrassWatch programs were applied. Results in terms of cover, density, canopy height, and species composition indicate large homogeneous seagrass beds of *Enhalus acoroides* at both sites, although seasonal variations in mean percent cover and mean canopy heights, as well as variations in the density of plants and amount of epiphytes were noted. No significant variability in the mean shoot density was recorded over time. This two year project is the first systematic monitoring at an MPA sites on the island of Guam and demonstrates a standardized method in assessing seagrass beds. Links to the Global Seagrass Network Monitoring (SeagrassNet) and the Global SeagrassWatch Monitoring were established.

## **Long-Term Monitoring of the Benthic Community (Invertebrates and Algae) at 5 Permanent Sites in Guam.**

**Ciemon Caballes, Lee Goldman, Nola Meyer, Pablo Rojas, Peter Schupp**  
University of Guam Marine Laboratory, UOG station, Mangilao, Guam 96923

In 2006, the UOGML established permanent transects at five long-term monitoring sites around Guam. Although Guam's coral reefs have been studied since the early 1970s, no permanent sites were ever established with the explicit objective of studying long-term change in coral communities. The five sites, including Pago Bay, Fouha Bay, Western Shoals, Tumon Bay, and Double Reef were selected in cooperation with DAWR for permanent monitoring. Each site represents a particular level of impact (e.g. natural, anthropogenic or a combination of both), ranging from the relatively healthy area at Double Reef to the highly impacted area of Fouha Bay. Pago Bay was selected as a representative site with easy access on the east side of the island; Western Shoals for being a highly frequented dive site within Apra Harbor; and Tumon Bay as it represents an MPA and monitoring will provide another opportunity to evaluate the effectiveness of MPAs. Four 50m transects were established at each site at depth of 3m to 10m. Transects were permanently marked with rebar and with tags identifying them as markers for scientific research. A GPS position was recorded for the starting and endpoints of each transect. All transects were surveyed every three months.

A SONY Mini-DV camera was used to survey the benthic community along each transect. Videos were subsequently analyzed using the MCORALID application (unpublished), which marked 100 point-intercepts along the transect line. The type of benthic substrate or organism was recorded at each point and each observation was graphed as a percentage of the total coverage for the given transect.

Preliminary results revealed that Pago Bay had a high percentage of dead coral, which was in accordance with an increase in the size of the COTS population over the past few years. It is possible that much of the observed coral mortality has been the result of COTS predation. Fouha Bay, which receives a large input of land-based sediment (and possible nutrient influx), exhibited the second lowest coral cover. Western Shoals, on the other hand, had the highest hard coral cover (about 85%) but the least number of coral species. Like the rest of Apra Harbor, Western Shoals is dominated by large stands of *Porites rus*. Coral cover and species richness in Tumon Bay were similar to that of Double Reef. While the Tumon Bay site does not appear to be impacted by sedimentation, it has, like Pago Bay, experienced high numbers of COTS in recent years.

It is anticipated that this long term monitoring will result in the collection of robust baseline data in order to assess the potential impacts of future natural and anthropogenic disturbances on Guam's reefs and to quantify their recovery. The monitoring of these sites will continue indefinitely, resulting in a reef monitoring database.

# Field Guide "Marine Plants of Guam"

**Tom Schils**

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Historically, the coral reefs of Guam are one of the best studied marine ecosystems within the Western Pacific and the larger Indo-Pacific region. The island has a well-documented historical record of human activity and related environmental disturbances (e.g., sedimentation and COTS outbreaks) with profound effects on the benthic communities and declining fish stocks. Because of the variety of deleterious anthropogenic impacts and continuous scientific efforts, Guam functions as a showcase and indicator for reef ecosystems throughout the tropics. Presently, actions are undertaken to restore and monitor impacted reefs and their fish communities. The restoration of fish stocks is highly dependant on a healthy equilibrium state between corals and algae. Phase shifts and trophodynamic interactions (e.g., the relationship between algae and herbivores) are among the most important factors affecting both fish population and benthic community structure. The tight coupling between benthic communities and fish populations asks for a holistic monitoring and restoration approach endorsed by Guam's research community. The goals set by current restoration programs depend on adequate taxonomic expertise. Therefore, marine ecologists and field researchers need comprehensive treatises on the different groups of organisms. The University of Guam Marine Laboratory (hereafter UOGML) publishes the series "Guide to the Coastal Resources of Guam" to support field workers and educators in their tasks. So far, the series consists of three volumes (Amesbury & Myers 1982; Randall & Myers 1983; Amesbury et al. 1986). The first booklet, "The Fishes", is out of print but initiated a spin-off publication (Myers 1983) that is regarded as the bench-mark identification guide for fishes in the Western Pacific Region. The second publication, "The Corals", is currently being revised and forthcoming editions are expected (e.g. "The Echinoderms"). A comprehensive field guide on the ecologically important group of macrophytic primary producers (algae and seagrasses: hereafter marine plants) is however missing. The high diversity and the pivotal ecological role of marine plants on Guam's reefs warrant a dedicated volume. Informal queries among resource agencies, researchers, students and naturalists reveal that marine plants are amongst the least-known marine organisms. Neighboring regions in the Pacific have recognized the importance of vulgarized treatises on tropical marine plants to stimulate research and to increase public awareness. Comprehensive books on the marine plants of French Polynesia (Payri et al. 2001), Hawaii (Abbott 1999; Abbott & Huisman 2004) and the larger South Pacific (Littler & Littler 2003) have appeared recently. The overwhelming number of species reported for these neighboring regions and the differences in floristic composition with Guam, including distinct habitat and ecological characteristics of similar species, hamper the popular use of these books in Guam and other Western Pacific islands.

