Southeast Florida Coral Reef Initiative
Technical Advisory Committee
Meeting minutes: 8th / 9th November 2004

Attendees:
Fred McManus, U.S. Environmental Protection Agency (EPA)
Vladimir Kosmynin, Ph.D., Florida Department of Environmental Protection (DEP)
Ken Banks, Broward County Environmental Protection Department (EPD)
Chantal Collier, Florida DEP
Dale Griffin, Ph.D., U.S. Geological Survey (USGS)
Ed Tichner, Palm Beach County Reef Rescue (1st day only)
Lou Fisher, Broward Co. EPD
Dan Clark, Cry of the Water
E.A. Shinn, Ph.D., USGS
Richard Harvey, U.S. EPA
Dick Dodge, Ph.D., Nova Southeastern University (NSU)/National Coral Reef Institute (NCRI)
Mike Risk, Ph.D., McMaster University
Nancy Craig, Ph.D., Broward EPD
Phil Dustan, Ph.D., College of Charleston
Erin Lipp, Ph.D., University of Georgia
Linda Horne, Florida DEP
Dave Gilliam, Ph.D., NSU
Alex Soloviev, Ph.D., NSU
Jules Craynock, NOAA Atlantic Oceanographic & Meteorological Lab (AOML) (1st day)
Tom Warnke, Clean Water volunteer (1st day)
Charlotte Purkis, Open University
Judy Lang, Ph.D., independent scientist
Alina Szmant, Ph.D., University of North Carolina at Wilmington (UNCW)
Esther Peters, Ph.D., Tetra Tech
Cheryl Miller, Harbor Branch Oceanographic Institute (HBOI)
Rod Braun, Palm Beach County
Bernardo Vargas, Ph.D., National Coral Reef Institute (NCRI)
Sam Purkis, Ph.D., NCRI
John Proni, Ph.D., NOAA AOML
Brian LaPointe, Ph.D., HBOI
Bernhard Riegl, Ph.D., NCRI
Valerie Paul, Ph.D., Smithsonian Marine Station (2nd day only)
Matt Lybott, Coastal Planning (2nd day)

Location: National Coral Reef Institute, NSU Oceanographic Centre. 8000 N Ocean Drive, Dania Beach.

1. 12:45 p.m. This second Southeast Florida Coral Reef Initiative (SEFCRI) Technical Advisory Committee (TAC) meeting was opened with a welcome from Prof. Richard Dodge from NCRI, who handed over this TAC meeting to Vladimir Kosmynin, who initiated the public comment period.

2. 12:50 p.m. Public comments:

   (i)   Dan Clark: Dan put his point across strongly. He has witnessed *Lyngbia*, particularly in the Hillsboro Inlet. He has now seen it in the staghorn thickets, too. He observed that ropes connected to buoys appear to be good habitat, and suggested that perhaps a change to another type of cord might be helpful. He further reported that hurricane waves appear to have washed some of the algae away, for at least a while. It appears to be spreading beyond the point sources. He's looking for an immediate solution to clean up the water. He wants to see standards set for measuring from outfalls and believes a good "full-blown" monitoring system is the way forward. He expressed his concern that there is not too much time left, and urged for the expediting of the start of monitoring.

   (ii)   Tom Warnke: A long time scuba diver and student of coastal and ocean systems since 1954, who also started the Surf Rider Foundation in 1997, said he is looking beyond education. He has witnessed the red tide and wants solutions. He hopes this group can make suggestions to the U.S. Coral Reef Task Force (USCRTF), particularly about signs of nitrification, all the way from Dry Tortugas to the Cape Canaveral area. He is quite concerned with effects of outfalls, shallow and deep wells, septic tanks, and injection wells. He is afraid it will take 30 years for the reef systems to recover. He has given 30-day notice to USCRTF agencies regarding his concerns (reference www.surfriderpbc.org).

3. 1:00 p.m. Vladimir Kosmynin went over the Agenda.

4. 1:05 p.m.   Chantal Collier introduced herself to the TAC and provided the background for the SEFCRI, the LBSP focus group and her role within the initiative. She explained the process over the past 18 months which has brought us to the identification of projects and the proposed financing for them, to date. She reviewed handouts that had been distributed, including USCRTF Priorities; Florida Priorities; Scope of Work for 1st two Land-based Sources of Pollution (LBSP) projects for Year 1; and a grid list of projects from all four Southeast Florida Coral Reef Initiative focus areas, with first-year projects highlighted in yellow and "high level" indicated as appropriate for Years 2 and 3.

5. 1:20 p.m. Ken Banks took over and in more detail talked through the LBSP issues and project identification, allocation of funds, and grants applied for. He mentioned the prioritization of projects and within those, where expertise was required from the TAC. He identified five overall issues:

   (i)   Determine the extent and condition of the reefs and associated habitats
   (ii)   Determine the sources and extent of pollution
   (iii)   Determine the link between resource and pollution
   (iv)   Design and implement activities to reduce LBSP

      (v)   Work with Awareness and Appreciation focus team to get in touch with the public.

