Report of the Coral Disease Working Group
Workshop on Coral Disease in East Africa

Report Contents	Page

This workshop was generously funded with support from the Khaled bin Sultan Living Oceans Foundation and the World Bank/GEF CRTR Program. It was a collaborative effort among the Disease Working Group of the CRTR program, and the Institute for Marine Sciences, with help from the Western Indian Ocean Marine Science Association (WIOMSA), the E Africa Coral Reef Task Force, Cornell University and the Australian Research Council COE for Coral Reef Studies.

Executive summary

The Coral Disease Working Group organized and conducted a workshop on coral reef diseases at the Institute of Marine Sciences, University of Dar es Salaam, Zanzibar, from 3rd April to 7th April 2006. The goal of this workshop was to bring together local scientists, students and NGO's to help integrate regional monitoring for coral disease in the Western Indian Ocean. In all, we had 25 participants from Tanzania, Kenya, Comoros, the Seychelles, Madagascar and Mozambique. Participants included program directors, scientists, research assistants and graduate students—all who are actually working in the field, observing their regional reefs. Through lectures, laboratory activities and field exercises and explorations, participants learned how to identify diseases of coral reef organisms, methods for identifying potential pathogens, and methods for monitoring coral disease. Armed with this new knowledge, participants were charged with sharing this information with colleagues and with trying to set up monitoring programs in their regions. Our goal is to write a collaborative paper on coral disease in the Western Indian Ocean in one year.

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Workshop Schedule

MONDAY, April 3rd		
10:00-11:00 AM		Registration at IMS
11:00-11:15 AM	Alphonse Dubi, Director IMS	Welcoming Remarks
11:15-11:25 AM	All	Self Introductions
11:25-12:10 PM	Bette Willis	Overview of DWG Objectives
12:10 - 12:20 PM	Vice Chancellor, Univ of Dar es Salaam	Opening Speech
12:20- 12:30 PM	All	Group Photo
12:40 PM		Lunch Serena Hotel
2:00 -2:30 PM	Annelise Hagan	Living Oceans Foundation
2:30 - 3:15 PM	Ernesto Weil	Coral reef disease in the Caribbean vs. Indo-Pacific.
3:30 - 4:15 PM	Bette Willis	Emerging Diseases on the Great Barrier Reef
7:00 PM		Dinner Together
TUESDAY, April 4th		
AM - Introduction to Coral and Disease		
9:15-10:00 AM	Chris Muhando	E. African Coral Reefs
10:00 - 10:45 AM	Ernesto Weil	Identifying Caribbean diseases
11:00 - 11:45 AM	Tim McClanahan	Disease and Bleaching in E African Reefs
11:45 - 12:30 PM	Garriet Smith	Methods to study the microbiology of coral disease
PM - Coral Taxonomy and Disease		
300 - 430 PM	Garriet Smith	Microbiology lab: isolating potential pathogens
4:30 - 530 PM	Bette Willis/ Ernesto Weil	Disease lab: examining diseased coral
WEDNESDAY,April 5th		
AM – Identifying Coral Diseases		
900 AM- 230 PM	Bette Willis/ Ernesto Weil	Snorkel trail: field-based introduction to coral and diseases
PM – Coral Disease Laboratory		
330- 430 PM	Garriet Smith,Sue Merkel	Laboratory: coral diseases and pathogens
4:30 -5:30 PM	Bette Willis	Survey Methods: the importance of comparable data
5:30-6:00 PM	Ernesto Weil	Photos from today's snorkel
Thursday, April 6th		
Disease Surveys		
900 AM- 200 PM	Bette Willis, Ernesto Weil	Snorkelling workshop on survey methods
		SCUBA Surveys of coral disease
3:30-4:00 PM	Garriet Smith,Sue Merkel	Laboratory: coral diseases and pathogens
4:00- 5:00 PM	All	Round table discussion on survey methods
7:00 PM		Dinner together at Tembo House
Friday, April 7th		
AM - Surveys and Experiments		
9:00 –10:00 AM	Bette W, Ernesto W., Tim M.	Results from monitoring surveys (Transect v Tim swim)
10:00– 11:00 AM	Ernesto W.	Review disease identification
11:00 AM-12 noon	Ernesto W., Sue M.	Discussion of monitoring plans ; Evaluation
3:00- 3:30 PM	Garriet Smith	Laboratory review of microbiology
3:30 PM	All	Issue certificates