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## **Improvement of Guam's Marine Resource Enforcement**

Division of Aquatic and Wildlife Resources, Mangilao, Guam

The initial Local Action Strategy for Fisheries Management focused on the need to improve the enforcement capacity of the Division of Aquatic and Wildlife Resource's Law Enforcement Section. The LE Section is often underfunded due to budget constraints and the lack of federal funding for enforcement. These projects were designed to supplement their existing programs and expand the capacity of the section. Projects proposed included the acquisition of four new four wheel drive vehicles, the creation of a user friendly fishing regulations pamphlet, and the creation of a Conservation Officer Reserve Program. The vehicle acquisition and the user friendly fishing regulation projects have been completed, however, the Conservation Officer Reserve Program is still awaiting final approval by the Attorney General's Office before it can be finalized and implemented. Once implemented, this program will provide the section with ten part-time conservation officers to assist with fisheries enforcement. This program is modeled after the GPD police reserve program.



## **Guam Coral Reef Symposium**

### **Panel 3: Recreational Impacts**

Presenters: David Burdick and Victor Torres

### **Recreational Impacts Affecting Guam's Reefs**

#### **Dave Burdick**

Bureau of Statistics and Plans Guam Coastal Management Program, Hagatna, Guam

Recreational overuse and misuse of certain high-profile reef areas for recreational activities continues to be a threat to Guam's coral reef ecosystems. According to a recent coral reef economic valuation study conducted on Guam, an estimated 300,000 dives are performed on Guam each year (van Beukering et al., 2007) and this number will likely increase significantly with the additional military personnel, their dependents and others associated with the military expansion. Reef habitat at popular sites is often adversely impacted. Colonies damaged by kicking, grabbing and standing are often observed and other impacts, such as trampling of coral and other benthic organisms, increased turbidity and alterations of fish behavior from fish feeding are also regularly observed. Of particular concern is the extraordinarily high level of use in relatively small areas of the Piti Bomb Holes and Tumon Bay Marine Preserves. An estimated 50-200 dives occur daily within a popular 0.25 ha (0.6 acre) "bomb hole" (e.g., solution hole) in the Piti Preserve. Even a conservative estimate based on these observations suggests that the number of dives that occur at this small site each year (>18,000) vastly exceeds the 4,000-6,000 diver per year "threshold value" established by coral reef dives site carrying capacity studies. Other sites with of concern are Blue Hole, Hap's Reef, Finger Reef and Western Shoals. It is important for recreational users and companies providing recreational services to take steps to reduce this impact to our fragile reefs. Another source of potential impact is the operation of motorized personal watercraft (PWC). These watercraft are restricted to four reef flat/lagoon areas around Guam under the Recreational Water Use Master Plan. These craft are loud, are known to leak fuel and have the potential to scour seagrass beds and corals.

For more Information About the Recreational Misuse and Overuse Local Action Strategy :

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## **Direct, cumulative and secondary impacts of personal watercraft in East Agana Bay**

