Status of the Coral Reef Ecosystems of Guam

Report Summary

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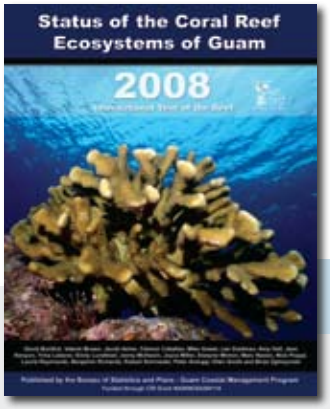
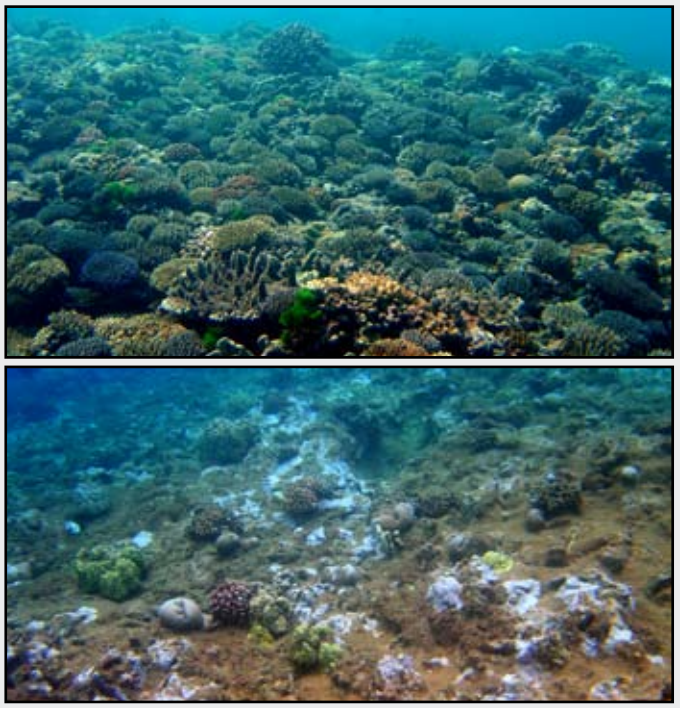


This briefing highlights the main scientific findings and key recommendations presented in a report on the status of the health of Guam's coral reefs published in December 2008 by the Bureau of Statistics and Plans. The full report, available at http://www.bsp.guam.gov, was developed collaboratively by scientists and managers from numerous local and federal agencies, The Nature Conservancy, and the University of Guam Marine Laboratory.

The importance of Guam's coral reefs

Guam's coral reef resources are both economically and culturally important, providing numerous goods and services for the residents of Guam, including cultural/traditional use, tourism, recreation, fisheries, and shoreline/infrastructure protection. A recent study conducted by an team of renown researchers estimated that **Guam's reefs contribute approximately $127 million to the local economy each year**. Guam's reefs host an incredible variety of marine organisms. Did you know that Guam has of the most diverse marine ecosystems among U.S. jurisdictions?



A rich coral community off the southeast coast near Ipan Beach Park (top) and a stressed reef community near Anae Island impacted by sedimentation (bottom). Photos: D. Burdick.

The decline in the health of Guam's reefs

Despite the critical importance of Guam's coral reefs to so many aspects of life on the island, they remain under assault from a range of threats. Paralleling the decline in the health of coral reefs across the Indo-Pacific, the health of many of Guam's reefs has diminished over at least the last several decades. As a result, their ability to provide important services to Guam's current and future residents continues to be be compromised.

In the past, Guam's reefs have recovered after drastic declines, but continued degradation of water quality, chronic crown of thorns seastar outbreaks, low numbers of important herbivorous (algae-eating) fishes and other threats make Guam's reefs less *resilient* – meaning they are less able to recover from disturbances such as major storms or severe coral bleaching events. A particularly distressing sign of declining reef resilience is the large decrease in rates of coral recruitment (i.e., the settlement of young corals onto the reef) in the last few decades. In areas without successful coral recruitment, recovery will likely be a long process – if it happens at all.