Summaries of Talks Given

[NOTE: the computer files referred to in the text can be found on the Coral Disease CD that accompanies this report]

Overview of the GEF Coral Disease Working Group
Bette Willis, School of Marine Biology and Aquaculture, James Cook University, AUS
[See Coral Disease CD: Willis 1 DWG Overview.pdf]

Over the past 20 years, coral reefs have been under increasing stress from natural and anthropogenic impacts, including climate warming, poor water quality and over-fishing. As a consequence, coral reefs worldwide are in serious decline. In recognition of the risk that such declines contribute to the environmental and economic instability of many coastal nations, The Coral Reef Targeted Research and Capacity Building for Management (CRTR) Program was established in December 2004. The CRTR Program is primarily funded by the Global Environmental Facility (GEF) through one of its three implementation agencies, the World Bank, with other partners including NOAA, IOC/UNESCO and approximately 50 research institutes and other third parties around the world. The overarching goal of the CRTR Program is to address gaps in our basic knowledge and understanding of coral reef ecosystems so that management options and policy interventions can be strengthened globally. This is being accomplished by aligning the expertise and resources of the global coral reef community around six key research areas (Bleaching, Connectivity, Coral Disease, Restoration and Remediation, Remote Sensing, and Modeling and Decision Support) related to the resilience and vulnerability of coral reef ecosystems. Working Groups have been charged with identifying and addressing key questions in each of these six areas. A major goal of the CRTR Program will be to integrate and disseminate research from the six Working Groups in formats readily accessible to managers and decision-makers. [For more information, see: **http://www.gefcoral.org/**]

The Khaled bin Sultan Living Oceans Foundation
Annelise Hagan, Living Oceans Foundation, currently at University of Cambridge, UK.
[See Coral Disease CD: Hagan_Living Oceans pres 3-4-06.ppt]

The Living Ocean Foundation has a “science without borders” philosophy. Its goals are to partnerships with governments, the private sector, scientists and conservationists from around the world to leverage resources, ideas and commitment to make substantial progress toward preserving our ocean ecosystems. Efforts must address all major threats (over-fishing, pollution,

disease, global warming) simultaneously on large regional ecosystem scales. the MY Golden Shadow (research vessel), they have initiated studies using remote sensing to assess habitat types over huge areas of coastal waters. Teams of scientists do air surveys and ground truthing to produce GIS maps. Preliminary studies have been done in Virgin Islands, Burmuda and the Saychelles. In 2006, they will engage in a Red Sea Expedition to habitat map the Farasan Islands Marine Protected Area (MPA), Saudi Arabia. They also supported an impact assessment of the Indonesian tsunami. The Khaled bin Sultan Living Oceans Foundation sponsors graduate fellowships for masters and doctoral students as well as post-doctoral researchers whose research focuses on conserving, protecting and rehabilitating marine resources. [For more information, see: http://www.livingoceansfoundation.org/]

Coral reef diseases in the Caribbean and Indo-Pacific
Ernesto Weil, Department of Marine Biology, University of Puerto Rico
[see Coral Disease CD: Weil-1-Overview of Caribbean.pdf]

Over the past decades, a combination of natural and anthropogenic factors has been putting increasing stress on coral reefs. These factors may act alone or in synergy and might be highly variable at spatial and temporal scales. Bleaching and infectious diseases are two "natural" factors that have become major players in the deterioration dynamics of coral reefs world-wide. The Caribbean is a relatively small, partially enclosed and highly interconnected water body surrounded by dense human populations. The wider Caribbean includes the Gulf of Mexico, Florida, the Bahamas, and Bermuda, all interconnected by the flow of Caribbean waters and the Gulf Stream. Only about 8% of the coral reef area of the word is found in this region, yet over 65 % of all disease/syndrome reports up to the year 2000 came from 38 Caribbean nations. Epizootic events in the early 1980's produced significant losses in keystone populations that brought about a cascade of ecological changes in the structure and dynamics of coral reefs over an unprecedented wide geographic range. Reports of disease outbreaks in several localities of the Caribbean are increasing every year. Because of the fast emergence and high prevalence of coral reef diseases and syndromes, their widespread distribution, and frequent epizootic events with significant coral mortalities, the Caribbean has been dubbed a "disease hot spot". Fewer diseases/syndromes with generally low prevalence, restricted geographic distributions and host ranges have been reported for the Indo-Pacific and the Red Sea. This scenario however, might change in the near future, as environmental conditions change.