Bureau of Statistics and Plans Guam Coastal Management Program, Hagatna, Guam

The Bureau of Statistics and Plans Guam Coastal Management Program contracted PCR Environmental, Inc. to assess the potential direct, cumulative, and secondary impacts of personal watercraft (PWC) on the coral reef ecosystem in East Agana Bay and propose recommendations for the Recreational Water Use Master Plan (RWUMP). Specifically, the study looked at the effect of PWCs on the abundance, diversity, and distribution of fishes, corals, macroinvertebrates, and marine plants, as well as the effects on substrate cover, water clarity, water quality, hydrocarbons, and damage or pollution. The results of the limited study indicate that levels of BTEX, MTBE, and TPH-g, all of which are pollutants emitted in PWC exhaust, did not exceed human health risk standards. Tidal flushing may be beneficial to the dilution of hydrocarbon contaminants, but further study is required to test the relative solubility, transport, and fate of exhausted hydrocarbon contaminants throughout the Bay. Turbidity exceeded water quality criteria during peak PWC activity, but decreased to pre-activity levels within a number of hours, suggesting that PWC-related turbidity does not chronically decrease photosynthesis. Further study may elucidate the relationship between turbidity and substrate cover, and the relative contribution of PWC to turbidity levels in the Bay, as compared to impacts from stormwater runoff and other natural processes.

The study also found that there are no apparent direct impacts of PWC propulsion on seagrass beds; no conspicuous scars or bare patches in seagrass beds were noted during transect studies. The researchers suggest that the daily movement of the PWC tracks in response to tide levels may lessen PWC-related impacts. PWC use did not appear to impact the diversity of resident fish communities, as the same number of fish species was noted in all study areas (8-9 species). While there were some differences in fish community composition between certain survey sites, these differences do not appear to be a result of PWC activity. The researchers also conducted stakeholder interviews and found that commercial operators are not in full compliance with RWUMP rules and regulations, including rules and regulations pertaining to course location, the presence of platforms and pontoons, operation outside designated course locations, and the leasing or subleasing of vendor permits.

The researchers recommend that the RWUMP be updated to resolve user conflicts between fishermen, PWC operators, and other recreational users, as the designated PWC courses in East Agana Bay as identified in the RWUMP do not fit the current needs of the users of the Bay. The researchers also recommend that the RWUMP be updated to include Executive Order 89-10, which temporarily prohibits PWC use in the Bay during the seasonal mañahak runs. Further recommendations include updating the designated course areas to indicate a specific distance from shore and/or installing permanent markers on the reef flat to identify course locations; posting signs along the Bay providing proper refueling procedures, vendor permit requirements, public access, and general operational restrictions; including more specific speed limits within course areas; including minimum distance requirements between PWC use and people in the water; and revising the definition of PWC to apply to a wider range of current technologies. The researchers also recommend examining PWC regulations adopted elsewhere, including the phasing out of two-stroke engines (Lake Tahoe) and the prohibition of PWC operation within 1200 ft of shoreline (San Francisco and Florida).



## Guam Coral Reef Symposium

### Panel 4: Coral Bleaching and Disease

Presenters: Laurie Raymundo, Rocky Myers, Ciemon Caballes, Valerie Brown  
and David Burdick

#### Field descriptions of Indo-Pacific diseases and compromised health states

**Laurie Raymundo**

University of Guam Marine Laboratory, Mangilao, GU 96923

#### 1. TISSUE LOSS: Known predation or stress resulting in compromised health

##### Fish bites

Look for predators in survey area (though they may actively feed at night) and distinctive scars on coral skeleton. These examples are not exclusive and other fish predators may leave different scars. Look for gouging, scraping, or other regular patterns of tissue loss, often clustered on colony surface.



a. Parrot fish: Irregular patterns of tissue loss associated with scrapes or gouges (i.e. bite marks or scars) that generally expose bare skeleton. Recent lesions are white and typically have discrete borders. Older lesions may be partially or wholly colonized by algae, the latter indicating that tissue loss is not progressing. Scars may be focused along exposed ridges of coral. Parrot fish are usually in the vicinity and feeding by day.



b. Puffer fish: Multifocal, linear to oblong paired areas of distinct tissue loss with mild erosion of bare skeleton (arrows). Puffer fish may be in vicinity, but may not be observed feeding. Less damaging to skeleton than parrot fish bites.



c. Pomacentrid fish: Irregular patterns of tissue loss producing lesions that may be linear, annular or irregular in shape. Lesions are colonized by algae that are farmed by pomacentrids visible in the area.



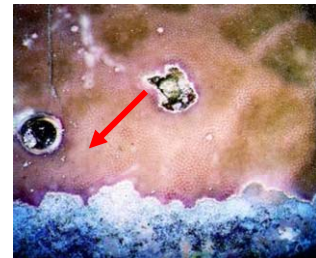
**Acanthaster planci  
(Crown-of-Thorns  
starfish; COTS)**

Irregular, amorphous area of tissue loss revealing intact, bare skeleton. Lesion margin may be scalloped (arrow) on plating, massive or tabular colonies. Lesion border is generally discrete and may have visible strings of tissue and mucus. Feeding usually occurs from colony edge (plating, massive, tabular forms) or base (branching forms), exposing large areas of white skeleton consistent with rapid tissue loss. Typically COTS are in vicinity either feeding or under colony by day.