The top threats to Guam's reefs:

- **Sedimentation from upland soil erosion**
- **Stormwater runoff and associated pollutants**
- **Overharvesting of reef fish**
- **Crown of thorns seastar outbreaks**
- **Climate change impacts**

Threats to Guam's reefs

The main threats to Guam's coral reefs continue to include sedimentation, freshwater runoff and associated pollutants, and heavy fishing pressure. Additional threats include crown of thorns seastar outbreaks, coral diseases, dredging, boat groundings, marine debris, coral bleaching, and recreational misuse and overuse. Guam also experiences a high frequency of storm activity, which can cause direct physical damage to the reef and can cause significant reductions in nearshore water quality resulting from stormwater runoff.

The direct and indirect impacts of U.S. Department of Defense plans to expand the military presence on Guam, increasing the population by up to 60,000 people and involving numerous construction projects, also pose significant threats to Guam's reefs resources.

Coral bleaching is also an emerging threat on Guam, and will likely grow more severe with increasing sea surface temperatures associated with global climate change. Although Guam has yet to experience widespread coral death from a severe bleaching event, recent and regularly-

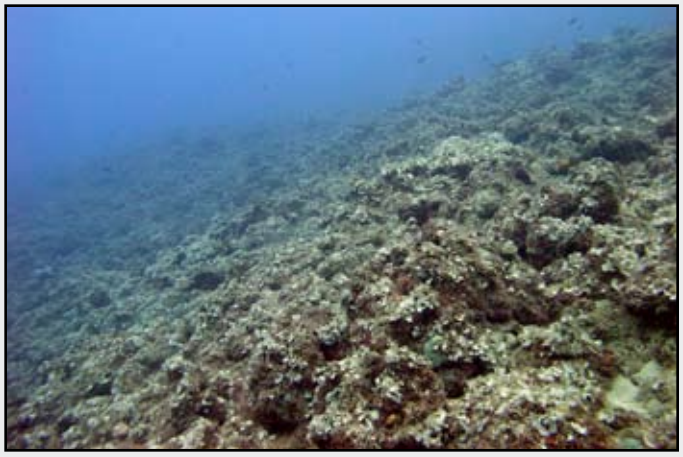
occurring bleaching events that have resulted in minor to moderate coral mortality may portend more severe effects of future bleaching events.

Findings of recent data-gathering activities

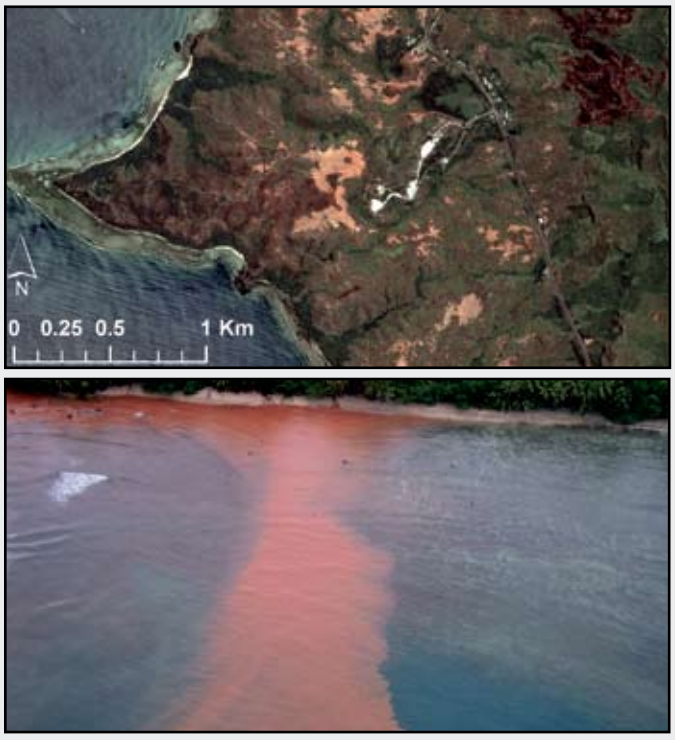
A long-term coral reef monitoring program has recently been initiated with funding from the National Oceanic and Atmospheric Administration (NOAA) Coral Reef Conservation Program, but data must be collected over the next several years to be able to detect changes in reef health at specific sites around the island. With this data not yet available, the overall health of Guam's reefs must be assessed by examining the results of individual scientific studies and assessments. The results of island-wide rapid reef assessments conducted by NOAA in 2003, 2005, and 2007 as part of the agency's Marianas Archipelago Rapid Assessment and Monitoring Program (MARAMP) will also contribute substantially to an understanding of the status and trends in reef health around Guam. A detailed analysis of the multiple years of NOAA MARAMP data is not yet complete, but some of the data is presented here.