Emerging Diseases on the Great Barrier Reef, Disease Outbreaks on Indo-Pacific Reefs and Potential Drivers
Bette Willis, School of Marine Biology and Aquaculture, James Cook University
[see Coral Disease CD: Willis 2 GBR IP Disease Outbreaks.pdf]

While diseases of coral reef organisms have been increasing, particularly in the Caribbean, comparatively little is known about coral disease in the Indo-Pacific. As part of the CRTR, we are starting studies to understand the impacts of localized stress and climate change on coral disease on Australia's Great Barrier Reef (GBR). Baseline surveys of coral disease, started in 2002, provide some understanding of the epidemiology of disease in the region. Results from these surveys disprove the tacit assumption that coral disease on the GBR is rare and that it has little impact on coral communities. Surveys of disease prevalence on 21 reefs spanning more than 1500 km indicate that six disease states [skeletal eroding band, white syndrome, black band disease, other cyanobacterial syndromes, brown band and tumors] are widely distributed. These six diseases are found in the northern, central and southern sectors of the GBR and affect species in at least three of the more abundant coral families.

Climate change may be playing a role in the dynamics of coral disease outbreaks. On the GBR, seasonal patterns in coral disease show dramatic increases in prevalence between winter and summer surveys in all major families of coral. For example, disease increased fifteen-fold in acroporids, twelve-fold in faviids and doubled in pocilloporids in summer surveys. Prevalence of 3 coral diseases increased significantly in summer surveys, with skeletal eroding band increasing more than two-fold, black band and other cyanobacterial infections more than three-fold and white syndrome more than fifty-fold.

Table 1. Most common reported diseases (D) and syndromes (S) of Caribbean sessile coral reef organisms [scleractinian corals (COR), octocoral (OCT)], their acronym, identified pathogen (s), and number of taxa affected. *= Kochs postulates fulfilled. From Weil et al. (2006).

Disease (D) / syndrome (S)	**Acronym [1]**	**Pathogen**	**Number of species infected**	
			COR	**OCT**
Caribbean				
Black band (D)	BBD	*P. coralliticum*, *Desulfovibrio, Beggiatoa* sp	19	6
White band – I	WBD-I	Gram (-) bacterium	2	
White band – II (D)*	WBD-II	*Vibrio harveyi/charchariae*	2	
White plague-I	WP-I	Gram (-) bacterium	12	
White plague-II (D)*	WP-II	*Aurantimonas coralicida*	41	
Aspergillosis (D)*	ASP	*Aspergillus sidowii*		10
White pox (D)*	WPX	*Serratia marsences*	1	
Tumors[2] (D)	TUM	*A. endozoica* (algae) and other causes	7	5
Red band (D)	RBD	*Oscillatoria* sp. and other cianobacteria	13	1
Yellow blotch(S)	YBS [a]	*Vibrio* sp ?	11	
Dark spots-I (S)	DSS-I [a]	*Vibrio* sp ?	10	
Dark bands (S)	DBS-II [a]	?	8	
Patchy necrosis[3] (S)	PNE [a]	?	1	
Indo-Pacific-Mediterranean				
Porites trematodiasis	PTR	*Podocatyloides stenometra*	4	-
Skeletal eroding band	SEB	*Halofolliculina corallasia*	2	-
Brown band	BrB	New species of ciliate–not described	2	-
Porites ulcerative white spots	PUWS [a]	*Vibrio* sp	3	-
Bacterial bleaching	BBL	*Vibrio shiloi*	1	-
Bacterial bleaching	BBL	*Vibrio coralliilyticus*	1	-

[1] Commonly used and modified acronym for each disease/syndrome.
[2] Tumors include hyperplasias and algal tumors.
[3] Patchy necrosis and white pox are considered the same by some researchers.
[a] Samples currently under investigation to identify putative pathogens.

Coral Reef Issues in Tanzania

Chris Muhando, Institute of Marine Sciences, University of Dar es Salaam, Zanzibar.

