

2nd Annual Coral Reef Conservation and Management Conference

November 8-9, 2006 - James L. Knight International Center - Miami FL

Conference agenda with a brief synopsis of talks

Wednesday, November 8

An Overview of the Threats to Reef Ecosystems

a.k.a. **“Type I and Type II Statistical Errors in Reef Conservation and Management: Making Bad Decisions for all the Wrong Reasons”**

William F. Prechet

Ecological Sciences Program Manager, PBS&J

Prechet opened the conference by calling to question the causes behind coral reef decline. Discovery Bay Jamaica received significant attention stemming from Dr. Jeremy Jackson's previous research that attributed coral decline to a pathogen that caused sea urchin (*Diadema*) mortality. Prechet discussed potential causes behind coral decline in general, including top-down over fishing of herbivores, bottom-up water quality issues, and the side impacts of global climate change. To begin, he mentioned that often anthropogenic causes are blamed for coral reef decline but that at San Salvador Island with no run off, no agriculture, and low populations, it has similar rates of decline as Florida's coral reefs. He continues to discuss the causes of coral reef decline in San Salvador and asks if the precautionary principle should be exercised there. When bringing up Discovery Bay he advocates alternative causes to coral reef decline such as coral mortality itself (caused by white banding disease and coral bleaching). He discussed the possibility that corals in Discovery Bay died due to global factors as opposed to local causes. As a result, his talk provoked lots of discussion regarding the need to manage at the local level. One attendee mentioned that even if global causes are to blame for coral declines in Discovery Bay that local management for healthy coral reefs will only help those coral communities to survive. She analogized coral reefs to humans that are likely to incur great mortality with suppressed immune systems during flu season. This talk provoked scientists and managers to question and attempt to address how local management of coral reefs can protect or improve resilience to global threats (e.g. disease, global warming).

Coral Reef Conservation-What are the Needs?

a.k.a. **“Coral Reef Decline: Science and a Strategy for Reversal of Fortune”**

Jean-Francois Bertrand (Graduate student under advisement by Les Kaufman)

Boston University, Marine Management Area Science Program

Bertrand begins by asking the question, “What can we as scientists do to reverse declines?” He reviewed a series of causal factors that operate at hierarchical spatial scales, including: extraction beyond sustainable levels, watershed impacts, global market impacts, and global warming/ocean

chemistry impacts. Cumulative inputs from each of these factors reduce MPA effectiveness. Therefore, as scientists it is important to inventory conservation methods and discuss what science can offer conservation and management. Some of the tools that are available include: Marine Management Areas (MMAs) and Marine Protected Areas (MPAs), proactive management (e.g. watershed protection and restoration, artificial reefs, restocking, etc.), education, and adaptive management. A challenge to management in general is the need to think globally and act locally. This background information prompted his further discussion of how science can be used to compare management regimes. Through a large Marine Management Science Program, Bertrand and others are comparing management treatments while monitoring coral reefs and examining their connectivity (genetic, dispersal) and resiliency. Lastly, he asked a provocative question, "When are our answers good enough for application." This question spurred lots of discussion as to when science is "sound enough" or whether science should keep asking questions that we already have some answers for. The overall consensus of the participants was that science should not stop and that management should use the best science available.

Shifting Baselines and Science Based Management

Steven Miller, Research Professor

University of North Carolina Wilmington, Center for Marine Science

Miller is a coral reef ecologist that is involved with a non-profit group called Shifting Baselines. Shifting baselines is a mass media campaign to use entertainment to get messages across. It primarily deals with the idea that we shift our baselines of comparison without realizing it. One example is fishing 100 cm fish at the turn of the century, then being excited about 80 cm fish, and now being excited about 60cm fish. As we do not see the change from the past to today, our baselines have shifted. Another example discussed the concept that the percent of coastlines open can change from 100% to 90% and then to 80% and we remain happy because we don't hold our baseline at 100%. A more detailed explanation of the organization is available at www.shiftingbaselines.org. Miller showed a variety of ads with different targets (e.g. head, heart, gut, etc.). He also showed several public service announcements and film clips that used humor to demonstrate coral reef decline. One example is the *sick ocean symphony* conducted by Jack Black (available at their website). Miller comments that we can't get people to care about what we are losing but we can provide them with information. He also mentions that as the battle is being fought to get people to care about the loss and degradation of our natural resources including coral reefs, other groups are banning together to discredit conservation campaigns.