Benthic cover

As mentioned above, little data exist to accurately describe long-term changes on the reef, including changes in coral cover (i.e., the percentage of the seafloor covered by living coral), the diversity of corals and other organisms, and other measures of coral reef health for specific reef sites around Guam. The data that are available, however, indicate that coral cover on the forereef slope (i.e., reef areas seaward of where the waves break) **decreased from an average of about 50% in the 1960s to less than 25% by the 1990s**. Percent coral cover, as measured during rapid ecological assessments conducted as part of the NOAA MARAMP at several sites around the island in 2005 ranged from about 12% on the southwest coast to 38% on the west side of the island. Average coral cover for Guam was about 26%. The results of towed diver surveys, which cover large distances, conducted during the same expedition yielded similar results, with coral cover similar in the west/northwest, east/northeast, and east/southeast regions of the island (25%, 26%, and 26%, respectively), while coral cover was lowest in the west/southwest region (12%). The comparatively low coral cover along the southwest coast may be a result of extensive coral mortality caused by sedimentation associated with a poorly-planned road construction project in the early 1990s, the continued poor water quality near the many river mouths along that section of coastline, and predation of corals by the crown of thorns seastar.



A severely degraded reef between Cetti and Fouha Bays, in southwestern Guam. Little living coral, and few fish, remain on this and other reefs along the southwest coast. This reef has likely been impacted by several stressors, but the improper construction of the nearby road about 20 years ago is reported to have caused widespread coral death from which this and other reefs have not recovered. Photo: D. Burdick.



A 2005 satellite image showing large areas of exposed soil and recently-burned areas in southwestern Guam (top) and a plume of sediment-laden water moving onto the near Anae Island (bottom). Quickbird image provided by DigitalGlobe. Photo: D. Burdick.

The results of baseline reef community surveys conducted by the UOG Marine Lab at five permanent monitoring sites indicate that live coral cover was highly variable between sites and ranged from less than 10% at the Pago Bay site, which has been heavily impacted by poor water quality and crown of thorns predation, to greater than 80% at a site within Apra Harbor mainly dominated by the coral

Only rubble remains where extensive fields of staghorn coral were once found on the reef flat in Piti Bay (pictured above) and other reef flat sites around Guam. Poor water quality, a result of improper upland development, wildland arson, and other sources of erosion, is likely a major contributor to the significant decline in this coral. Photo: D. Burdick.

species, *Porites rus*. Continued monitoring of these sites will provide insight into long-term trends in these coral reef communities; additional sites will be established as part of a new comprehensive coral reef monitoring program.

Baseline coral disease assessments conducted in 2006 by the Marine Lab at several sites around the island found that diseases affecting Guam's reefs are largely similar to those reported elsewhere in the region. Of the 10 sites surveyed around Guam, three sites exhibited disease prevalence values >10%, which can be considered high and potentially problematic.

Water Quality

Extremely high sedimentation rates (i.e., the amount of soil from the uplands entering the ocean during a certain period of time) continue to be devastating for reefs near river mouths.

A 2005 National Park Service study found that **sedimentation rates in Asan Bay were among the highest reported from around the world**. The extremely elevated rate of sedimentation raises serious concerns about the long term health and survival of some of Guam's reefs. A related National Park Service study that examined the relationship between sedimentation and coral recruitment in Asan Bay over a two-year period observed rates of coral recruitment that were among the lowest reported in the scientific literature; these rates were 10-100 times lower than recruitment rates reported for Guam in the 1980s.

A 2004 Marine Lab study found that sedimentation rates were extremely high within Fouha Bay, greatly exceeding any of the several published sediment-tolerance thresholds for corals. A comparison of the results of coral community surveys conducted within the bay indicated a steep decline in the number of coral species over a 25-yr period, with more than 100 species reported in 1978 and fewer than 50 found in 2003.