[see Coral Disease CD: CD_Wrkshp_Status of Coral reef_Tz_5.ppt]

Stressors to coral reefs include over fishing and destructive fishing practices, sedimentation from river mouths and pollution. A massive coral bleaching event in 1998 caused from 20-89% mortality. Algal overgrowth often follows. Crown of thorns starfish infestation began in 1996, causing up to 40% mortality in some sites. Settlement does not seem to be limited to larval numbers. This is an ongoing research project at the IMS Center of Excellence. Coral reefs are being monitored through a joint program with the IMS, the Tanga Coastal Zone Conservation and Development Program, and the Kinondoni Coastal Area Management Programme. This includes monitoring for benthic cover, macro-invertebrates, and for reef fish. Results show there is high variability is reef benthos; a high density of sea urchins and crown-of-thorns starfish; and increasing fish density in protected areas.

Planned research activity at the IMS COE include: investigations on coral settlement, recruitment, restoration and associated environmental factors; mapping and characterization of coral reefs and associated threats, and information dissemination on coral reefs and indigenous knowledge. [For more information on the GEF COE, see:

http://www.gefcoral.org/CentresofbrnbspnbspnbspExcellence/EasternAfricaCentreofExcellenceTanzania/tabid/342/Default.aspx]

Disease and Bleaching in East African Reefs

Tim McClanahan, Wildlife Conservation Society, Marine Program, Bronx, NY

[see Coral Disease CD: DiseaseEastAfrica.ppt]

The paper will discuss the recent history of two bandless diseases observed along the East African coast. One is similar to white plague reported in the Caribbean that caused mass mortality of corals in 2002 and the second is a tumor-forming syndrome that forms on massive *Porites* and studied in some detail in 2005. The white plague-like syndrome emerged in early 2002 caused coral mortality occurred along 600 km of coastline from Tanzania to Kenya and has since been rarely observed. *Astreopora*, *Echinopora*, and *Montipora* species were severely affected, with *Montipora* being nearly eliminated from Kenyan reefs. *Acropora*, *Platygyra, Goniopora*, and massive *Porites* were also affected; however, *Porites* and *Goniopora* rarely died and often recovered, whereas death for most other species occurred within two weeks. In *Echinopora* and *Montipora*, a dull ashy tissue color and brittle skeletons characterized the early stages of this event with a mucus layer on the tissue surface evident in intermediate stages. Mucus and embedded debris then disappeared and surfaces were left covered in a white calcareous dust that sometimes capped a black layer. *Astreopora* tissues became dull and pale, seldom produced mucus, and eventually the skeleton became bare and white. Either a colorless translucent or brownish thin margin of tissue was visible between living tissue and bare skeleton, depending on coral species. Tumors are prevalent in as many as 15% of the massive *Porites* colonies and appear to persist for many years. Studies in 2005 found they were most closely correlated with bleaching and associated environmental factors. Scanning electron micrographs of affected corals in both syndromes revealed the presence of fungi. I have developed a hypothetical model that relates coral bleaching to bandless disease syndromes where fungi are present and suggest this as a possible link between bleaching and these syndromes.

Methods to Study the Microbiology of Coral Disease
Garriet W. Smith, Biology Dept., University of South Carolina Aiken
[see Coral Disease CD: Smith-Microbiology-Zanzibar06.pdf]

Often when coral disease is suspected, transfection experiments can determine if damage is done by infectious agents or not. This simply involves exposing healthy tissue to areas in question. Coral samples taken for microbiological analysis can be taken in basically two ways, syringe samples and cores. Samples must be taken of both diseased and healthy areas for comparison. If possible, syringe samples are preferable because they are nondestructive but often both yields more information. After samples are taken, comparative microscopic analysis is preformed. Eukaryotic organisms may be suspected of being putative pathogens, if associated with disease but not healthy coral tissue. Prokaryotic putative pathogens require a tissue comparison of bacterial/viral components using both culture dependent and culture independent techniques. So far, most coral pathogens have been cultivable bacteria. These should be plated out on a permissive medium, compared (healthy and diseased) and those isolates found only or primarily with diseased samples should be subcultured. These can be tested by inoculations back onto healthy coral tissue. Inoculation methods vary considerably and depend on the organisms isolated, coral to be inoculated and available facilities. Tecniques that have been successfully used in the past will be discussed.