6. 1:30 p.m. Presentations: (Steve Krupa was not in attendance, so Gene and Dale gave a presentation.

7. Gene Shinn: USGS has successfully used a series of monitoring well arrays to study a variety of water-quality issues, such as finding micromarkers. Erin Lipp and Dale Griffin are using this methodology in work they are doing. The method is original, objective, and stands up well in court. His example concerned the highly criticized use of septic tanks. The wells off Key Largo were used to measure the movement of groundwater. Microbial fecal indicators were detected (refer to '95-96 publications). They have just installed some wells on Ft. Jefferson, outside of which human sewage traces were detected five miles offshore. Diagrams of the well array system were distributed.
Brian LaPointe: Referred to his experience with the Florida Keys TAC, where there was the need to link water quality to resource. His approach has also been used in Tobago and Jamaica. There is a need to provide managers with information on water quality and how it affects the resource. He promotes an integrated monitoring approach, concerning coral reef hard bottom communities with water quality. In his current work, the first step was to survey 84 partially distributed randomly stratified points (shallow, mid-depth, and deep) for quantitative assessment of macroalgal abundance, using digital video imagery along 25-m belt transects. A subset of six stations (2 shallow, 2 mid-depth, 2 deep) along two offshore transects are then studied. He then looks for isotopic signals in the macro algal tissue. Water samples are collected from various natural (upwelling) and anthropogenic-nutrient sources, such as sewage outfalls, canal discharges from agricultural areas, looking for C, N, and S. His work also characterizes macroalgal herbivory, evaluating the chemical ecology of HAB species, especially *Caulerpa* species, and is looking into the palatability of *Caulerpa* and others. He pointed out the use of *Palythoa* as an indicator for pollution-nutrient enrichment. His research covers the area from St. Lucie to N. Miami-Dade. He spoke about the fundamental differences in biogeochemistry within Southeast Florida, with siliclastic bottom in the north to carbonate in the south. His integrated approach calls for the use of laser airborne depth sounder and divers. The effects of the hurricanes and beach renourishment are taken into consideration. This approach can be used as a scientifically replicable integrated approach, which is multi-disciplinary.

8. 2:45 p.m., After a break, short presentations followed.
Mike Risk: He reported on the EPA/NOAA sponsored LBSP meeting in Hawaii. Questions are always the same: how do we quantify and how do we measure? His conclusions are that (1) nobody talks to anybody, and that (2) nobody reads any more (particularly the young). He feels strongly about the need for not re-inventing the wheel. All the needed techniques are already on the shelf; they've been

published. The methods are there! The approaches adopted are not inter-disciplinary enough, always shadowed by a fruition of biologists. He identifies communication as a key issue in the management of such initiatives. He strongly supports identification of key bioeroders and the use of bioindicators, e.g., *Cliona delitrix* and *C. lampa* for indicating total nitrogen. Everywhere there is human waste in the water, it can be found in these sponge tissues. Where hard corals have died, there can still be soft corals. *Plexaura homomalla* lays a new band each year. This attribute can help determine age and nitrogen history to within a precision of weeks. For some time, EPA guidelines have divided water into relatively clean and relatively dirty ratings. The latter has been increasing at a relatively more rapid rate in the last decade. The data tend to be noisy because of upwelling. In response to a comment made by Brian LaPointe about how far some of the N data goes back, Mike agreed, saying it was older than some of the people in the room.

Phil Dustan: He reported on some work Craig Downs has done using biomarkers. He commented that animals and plants make all sorts of molecules that react to all sorts of insults. As an example, irgarol molecules used in bottom paint for boats: just one part per billion will increase photosynthesis within 1 hour. Phil also feels strongly about the use of biomarkers for heavy metal indicators. The SEFCRI coral biomarker pilot study came out of a Caribbean/Atlantic LBSP meeting in Puerto Rico between Chantal, John Fauth (UCF) and several members of the SEFCRI LBSP team. It will involve Ken Banks, Bernardo Vargas-Ángel, and others.

3.00 p.m.   Alina Szmant gave a presentation on sediment nutrification and algal community biomass in the Key Largo area. She says she put together a "hodgepodge" presentation i.e. discusses various studies. High levels of turbidity particularly from the storms are her focus. She put out a series of sediment traps from inshore to outer reefs, six stations per transect from Fowey Rocks down to Middle Keys and Looe Key viaduct. Steven Miller cruised the outer reefs in about 50-60 feet and sampled up and down the transects. She conducted pore water analyses but the data was very noisy. The sediment samples were measured for total nitrogen (TN) and total phosphorous (TP). There was found a clear pattern of decrease in TN from inshore to offshore. Levels of N in sediment offshore were 30-40 mg N per g of sediment. This was compared with sediments from the Bahamas and St Croix reefs, where she found they contained several 100 mg atoms of N per g of sediment, to Florida Bay where she found 500-1000 mg atoms of N to gram of sediment. This is total mass of N per mass of sediment. Pore waters in the offshore stations were 10 micro molar (mm) total DIN – very low. All in 96 paper. Whereas inshore were much higher at 50-60 mm total DIN.