Reef fishes and other reef-associated marine life

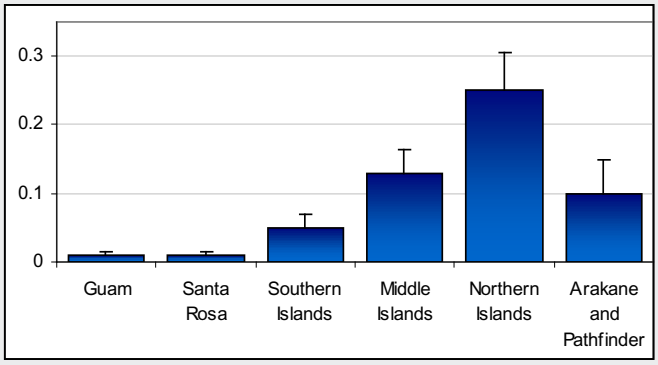
Guam's coral reef fisheries are both economically and culturally important and target a large number of reef fishes and invertebrates. Despite improvements in gear and technology, however, Guam's fishery catches have declined significantly over at least the last few decades. Data from creel surveys performed by DAWR suggest that Guam's fisheries have not recovered from a sharp decline in the 1980s. A recent re-estimation of small-scale fishery catches for Guam suggests that catches have declined by up to 86% since 1950. While there are other factors involved in this decline, fisheries impacts are certainly a major contributor.

*A young humphead wrasse (*tanguison) *and a humphead parrotfish (*atuhong). *These fish species have become increasingly rare on Guam, likely a result of the use of scuba spearfishing. Photos: D. Burdick.*

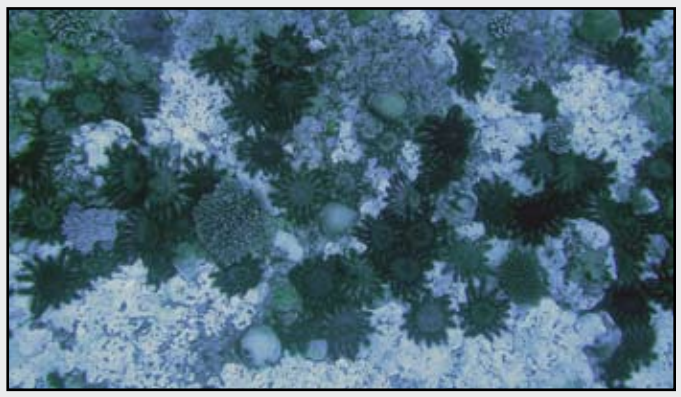
In-water visual surveys have also indicated that large reef fish are still conspicuously absent from many of Guam's reefs, including reefs with relatively healthy coral communities. The results of recent NOAA surveys indicate that the amount of large reef fish (> 19 in) is five times greater around neighboring islands in the southern Marianas than around Guam and Santa Rosa Bank and 25 times greater in the more remote northern islands.

Particular concern has been raised over the use of SCUBA and flashlights for spear fishing, along with the continued use of monofilament gill nets. These methods have been banned or heavily restricted in most of the Pacific region, including the Commonwealth of the Northern Mariana Islands and American Samoa, but remain legal on Guam. Local fisheries biologists suggest that these methods may have led to a boom and bust harvest of large Napoleon wrasse, the depletion of large groupers, a shift from preferred species (large slow-growing fish) to smaller, faster growing species, and a decrease in the number of other large wrasse, parrotfish, snapper, and grouper caught by other methods.

The results of macroinvertebrate (e.g., sea stars, urchins, *Trochus*, sea cucumbers, lobsters, etc.) surveys conducted in 2005 and 2007 as part of NOAA's MARAMP indicate that abundance of these organisms was relatively low around the island, with the exception of high urchin and



Large fish (>19 in) biomass (tons/hectare) measured on towed-diver surveys in the Mariana Islands in 2005. Source: Burdick et al., 2008.



A large group of crown of thorns sea stars feeding on coral near Tanguisson Pt. in 2006. The white area at the bottom of the photo is the area of coral recently eaten by the sea stars. Photo: Ciemon Caballes.

exceptionally high crown of thorns seastar densities at some sites. Manta tow surveys conducted by the Marine Lab in 2006 corroborate the results of the NOAA surveys, with large crown of thorns seastar outbreaks and heavy coral mortality evident around the island.