Lab And Field Exercises

NOTE: for the field work, each participant received a set of laminated sheets as a **"Field Guide to Indo-Pacific Coral Disease,"** a booklet on **"Scleractinian Corals of Tanzania,"** and a clip board with underwater paper with templates for coral surveys. In addition, we provided copies of **The Staghorn Corals of the World** by Carden Wallace the IMS library.

Identifying Coral Diseases

[For coral disease images, see Coral Disease CD: Weil-2-Caribbean coral reef diseases.pdf and Willis 3 GBR IP Disease ID.pdf]

Lab investigation of coral disease
Objectives:

- to introduce the common coral diseases found on Zanzibar reefs
- to review corallite structures used in the classification of corals and skeletal characters of the common families, genera and species (if appropriate) of Tanzanian corals

Instructors collected samples from Murogo Reef to view under the microscope and to use as samples for isolating microbial pathogens.

Snorkel excursion – field-based introduction to Zanzibar corals and disease
Objectives:

- to become familiar with field characters of the common Zanzibar coral diseases
- to review field identification of the common families and general of Tanzanian corals

Instructors and participants snorkelled in Chumbe Island Coral Park to look for diseases and syndromes. While these reefs are overwhelmingly beautiful and very healthy, we were able to find some disease and syndromes to help participant with identification.

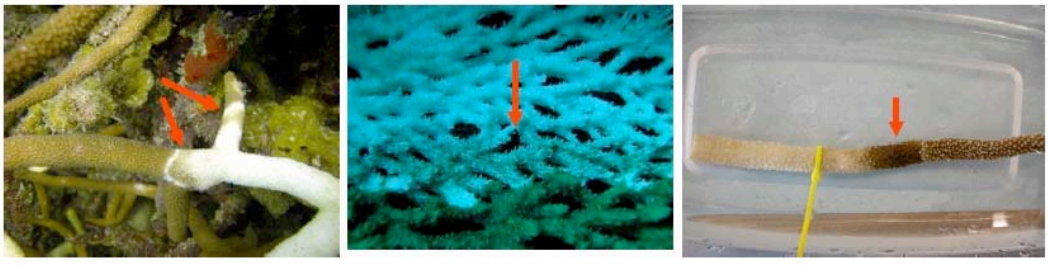
Disease and syndromes found:

- ***Acropora* Brown band(BrB):** Affects mostly staghorn and tabular acroporids. Band is formed by dense populations of ciliates, moving along the branch. A narrow white band between ciliates and live tissue may be present.
- **Bleaching:** Colonies pale or white but tissue still present. Intensity or degree of bleaching may vary within and across species, and within and between sites depending on susceptibility and level and duration of high temperature.
- **Compromised health – Pigmentation response**. Pigmentation responses *in Astreopora* and *Porites* is found in areas with necrotic tissue or unhealthy looking tissues.
- **Compromised health – unusual bleaching pattern in *Acropora*.** Small white spots along and around branches, sometimes intermixed with small fish bites. Other larger blotches are also found.
- ***Porites* ulcerative white spots(PUWS):** Affects mostly massive and branching *Porites.* White spots have depressed center with or without dead area. Spots can coalesce when dense. Possibly caused by a *Vibrio***.**
- **Tumors**. Includes hyperplasias or abnormal growth of tissue and skeleton in which the skeletal and calical structures are enlarged but otherwise not significantly modified. The skeletal structure is lost in Neoplasias..
- **White syndrome**. White areas that may progress from base of colony or blade. Clean area is not too wide and there is secondary algal growth behind it. Inter-phase border of tissue-clean skeleton may be uniform or not (need to check thoroughly for *Drupella* and other predators).
- Predation damage was also seen.

Coral reef diseases/syndromes in the western Indian Ocean

Ernesto Weil and Bette Willis

***Porites* ulcerative white spots(PUWS)**: Affects mostly massive and branching *Porites*. White spots have Depressed center with or without dead area. Spots can coalesce when dense. Possibly caused by a *Vibrio*.