Understanding Regional Causes of Coral Mortality

John Bruno, Research Professor

University of North Carolina Chapel Hill, Department of Marine Science

Bruno looked at regional and global patterns of coral reef decline. When looking at management efforts one could rank coral reefs globally; however, reefs with different levels of management can also be highly similar in percent coral cover. Additionally, he brought up the point that coral morphology influences coral cover which may make coral cover misleading when comparing taxa that have different morphological structures. When looking at effects of bleaching on coral reefs

he mentions that synergistic effects of coral cover and high sea surface temperatures (SST) may be influenced by coral density. Additionally, the use of percent coral cover as a proxy for coral health relies on the assumption that coral health and percent coral cover are linked (which he suggests as potentially not being the case). Depth can also skew comparisons as SST anomalies plus Ultra Violet light produce feedbacks that actually cause bleaching. Therefore, deep corals with limited UV radiation but high SST anomalies may not cause declines in percent coral cover. Bruno suggests that future research should focus on testing ideas of coral resilience looking at how coral cover and/or fish biomass buffer declines.

The Future of Coral Reef Ecosystems

Robert van Woesik, Research Professor
Florida Institute of Technology, Department of Biological Sciences

This presentation nicely followed that of Bruno because it discussed the strength of the relationship between SSTs and coral cover/health. Van Woesik discussed how global climate change may alter coral reef communities by selecting for smaller colonies that can therefore effect reproduction. Often the effects of global climate change are not all consistent in all coral colonies; therefore, global warming may cause some corals to loose and others to win. Coral tolerance during high SSTs depends on a variety of conditions including: local light conditions, water flow rates, colony size, colony shape, and species. Lastly, projected climate change may drive temperatures and sea water chemistry to levels outside of modern reef experiences which could affect the ability of corals to persist.

Managing Coral Reefs in the Context of the Human Footprint

a.k.a. “Managing Coral Reefs under the Human Footprint”

Andrew C. Baker, Research Professor
University of Miami, Division of Marine Biology and Fisheries

Baker's presentation stems from the criticisms of Pandolfi and others recent *Science* paper entitled, “Are U.S. Coral Reefs on the Slippery Slope to Slime.” Baker suggests that it is difficult to compare coral reefs from different regions and that we should instead be looking at percent reef degradation vs. a proxy called the human footprint (Sanderson et al. 2002, *BioScience* 52: 891-904). Baker begins the presentation by describing the results of football matches in Europe, mentioning the difficulty in comparing English to Italian teams and the need for playoffs. Thus, the focus of his presentation was on the potential use of such metrics and how human footprint proxies may assist in understanding levels of coral reef degradation. He plots a terrestrial measure of the human footprint verses percent reef degradation for all of the reefs included in the Pandolfi and others study. When using a dose-response curve (humans=the dose, ecosystems=the response), US managed reefs appear healthier than inferred by Pandolfi et al. While outliers do occur representing both degraded and healthy reefs this is likely caused because the human footprint does not capture local impacts (e.g. fishing vs. non-fishing communities), distance impacts, differential natural resilience of reef communities, and differential management effectiveness. The results of Baker's analysis show that eastern Panama, the

Bahamas, and Moreton Bay are at least as degraded as US reefs but have lower human footprint values, therefore, indicating that US reefs are potentially doing better per the impact factor. Baker also emphasizes the importance of developing a marine human footprint proxy and the need to take these impact factors into account when managing marine ecosystems. Additionally, management should consider ways to reduce human footprints in both terrestrial and marine systems.

Thursday, November 9

Coral Distribution, Abundance and Recruitment with Genetic Affinities in the Northern Gulf of Mexico: Implication for Reef Conservation and Management

Paul Sammarco
LUMCON

Sammarco discussed coral reef management in the Gulf of Mexico with reference to the Flower Garden Banks and the formation of reefs on oil barges. He examined how isolated the Flower Garden Banks are (via coral distribution and abundance), coral recruitment (on vs. around the Flower Garden Banks), and genetic affinities within and between the Flower Garden Banks and other populations in the Florida Keys and Bahamas. Sammarco found no significant relationship between coral abundance or species diversity of corals on platforms and distance from the Flower Garden Banks. There was also no significant relationship between *Diploria strigosa* abundance and platform age but he found a negative relationship between *Tubastrea coccinea* and platform age in shallow water. Additionally, a significant positive relationship between platform age and the number of coral species occurs in Hermatypic corals. Sammarco showed the results of cross-shelf transects of platforms at various longitudes in the Gulf of Mexico (e.g. coral density, etc...) Additionally, he used amplified fragment length polymorphisms to look at degrees of self-recognition, cross-recognition, gene flow, and self-seeding of dominant corals (*Diploria strigosa*, *Madracis decactis*). In addition to numerous scientific results and conclusions, one that stands out is that the Flower Garden Banks are very isolated (e.g. genetically) reefs requiring high degrees of protection.

A Coral Reef Before and After Protection: A Case Study at the Flower Garden Banks, Northwest Gulf of Mexico

Ken Deslarzes, Senior Marine Ecologist
Geo-Marine, Inc.