**Tube formers**

Focal to multifocal, circular to amorphous areas of tissue loss with erosion of skeleton and annular thin band of white or pink tissue accompanied by presence of boring polychaetes (tube worms), gastropods (vermetids; arrow), or barnacles. Feeding structures and gills protrude from the coral surface. Common on massive *Porites*.



**Gastropod predation**

The following two genera are major predators of Indo-Pacific corals; limpets and other molluscs are also known corallivores.

a. Drupella: Irregular areas of tissue loss extending from bases of branches or edges of colonies, revealing bare, intact skeleton (arrow). Lesion typically has a discrete border. Rate of tissue loss typically slower than for *A. planci* predation. *Drupella* in vicinity hiding at colony base by day, often clustered, or feeding by night. Dead shells also indicate presence. Close inspection of feeding margin sometimes reveals shredded strings of tissue.



b. Coralliophila: Focal to multifocal areas of tissue loss revealing bare eroded skeleton and occasional raised thin pink annular band (pigmented coral tissue encircling lesion). Shells are relatively immobile and firmly attached to colony surface; may be heavily fouled and more visible on massive corals. May be clustered in colony crevices, and show strong preference for massive and branching *Porites*. Old feeding scars may be present (arrow).



**Sediment damage**

Irregular amorphous area of tissue loss revealing skeleton covered by sediment. Water is typically highly turbid and sediment visible on benthic surfaces. When it accumulates on live coral, it leaves dead, fouled skeleton underneath.



### Algal overgrowth

Colonization and overgrowth of living coral tissue by algae (various species). With heavy overgrowth, underlying coral tissue usually dies, leaving bare skeleton. Abrasion may cause a pigmentation response (see below), but this is not always present.



**2. TISSUE LOSS, disease:** lesions that do not have any of the discrete patterns of tissue loss or damage consistent with predation or compromised health states described above.

### 2. a. Pigmented band diseases: presence of a distinct narrow band of pigmented material

#### Black Band Disease

Black or dark reddish-brown linear, irregular or annular bands at the interface between live coral tissue and exposed skeleton. Band comprises black-red filamentous organisms (cyanobacteria) peppered with white filaments which can only be seen microscopically. Band radiates outward from the colony margin or a focal site of injury on massive corals or encircles branching corals. In moderately progressing infections, denuded skeleton is colonized by filamentous algae and other epibionts. May be >1 disease front per colony which may merge over time. Affects at least 40 species of corals, particularly *Acropora* species.



#### Skeletal Eroding Band

Black or dark green “salt-and-pepper”, speckled, diffuse band. May form either a discrete, dark band several mms - cms wide at interface between healthy tissue and recently exposed skeleton (1° infection; photo) or a diffuse, scattered patch on exposed skeleton (2° infection following predation or other tissue loss). Speckled appearance caused by boring ciliates which erode skeleton. Common in *Acropora* and *Pocillopora*.



#### Brown Band

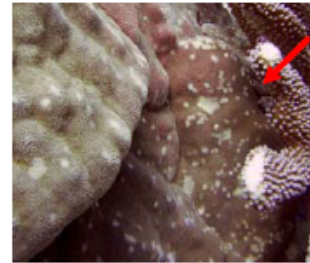
Brown linear, irregular or annular band at the interface between live coral tissue and exposed skeleton. Lesion border is typically discrete. Tissue loss may be rapid and generally begins from branch base but may spread to adjacent branches at contact points. Band consists of mobile ciliates, which may contain zooxanthellae from consumed tissue (visible under microscope; gives band its brown color). There may also be a thin white band between the brown band and healthy tissue. Observed most commonly on branching *Acropora* spp.



## 2.b. Tissue loss without distinct band

### Ulcerative white spots

Multifocal tissue loss exposing intact, bare white skeleton. Lesions are small (<1cm diameter), regularly ovoid, with discrete margins and may either contain bleached tissue or be devoid of tissue. Heavy infections may result in lesion coalescence (arrow) followed by algal colonization. Most common on *Porites*; also on *Montipora*, faviids, and *Heliopora*.



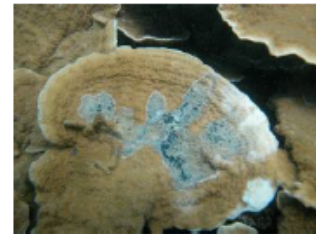
### White Syndromes

Irregular areas of tissue loss exposing bare, intact skeleton. No band apparent between healthy tissue and bare skeleton; lesion border may be discrete or diffuse, but not pigmented. Rate of tissue loss moderate to rapid. Lesions behind active disease fronts are white, grading to brown distally as skeleton becomes fouled. Can resemble bleaching, but close inspection reveals absence of tissue. Host range wide; affects at least 15 genera.