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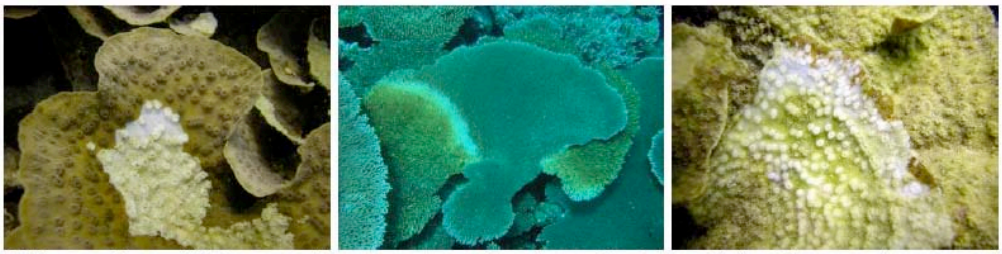

White syndrome. White areas that may progress from base of colony or blade. Clean area is not too wide and there is secondary algal growth behind it. Inter-phase border of tissue-clean skeleton may be uniformr or not (need to check thoroughly for *Drupella* and other predators).

Bleaching: Colonies pale or white but tissue still present. Intensity or degree of bleaching may vary within and across species, and within and between sites depending on susceptibility and level and duration of high temperature.

LAB INVESTIGATION: IDENTIFYING CORAL DISEASE PATHOGENS

[for more information, see Coral Disease CD: Bacterial Medium]

Objectives:

- to become familiar with methods used to begin to isolate and identify coral diseases, including microscopic examination of lesions selective plating isolation techniques

Samples were taken with a syringe from the water column and from the mucoid surface of diseased and healthy coral. Samples were mixed with sterile water and used to inoculate an EcoPlate and various selective media. Samples from diseased and healthy coral were examined. Samples from diseased coral had more bacteria overall, and more *Vibrio* colonies.

Microbial Community Analysis with EcoPlate: A 96-well substrate based EcoPlate was inoculated with each water-sample solution to observe patterns of growth with various carbon sources. After 48-hour incubation, the patterns were different in the water column, mucus from diseased coral and mucus from healthy coral. Further investigation would be needed to make these results more meaningful.

Selective Agar Plating: Sub-samples were swabbed onto 3 types of media: Nutrient-Glycerol agar to encourage growth of most microbes; GPYA (glucose, peptone, yeast extract agar) with antibiotics for fungi; and TCBS (thiosulfate Citrate Bile Salts Sucrose Agar). medium for *Vibrio*. After 24-hours, there was most growth on mucus from diseased coral sample, relative to water column and mucus from healthy coral. Vibrios grew on the TCBS agar only from the mucus from diseased coral sample. These were picked and streaked onto GPYA to get pure culture colonies fro future analysis, including PCR of 16s rRNA for identification.

FIELD WORKSHOP ON SURVEY METHODS

Objectives:

- to become familiar with methods for surveying coral disease prevalence
  [# of diseased colonies / total number of colonies] in the field

Participants observed and took part in two different survey methods. Tim, Nyawira, Haji and Chris recorded disease with the Kick-Swim Swim method while the rest of us did three 20m x 2m belt transects (described below). Coral colonies and disease were counted so we could compare numbers (data being analysed). In both cases, disease prevalence is based on the total number of colonies examined. There was much discussion over appropriate categories, and what different syndromes should be called.

Transect Survey Method [see Coral Disease CD: Willis 4 Survey Methods.pdf]
The Disease Working Group Standard Protocol is to survey 3 replicate (20m x 2m) belt transects per site and 3 replicate 20m line intercept transects (LIT) to measure percent coverage (the LIT is done on the same transects). With a 3-diver team, the first diver lays out a 30m long transect and does the LIT. Divers 2 and 3 each take one side of the transect and examine all colonies and records whether they are healthy

Some Advantages
1. There is less potential for bias when there is an area defined by a transect tape or pole - i.e. without the markers, there may be a tendency to key into and record colonies with bleaching or disease but miss healthy colonies or vice versa.
2. There is an exact record of the area of reef searched. For monitoring over the years, it is important to do repeat surveys of reefs. This might not be a major problem if the Kick-Swim method is done over the same areas and habitats year after year.