Deslarzes was an ideal follow up to Sammarco's talk as he discussed the need to protect the Flower Garden Banks. A current and ongoing threat to the Flower Garden Banks includes the oil industry's drilling, exploration, and subsequent damage by these factors. Strong trace metals have also been measured within 100 to 1000 m of the platforms. Protective measures for the Flower Garden Banks include anchor regulation, the prohibition of fishing in manners other than hook and line, and limits to diver visits to reduce oil from these boats. The anchor regulations, while they carry fines are often hard to enforce. However, citizens have been very proactive and voluntarily put in mooring booths. Additionally, the hook and line regulations allow for fishing with no limits by either private individuals or commercial groups. Deslarzes discusses the possibility of invoking the precautionary principle that would more heavily regulate the number of fish taken from this area. Lastly, he discussed the need to make sure the Flower Garden Banks are healthy in order to help insure greater resilience to potential global disease (i.e. you have a better chance of surviving flue or plague if you are healthy as opposed to immune-suppressed).

Trophic Cascades and Marine Protected Areas

Burton Shank (Graduate student under advisement by Les Kaufman)
Boston University

Shank's discussion focused on understanding trophic cascades, their assumptions, and implications for MPAs. He opened by mentioning that fishing and benthic dynamics are frequently linked. It is also often assumed that fishing is detrimental to the overall health of coral reefs through trophic linkages. However, the links between reef health and fish populations are still very poorly understood. The assumptions behind trophic cascades are important to note. These include, the following: ecosystems tend toward equilibrium states, trophic levels are discrete (no omnivory), and herbivore and primary producers are controlled by top-down influences (i.e. no recruitment limitation). Shank proceeds to build a marine food web from an unrealistic simple model to a more complex model involving multiple connections. He proceeds to demonstrate that coral reef trophic levels are not discrete and many organisms eat at multiple trophic levels. He also discusses how various fishing pressures may impact the rest of the food web. He states, "In this greatly-simplified model, intensive fishing modifies a diverse system from a robust, resistant community to a depauperate, unbalanced system with the potential for catastrophic shifts. However, more than one trophic level and guild had to be removed to create these conditions." Lastly, he points out that there is a lot that is not known that needs to be modeled into these systems to better understand the effects of fishing on the entire food web.

Global Change and Biotic Homogenization of Coral Reefs

William F. Precht, Richard Aaronson, Ian Macintyre
Presented by Precht, Ecological Sciences Program Manager, PBS&J

Precht opens his talk with the statement, "Global loss of biodiversity is really stupid." He then proceeds to explain how biotic homogenization occurs, explaining that intense, prolonged, or frequent perturbations allow stress and disturbance tolerant species to dominate which reduces variability among local assemblages (beta diversity). In short, long lived species are replaced by short-lived species. Precht then asks how beta diversity has changed in the past. In order to answer this question he examined the paleoecology of coral reefs in Belize (Barrier Reef) and Panama (Bahía Almirante). The research team took 5 m long cores at these sites to compare coral diversity over time. In Belize they had 20 coring sites within a 375 km² area with a minimum of 2 cores sampled at each site, with a total of approximately 50 cores. They were able to determine that previous excursions from *Acropora* dominated corals were rare within the last 3000 years; therefore, turnover events were recent. In Panama 12 coring stations were set up within a 125 km² area. These cores revealed a dominance of *Porites* with rare excursions. Similarly, the scale of turnover events increased recently. Precht concluded that zonation emerged for the first time in both of these areas, recently, for different reasons having to do with the depth of water and water quality issues. He also suggested that increased between-habitat diversity is what drove a reduction in geographic scale diversity; therefore local, regional, and global-scale perturbations are homogenizing reefs. Thus, it is important to understand the life history and functional ecology of dominant corals over time to properly manage and conserve coral reef ecosystems.

Coral Reef Restoration: What to Restore and Why?

Michael Moore, Founder

EcoReefs, Inc.

Moore, the founder of a coral reef restoration organization, discussed how artificial reefs can help facilitate coral recruitment and restore areas that have been previously devastated. His artificial ceramic modules are mass produced, assembled on site, and installed in close packed groups. These modules provide dense canopy habitat for small grazers, site-scale sediment stabilization, substrates for coral recruits, and they have a high niche potential. Ceramic is the preferred material because it is non-toxic, pH neutral, non-reactive with salt-water, has micro-porous surfaces that have been sterilized during firing, it can be formed into realistic coral shapes, and can be mass produced. Moore tried to dissuade people from using such material as cars, tires, etc.. Also, by using less durable materials (i.e. ceramic) it facilitates natural successional processes. If done right he believes that within 10-20 years there should be little to no evidence of his artificial reefs. In conclusion, reef restoration goals should drive technology as opposed to using materials opportunistically. Moore also stressed the need to involve communities in restoration projects. Through involving communities in the building and installation of reefs, a feeling of community ownership of the restoration project is fostered. This support is necessary for long term successes in coral restoration.