### Atramentous Necrosis

Multifocal to irregular pattern of tissue loss exposing bare, white skeleton subsequently colonized by a distinctive grayish-black fouling community. Lesions typically start as small bleached spots followed by tissue loss and coalescence of adjacent lesions. Bare skeleton may be covered by a thin white film, under which a black sulfurous deposit may accumulate, giving the lesion a grayish appearance. Chronic infections result in colonization by epibionts which obscure typical signs of disease. *Montipora* spp are most susceptible, but also observed on *Acropora*, *Echinopora*, *Turbinaria* and *Merulina*.



## 3. TISSUE DISCOLORATION

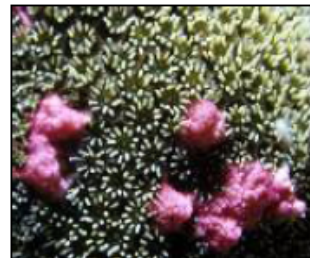
### Pigmentation Response

Multifocal or irregular areas of pink, purple or blue brightly colored tissue discoloration. Tissue on corallite walls may appear swollen or thickened. Pigmentation may form lines, bumps, spots, patches or irregular shapes. Considered a response of the coral host to a variety of stressors (e.g. competition, boring fauna, algal abrasion; arrow), suggesting that coral health is compromised. Common on *Porites*, which shows bright pink or purple pigmentation.



### Trematodiasis

Multifocal, distinct pink to white, small (1-2 mm) areas of tissue swelling. Swelling is a response to presence of an encysted parasitic trematode (visible under microscope if tissue is sampled). To date, only observed on massive *Porites*.



### Unusual bleaching patterns

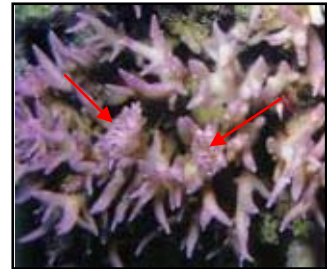
Irregular, focal, or multifocal-to-coalescing amorphous areas of white tissue with a discrete margin. Loss or reduction in the number of endosymbiotic algae (zooxanthellae) from coral tissue. Note that tissue is present, but with reduced or absent pigmentation. Distinguished from thermal bleaching which typically affects upper or entire surfaces of corals. Unusual bleaching patterns include white stripes or patches often with discrete borders. The degree of bleaching can vary from pale to white, and indicates compromised health.



## 4. GROWTH ANOMALIES

### Galls

Focal to multifocal skeletal deformation associated with the presence of an organism (e.g. crab, barnacle, etc.). Deformations caused by skeletal deposition around the resident invertebrate in uncharacteristic patterns. Resulting lesions may be focal or multifocal, circular to irregularly shaped masses of thickened coenosteum (arrow), elevating polyps several mm above the surface of the colony.



### Growth Anomalies of unknown cause

Focal or multifocal, circular to irregularly shaped lesions consisting of abnormally arranged skeletal elements (corallites, ridges, valleys), which are larger or smaller than those of adjacent healthy tissue. They may protrude above the colony surface, and may or may not be covered by intact normal-appearing tissue. Pigmentation may be normal, lighter (suggesting loss of zooxanthellae), or completely absent (suggesting an absence of zooxanthellae). In some types, corallites may be completely absent, and the GA resembles a white plaque over the colony surface. In other types, corallites may be highly disorganized and tissue may die in irregular patches and bare skeleton may be colonized by epibionts. Includes conditions referred to as: gigantism, area of accelerated growth, growth anomaly, chaotic polyp development.



Modified from: Raymundo, L., Couch, C., Bruckner, A., Harvell, C.D., Work, T., Weil, E., Woodley, C., Jordan-Dahlgren, E., Willis, B., Aeby, G., Sato, Y. *A Coral Disease Handbook: Guidelines for Assessment, Monitoring and Management*. In press. Currie Press, Inc., Brisbane, Australia. 150 pp.