Kick-Swim Method
The person doing the survey kicks a random number of fin kicks and then stops and surveys every colony in his/her field of vision, recording corals according to the data sheet. Colonies are counted over a 30-minute swim into one replicate survey. Disease and coral types are recorded at the same time.

Some Advantages
1. Corals are examined over a larger spatial extent of the reef than in 3 belt transects. This might overcome the problem of missing outbreaks just off the end of the transect line. Though, such outbreaks could still be missed if the method is truly random.
2. This method only requires one buddy pair working somewhat independently. Slates are the only equipment need, and shallow reefs can be surveyed by snorkelling.

Preliminary analysis
The Kick-Swim method sampled more colonies, partially because the team of four were more experienced at surveying these corals underwater than the people doing the transect surveys. With more experience, the transect surveys would probably be faster. Where the transect method takes up a bit of time in laying the transect tapes, once laid, surveyors can move very efficiently along the line. Hopefully, researchers will adopt the protocol that works best for them, so that we can get the most reliable disease prevalence data from a more comprehensive series of sites.

[For data sheet templates, see Coral Disease CD: Templates file]

Summary

We ended our workshop with a discussion about sampling techniques. Each group was charged with sharing what they learned with colleagues in the field, and with continuing communication among each other and the participants, with plans for a collaborative publication on disease in the Western Indian Ocean in one year, to be spearheaded by IMS. We are now hoping to have a follow-up workshop in 2008 with the CRTR-Bleaching Group, and will explore the possibility of some participants continuing their training in coral disease at associated laboratories.

Products developed for this workshop:

- laminated sheets as a **"Field Guide to Indo-Pacific Coral Disease"** (E. Weil)
- a booklet on **"Scleractinian Corals of Tanzania"** (B.Willis)

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Evaluation Results

How useful were each of the following in helping you to better understand coral disease

Little help	Moderate help	Much help	Very much help	**mean (of 4)**
The lectures on coral reef disease in the Caribbean and Indo-Pacific.				
		9	8	**3.5**
The laminated photos on Coral taxonomy and reef disease				
		4	12	**3.8**
The lecture on methods to study the microbiology of coral disease				
	4	5	8	**3.2**
The lab looking at coral disease				
	3	9	5	**3.1**
The microbiology lab sessions				
	4	8	5	**3.1**
The snorkeling session				
	5	6	6	**3.1**
The discussions on survey methods				
	2	7	7	**3.3**
The SCUBA/Snorkel practice survey				
1	4	6	5	**2.9**
The discussion on setting up experiments & monitoring surveys				
1	2	9	5	**3.1**

What were your expectations for this workshop? Were those expectations met? Please explain
To learn on coral diseases and set up the baseline for surveys in Kenya
I expected to be able to identify a diseased coral by the end of the workshop. At this point I can tell what the problem could be. However, with more practice in the reefs in my country, the exercise should be much better.
Were 1. To win a package of knowledge regarding the coral diseases in general. 2. To be exposed to