What's being done to stop the reef decline?

A broad network of local and federal agencies, NGOs, legislators, private enterprises, teachers, students and other concerned citizens continue to partner in the implementation of ambitious and creative ways to address the threats to Guam's coral reefs. Re-vegetation efforts, outreach campaigns, enforcement of the marine preserves, development of a comprehensive coral reef monitoring strategy, the strengthening of existing policies and the planned implementation of new ones are all examples of Guam's commitment to improving the health of its coral reef resources. Major public works projects, including the extension of sewage outfalls and the closing of Ordot dump, will also contribute to a healthier reef system. Guam's participation in the Micronesia Challenge represents a major step towards effective management of the island's natural resources, setting achievable conservation goals, identifying sustainable financing strategies, and providing an opportunity to further engage the community in natural resource management. An increasing level of community participation in cleanups and erosion control efforts, as well as the success of recent outreach and education activities, indicate that public awareness is increasing.

Challenges remain, but there are solutions

Although Guam has made a great deal of progress in coral reef protection, monitoring, and public outreach over the past several years, many challenges still remain and the health of Guam's coral reefs continues to decline. Financial and human resources remain limited compared to the need, and are disproportionately low compared to the value of goods and services generated by coral reefs. Present capacity will be further stretched by the planned military expansion.

Global climate change poses a particularly grave and increasingly pressing threat to the vitality of Guam's reefs. The expected increase in incidences of coral bleaching, ocean acidification and the potential for stronger storms will directly affect reef health, challenging even the most resilient reefs.

Bleached staghorn coral at Ypao Beach in August 2007. Bleaching events like this are expected to become more frequent and more severe as climate change causes sea surface temperatures to increase, potentially causing widespread coral death. Photo: D. Burdick.

Are Guam's Marine Preserves working?

To help combat fishery declines, the Government of Guam created a system of five Marine Preserves. The results of initial surveys conducted by DAWR, and reported to the Guam Legislature in 2003 as required by the law, show that fish stocks in the preserves increased significantly after enforcement began in 2001, indicating that the preserves are working as designed. In fact, **reef fish abundance increased by over 100% in both the Piti and Achang Marine Preserves after only 3 years of protection**. Two recent Marine Lab studies indicated that the biomass of certain reef fish groups is significantly higher inside the preserves than in nearby non-protected areas. Further studies, in conjunction with the regular creel survey monitoring conducted by DAWR, will help determine if the spillover of adult fishes and fish larvae are helping to restore reef stocks around the island.

Algae-eating fishes such as parrotfishes and surgeonfishes play an important role in keeping reefs health by eating algae that compete with coral for space. Marine preserves provide an area for these fish to grow large and produce lots of eggs. Photo: D. Burdick.

Policy interventions must be prioritized in an economically sound manner in order to most efficiently allocate the limited financial and human resources available to coral reef managers to address pressing issues of coral reef degradation. Site-based approaches, involving strong community participation and a coordinated network of multiple organizations, could focus resources on management actions that address a range of threats within a specific area. The financial and staff capacity of the resource management community must be significantly increased if current coral reef threats and threats associated with climate change and the anticipated military expansion are to be adequately addressed. Three specific priority projects recommended for immediate implementation include the use of stop-gap measures to greatly reduce soil erosion in southern Guam, the subsequent, rapid, large-scale restoration of southern watersheds, and an island-wide ban on the use of monofilament gillnets and SCUBA for spearfishing. **Without a substantial reduction in the amount of sediment reaching the reef and the recovery of reef fish stocks, particularly algae-eating fishes like parrotfishes and surgeonfishes, the recovery of Guam's degraded reefs, and the survival of even the healthiest reefs in the face of climate change is in serious question.**

Recommended actions for immediate implementation:

- **Carry out stream bank stabilization projects and other stop-gap measures to significantly reduce upland soil erosion**
- **Adopt and strictly enforce progressive land use plan and soil erosion and stormwater management regulations to minimize impact of coastal development**
- **Ban harmful, non-traditional fishing methods such as scuba spearfishing and the use of monofilament gillnets**

If you have any questions about the information presented in this report or if you would like to receive an electronic version of this document, the full report, or previous reports, please contact the Bureau of Statistics and Plans at 472-4201.