## **Guam reefs show a link between disease prevalence, the dominant genus *Porites* and temperature**

**Roxanna L. Myers and Laurie J. Raymundo**

University of Guam Marine Laboratory, Mangilao, GU 96923

Coral diseases are considered to be a major cause, and often a result, of the recent world-wide decline in coral reef health and productivity. The increase in the number of disease reports, new or emerging diseases, host species and geographic range is hypothesized to be linked with increasingly poor water quality and stress to corals, and is also a significant cause of coral mortality. Relative to the Caribbean, little is known about the impacts of coral diseases on reefs in the Indo-Pacific. However, reefs in this region are more widespread, more diverse, and often more impacted by dense human coastal populations. Therefore, an understanding of the impact of coral disease on Guam reefs was considered an important management issue for local scientists and for the region as a whole. Initial surveys of 12 Guam reefs were conducted in 2006-08 to establish baseline levels of reef benthic composition, coral disease prevalence, and host species range. Guam reefs were taxonomically diverse, represented by 13 families but dominated by Poritidae, and live hard coral cover ranged from a high of 72% (Western Shoals crest) to a low of 11% (Pago Bay and Tupalao Bay). Total mean disease prevalence was highly variable both within and between sites, ranging from a low of 2% (Pago Bay) to a high of 38% (Cocos Lagoon). We observed six described diseases on Guam reefs: white syndrome, black band, growth anomalies, ulcerative white spots, brown band, and skeletal eroding band; all known from other locations in the Indo-Pacific. Five of these diseases affected various species within *Porites*. Four sites were selected for long-term monitoring of disease prevalence, changes in benthic composition and temperature. Results from the first 18mo. of monitoring on Luminao Reef suggest highest disease prevalence corresponding to the period of warmest temperatures (temperature ranged from 27°C (January-February) to 30.5°C (July-August) with prevalence increasing from 6% to 30% (August 2007) in one year. Further, our results showed a strong link between disease prevalence and abundance per family; mean prevalence of disease within Poritidae alone was  $9.1\% \pm 4.1\%$ . The fact that the genus *Porites* is the primary reef builder on Guam reefs suggests that coral diseases which result in partial or full colony mortality may have significant long-term effects on community structure and live coral cover.

## **Monitoring of Crown-of-Thorns Seastars (*Acanthaster planci*) Around Guam and the Role of Chemical Signals in their Feeding Behavior**

**Ciemon Frank Caballes and Peter J. Schupp**

Marine Laboratory – University of Guam, UOG Station, Mangilao, Guam 96923

The crown-of-thorns seastar, *Acanthaster planci*, is a corallivore known for its capacity to cause large-scale coral mortality at high population densities and continues to be a reef management problem despite previous control efforts. There has been no large-scale active control of *A. planci* populations on Guam since the 1970's and manta tow surveys conducted in 2006 and 2007 confirmed that *A. planci* continues to damage reefs around Guam. Large aggregations of up to 336 individuals/ha of reef were spotted in Tanguisson, Gun Beach, Faifa'i Beach, Haputo Point, Uruno Point, Pago Bay, Tagachan Point, and Taguan Point.. In these

major impact sites, we observed that *A. planci* feed mainly on Acroporids, especially encrusting *Montipora* corals. Preferential feeding by *A. planci* causes differential mortality among coral species, which can exert a major influence on community structure. However, the role of chemical signals in *A. planci* prey selectivity is still poorly understood. We tested the effectiveness of organic extracts from different coral species and  $\alpha$ -linolenic acid, a previously identified feeding attractant. Feeding assays with *A. planci* were conducted in a Y-maze, using crude extracts incorporated into agar-based feeding plates at natural concentrations. *A. planci* individuals were attracted to crude extracts of *Montipora* sp. ( $n=25$ ;  $p<0.05$ ), *Acropora surculosa* ( $n=25$ ,  $p<0.01$ ), and 1%  $\alpha$ -linolenic acid ( $n=15$ ;  $p<0.01$ ); but not to *Porites rus* ( $n=25$ ;  $p>0.10$ ). We conclude that with further isolation and characterization, these feeding attractants could be incorporated into the design of traps or bait stations as an alternative tool for the management of potential *A. planci* population outbreaks.

## Effects of Coral Bleaching on Guam's Reefs

Dave Burdick<sup>1</sup> and Valerie Brown<sup>2,3</sup>

<sup>1</sup>Bureau of Statistics and Plans Guam Coastal Management Program, Hagatna, Guam

<sup>2</sup>National Marine Fisheries Service, Pacific Islands Regional Office, Guam Office, Mangilao, Guam

<sup>3</sup>Joint Institute for Marine and Atmospheric Research, Honolulu, Hawaii