methods for coral diseases identification in the field. 3. To be exposed to the world of scientific presentations and discussions. Expectations were met (90%)
To have the knowledge over the ABC's of diseases of coral. To advance in monitoring techniques for coral (cover) and so for diseases
To learn how to identify and assess coral diseases. Yes, the workshop met my expectations by combining theory and practice
Exposure to coral diseases and meet people who are doing research it the same. Sure!-My expectations were met because it got exposed to coral diseases and met the scientists
My expectations were to know the coral diseases, their causes and how to mitigate the problem/diseases. Yes, the expectations have been met, expect that up to now I don't know how should they be cared(?) apart from management aspect.
Know coral disease: identification: visual & microbio causes & drives (?) of the disease. Mitigation (if any). Most if not all of my expectations were met. I go back knowing more about the coral disease, drives, tests & identification
Identification of disease – evaluating mortality/impacts – Enough skills to make participants start assessing diseases has been provided
To learn about coral diseases, how to recognize them in the field and survey methods. My expectations were mostly met, I would have preferred more field time
Expand & update knowledge, yes
Learning to identify coral diseases, They were met somehow-more practice is needed – more info needed on caregiving(?) diseases
To be able to understand coral diseases of EA (?) Expectation met. To be able to isolate and culture coral disease pathogens. Expectation met
To learn what to look for in terms of coral disease ie what symptoms are displayed & what diseases you can expect to find in the Indian Ocean. Yes – the lectures snorkeling tip & lab session to look at diseased corals were excellent.
To understand coral diseases, methods of identifying & monitoring their prevalence and extent. Yes my expectations were highly met.
Didn't have any specific expectations, but am very happy with what was delivered! Generally well done!!
I expected to learn how to design and conduct research on coral diseases. I can confidently say that now I can design and conduct research on coral diseases very well
From which aspect of the workshop did you learn the most?
The identification and clarification of coral diseases
Seeing the different diseases (photos) that are likely to be met in the field in addition to the lectures that went with them
The aspect of coral disease identification in the field
Field-based introduction to coral and diseases
The lectures on disease, the lab session for disease and the practice survey
Lectures and field sessions
The most expect I have learnt is how to identify the coral diseases
Snorkeling & lab sessions
Field methods for monitoring disease incidences
The field exercise
Microbiology
Lectures in coral reef disease in indopacific & atlantic
Understanding coral diseases and isolate and culture the disease pathogens
Presentations showing photos of disease examples on different corals & then going snorkeling to look at these coral diseases in the field.
All see in corals look like bleaching, from this workshop I learned that some of this are coral diseases and not just bleaching.
The slide shows on disease ID & data/results based on recent studies
Lab work especially microbiology session was very good. We were introduced to simple methods to learn. However, I think we needed much time and big lab for this important aspect of coral diseases.
Which aspect of the workshop did you enjoy the most?
The field surveys (i.e. snorkeling)

The snorkeling sessions because we were actually left on our own to do sightseeing
The aspect of studying microbiology of coral diseases
Field survey on corals & diseases thereof
The lab session on disease and the 'in water sessions'.
Learning while interacting
The most aspect I enjoy was the good interaction among the participants
Snorkeling & lab session
Scuba/snorkel practice surveys
The field exercises
Sampling in the field
Lab working & microbiology lab sessions
Field and laboratory works
Getting out into the field for snorkeling & diving so we could observe & put into practice what we'd learnt about in the lectures.
The team work especially from the organizers, it looked like they were from one institution.
-the informal atmosphere – opportunity to meet key people in the field of coral disease & network/ establish contact
Field trips were superb.
What would you change about this workshop?
For a start, the workshop was well organized and for a beginner in coral disease, it was just appropriate. But the snorkeling exercise should have included more on transect (?) laying(?) and data collection.
The snorkeling did not have somebody to guide them or help them in identifying what would have been problems in the corals- from their observations. Somebody should be left behind to help them i.e. not all lecturers (experts) should go diving. Taxonomy was not done as had been suggested.
Nothing has to be changed except that the serious implementation and practice of knowledge obtained. This can be assessed by establishing a region network to which each group belonging to the certain site should submit their results of the field work.
Nothing to change but call for more efforts to bringing together especially the growing scientist (maybe biologist) in such aspects of coral diseases etc.
Make the snorkel session more structured – have one expert for 3-4 trainees in the water and go through the disease/health categories one by one (if present on the reef)
Snorkelers did much less methodology try outs than the divers – next time please set a side something for them to reduce the knowledge divide between the two groups. I believe that if we saw coral diseases on the first snorkeling session, we could take part in comparing the two methodology from the shallow sites. Though we haven't logged 50 hours, it would be of much help if we too tried out the methods on shallow sites – this is where we do the monitoring mostly.
The workshop should also look/advice on the treatment/ management of coral disease after identifying the pathogens
The survey methods: only the participants who dived were able to practically try out the methodology. It should have given the opportunity to snorkelers to try out the survey methods at a more shallow in depth
Include coral disease in the ongoing coral monitoring programs
More time in the field, less in the lectures
None
Put more field and laboratory works
Maybe have more snorkeling trips in different areas so that you could cover a wide range of diseases at different sites
1. Site/venue – To find an area with more prevalence of this coral diseased, since one need to differentiate between diseases and bleaching
- have more samples available to look at in the lab. – given the diverse background of participants if may be worth sending out some basic info i.e. on coral ID etc. prior to the workshop
I think as a young and very new in this field, I needed longer time to stay with these specialists. We need longer period (2 weeks) – more fields and lab work. Genetic identification of the microbes should be included in the programme.