After nearly a decade without reports of large-scale bleaching, coral bleaching was observed in September and October 2006 and August and September 2007. Both the 2006 and 2007 events appear to have been associated with above-average sea surface temperatures and co-occurred with bleaching watches/warnings issued by the National Oceanic and Atmospheric Administration (NOAA) Coral Watch Program based on satellite measurements of sea surface temperature. During both events, bleaching was observed among numerous species on the reef flat and reef front to a depth of 7 m at several sites around the island. The wide-spread distribution of the 2007 bleaching event was confirmed with observations from an aerial survey carried out in August 2007. The effect of the 2006 and 2007 events on Guam's reefs was difficult to properly assess, as limited resources and reef access resulted in only a handful of observations and even fewer quantitative data. A survey of *Pocillopora verrucosa* colonies at Ana'e Island, off Guam's southwest coast, found that 67% of colonies at 1-3 m water depth were pale or full or partially bleached in September 2006 (Lisa Chau, UOGML, unpublished data). Of a total 36 tagged *P. verrucosa* colonies, all appeared to have fully or partially recovered after more than three months. In contrast, about 60% of all coral species surveyed in October 2006 along a single transect on the reef margin in the Tumon Bay Marine Preserve exhibited partial or full mortality. The results of a survey of an arborescent *Acropora*-dominated coral community in Tumon Bay in August 2007 indicated that approximately 60% of the total live coral and >90% of the *Acropora* species along five 25 m transects exhibited paling or partial bleaching. Because this nearly monotypic, *Acropora*-dominated coral community is not common on Guam, the observed bleaching rates are not representative of other reefs around the island. A qualitative survey of the north side of Cetti Bay indicated that at least eight scleractinian coral genera were affected to a depth of about 7 m.

For more Information About the Climate Change, Coral Bleaching and Disease Local Action Strategy :

Local Navigator: Dr. Laurie Raymundo

University of Guam Marine Laboratory

UOG Station, Mangilao, Guam 96913

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Email: [lraymundo@guam.uog.edu](mailto:lraymundo@guam.uog.edu)



## **Guam Coral Reef Symposium**

### **Panel 5: The Human Dimension**

Presenters: Valerie Brown and Evangeline Lujan

### **Results of the Guam Coral Reef Economic Valuation**

#### **Valerie Brown**

National Marine Fisheries Service, Pacific Islands Regional Office, Guam Office, Mangilao, Guam  
Joint Institute for Marine and Atmospheric Research, Honolulu, Hawaii

In 2004, the Guam Coral Reef Initiative with assistance from NOAA, began work to develop a scope of work for a Guam Coral Reef Economic Valuation. In 2005, Herman Cesar and Pieter Buerking, a world known coral reef valuation team, were hired through the University of Guam Marine Laboratory. The objective of this study was to carry out a comprehensive economic valuation of the coral reefs and associated resources in Guam. The valuation of Guam's coral reefs involved a series of steps that ultimately led to the estimation of the total economic value. At the same time, they looked at (1) people's relationships with marine ecosystems (2) local willingness to pay for coral reef conservation (3) the economic importance of reefs and (4) the spatial variation of reef-associated values and threats. The study focused on five areas of coral reef use: Tourism and Recreation, Fishing, Amenity Value, Coastal Protection, and Research and Education. The researchers aggregated the individual value of each of these categories to find the total economic value of coral reefs in Guam. This value was estimated to be US\$127 million per year. The three most important values are tourism (74%), amenity value (8%), and recreation (7%). Fisheries have a relatively small contribution to this value of \$4 million per year. The study looked primarily at economic values, however, the discrete choice experiment used in this study suggests that the total value of these resources are much higher due to their cultural and existence value. The study also looked at the spatial distribution of these economic values based on data from benthic habitat maps, creel surveys, property values, and recreational use. These spatial findings suggest that the average value of Guam's reefs is approximately \$2 million / km<sup>2</sup>/ year while a few reefs are valued at approximately \$15 million/km<sup>2</sup>/year. The researchers made three policy recommendations: 1.) Make use of the cultural importance residents place on marine ecosystems to improve coral reef management. 2.) Limit the commercial consumptive use of coral reefs by prioritizing stronger enforcement and protection of marine protected areas in Guam. 3.) Actively involve the tourism industry in the development of sustainable coral reef management.

## **Tackling the problem of Lack of Awareness: Education and Outreach Efforts on Guam**

**Evangeline Lujan**

Bureau of Statistics and Plans Guam Coastal Management Program, Hagatna, Guam

One of the main challenges in coral reef conservation is lack of awareness. Communicating the value and importance of Guam's reefs is a challenge because of limited funding, disparate efforts, and the lack of information pertaining to the general public's attitudes and perceptions. Projects highlighting our education and outreach efforts include the Guam Coastal Management Marketing Survey, the development of Kika Clearwater- icon of the Coral Reef Initiative, coordinated events through the Guam Environmental Education Subcommittee, Marine Biology education curriculum, Reef in the Box, and the Guardians of the Reef.

## **Piti/Asan Watershed Restoration and Management Enhancement**

Bureau of Statistics and Plans Guam Coastal Management Program, Hagatna, Guam

The Piti Bomb Hole Marine Preserve is one of Guam's five marine preserve. The area has become an important recreational dive area and these activities are causing damage to the coral reef. This multi-phase project addresses watershed management, land-base sources of pollution; recreational use and mis-use; and lack of awareness by enhancing and developing the erosion-prone areas adjacent to the Piti Bomb Holes Marine Preserve in order to provide an alternative site to the heavily used area, relieve recreational pressures, and foster community support.

Phase I (the Planning Phase) of this project includes the assessment of the existing conditions and the development of a plan for the improvement of the area, including any infrastructure development that may be required. The assessment will look at alternatives to manage non-point source storm water runoff from the major highway adjacent to the park; and identify generalized actions to manage non-point source pollution generated from development of upland areas that possess similar characteristics (i.e., management of non-point source pollution generated from infill development). Funds will be used to hire an architectural and engineering firm to conduct this assessment and provide recommendations on the control and prevention of non-point source pollution.

Phase II (Implementation Phase) will actively deal with issues related to stormwater runoff, sedimentation from upland erosion and revegetation of riparian areas. Working with the Department of Agriculture and the Department of Public Works, major infrastructure and watershed management activities for the upland area will be implemented to address the priorities established in Phase I of this project. An engineer will be contracted to review project design and ensure that best engineering practices are implemented to help minimize coral reef impacts by the roadway stormwater runoff.

Phase III of the project will be to implement a community based educational program with the Piti and Asan residents. Working with the Mayors of the two villages and using the Nature Conservancy's Conservation Action Planning Tool, the needs of the community will be prioritized and addressed accordingly. Eventually, an educational program will be developed to assist park visitors, as well as community members to highlight the unique coral reef habitat. Residents will be trained in the type of habitat and the appropriate way to enjoy the resource<sub>25</sub> without damaging the corals during diving or snorkeling.



## Guam Coral Reef Symposium

### **The status of the shallow coral reef ecosystems of Guam\***

\*Based on the information provided in the Guam section of NOAA's 2008 State of the Coral Reef Ecosystems of the United States and Pacific Freely Associated States report

**David Burdick**

Bureau of Statistics and Plans/Guam Coastal Management Program, Hagatna, Guam

The 2008 State of the Coral Reef Ecosystems of the United States and Pacific Freely Associated States report is the third in a series of national coral reef ecosystem status reports compiled by the National Oceanic and Atmospheric Administration's (NOAA) Center for Coastal Monitoring and Assessment (CCMA). This report, which will be released at the International Coral Reef Symposium in July 2008, represents an evolving effort to determine the condition of coral reef ecosystems at both local and national scales and serves as a vehicle for the dissemination of information about data collection activities in the U.S. and the Freely Associated States. The 2005 and 2008 reports are different from their predecessors in that they are based primarily on the most recent quantitative monitoring data available, rather than qualitative assessments of ecosystem conditions. In addition, local writing teams, composed of experts from numerous research and management institutions, served as the primary authors of each jurisdiction chapter and thus were responsible for determining the content and scope of information included.

The Guam section of the 2008 report was developed by a team of coral reef managers, technicians and researchers based on Guam. The findings of various monitoring activities, assessments, and stand-alone investigations conducted by local and federal agencies, educational/research institutions, and government contractors since 2004 were synthesized to obtain an updated, holistic view of the status of Guam's reefs. The report includes 1) a description of the geographical distribution of reefs and salient background information; 2) a discussion of each of the key threats affecting Guam's reefs; 3) a description of existing monitoring programs and specific data sets upon which the assessment is based; 4) a description of the methods, results, and discussion for each monitoring data set, organized around the three primary themes of water quality, benthic habitats, and associated biological communities; 5) an introduction to the conservation and management actions currently being undertaken to respond to issues of concern; and 6) an overall summary of the status of Guam's coral reef ecosystems and priority recommendations for future research and management alternatives. An expanded version of the Guam section of the 2008 report will be developed and printed locally in order to provide more background information and additional materials not included in the national report to policy makers, managers, researchers, educators, and the general public. An executive summary, highlighting the report's most significant points, will accompany the local version.





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**For More Information on Guam Year of the Reef Events:**

**<http://www.guamiyor08.com>**

**For More Information on the Guam Coral Reef Initiative:**

**<http://www.guamcri.com>**

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**Guam Environmental Education Partners, Inc.**