   When looking at phosphorous (P) content she found opposite trend. If P enriched sewage is entering groundwater and into the sediments, then one would expect elevated levels of Phosphate inshore. However she found that offshore samples collected by Steven Miller had the highest levels of phosphate. She also observed the sediment size and colour, offshore coarser larger particles as a result of storms resuspending sediments. The finer sediments get washed inshore where less

energy allows for settlement. She found coarser and less sediment in offshore traps, except when wind events occur.

She then looked at nutrient concentration in sediment traps and found that inshore finer sediments are more enriched with nitrogen than offshore resuspended coarser sediments. With Phosphorous, offshore are richer than inshore. N:P Redfield ratio in sediment traps were also studied. Then she set up a model gradient with anthropogenic and terrestrial nutrient sources (N) assimilated into marine plants, (discusses microbial loop). Storms are important in movement of this; detritus gets resuspended and biogeochemical nutrient cycles occur inshore. Basically, excess P is coming from the ocean offshore.

She expected more coral recruitment on offshore patch reefs. She was surprised at the abundance of coral recruits on the patch reefs, but not seeing large corals. Why? Not seeing survivorship maybe because all the offshore reefs are getting battered by storms (resuspended coarser sediment) – lots of abrasion killing the small corals.

Acropora palmata was doing fine in terms of recruitment and larval production until 1998 bleaching event. Now it is rubble after Hurricane George.

Algal species of *Dictyota* and *Halimeda* now dominate as she looked at biomass and percent cover. Did a study on algal turf recruitment with these species using plates 2 years in a row and got same results. Enrichment plates did not have significant effect in algal biomass.

Looking back to 60's and 70's when she was studying in Puerto Rico, she remembers fewer storms. Wind data variation was very little then. Now we are in a different energy period.

Diadema die-off was discussed as an herbivory control on the growth of algae on corals. In 1983, before the die-off, there was huge abundance of *Diadema* on reefs at night.

Szmant and Brian Lapointe did not agree on enrichment study results and the causal factors. He disputed her paper in Coral Reefs.

3.45 pm Alex Soloviev: Hydrodynamic aspects of coral reef pollution from land based sources on southeast Florida. A strong highly baroclinic current (Gulf Stream) is confined to flow over a rapidly changing, three-dimensional topography producing an energetic regime on the southeast Florida shelf. A substantial diversity in wind and weather conditions (including hurricanes) exists.

A NSU/USF Environmental Array is designed to: Support the ONR activities in the area, collect a complete seasonal cycle for describing western boundary current/ continental shelf interactions, including extreme conditions during hurricanes, and provide data useful for understanding a variety of scientific questions.
The mooring array Design includes:
- Acoustic Doppler current profilers (ADCP)
- Sea level and wave gauge
- A combination of inductively coupled temperature and salinity sensors
- A meteorological package
- Spread-spectrum radio communication link

- Monitoring via ARGOS

Since 1999, the Environmental Array has been operated in different configurations, provided 5 years of data and supported several ONR funded activities in the area:
- 4-D SFOMC Experiment (1999)
- Adverse Weather SFOMC experiment (1999-2000)
- UM Acoustic Experiment (Winter 1999-2000)
- US Navy Fleet Battle Experiments in 1999 and 2000
- FAU Acoustic Experiment (2003-2004)

This had substantial interest from the local community: protection of coral reefs, navigation, beach, etc. Several oceanographic studies have been done based on the collected data, including Baroclinic Oscillations with 10 Hour Period, Annual and Interannual Change of the Spectral Energy of the Velocity Oscillation in the 8- to 12.5-hr Band, Velocity Oscillation Magnitude Within 8- to 12.5-hr Band. Their hypotheses to explain the Energetic Baroclinic Oscillations: Internal seiching - the semidiurnal, internal tide Doppler-shifted by the Gulf Stream. The inertial peak shifted to a higher frequency due to vorticity.
Concluded that the Array provides a basis for an eventual transition to an observational real time node as part of a larger scale, integrated coastal ocean observing system.

3.55 pm Esther Peters: Discussed *Cliona* sponge study and how *Cliona* is used as a value indicator of high nutrient sources and bacteria loads in the water column. A histology based study, found that *Cliona* had more granular amebocytes. The abundance of amebocytes may make them a heartier species and she suggests this is the reason for *Cliona* abundance at certain sites. This could be used as a powerful screening tool.

4.05pm Bernhard Riegl: Reef Mapping Update – currently working with a coherent footprint of the parallel reefs in Broward county.   Wants a uniform footprint therefore utilizing two different systems for controlling the data and processing the signals with algorithms. One system looks at total waveform return, the other looks at the end of the waveform coming back. Waveform has 2 backscatter returns but two systems provide reasonably similar outcomes. The use of stats and groundtruthing provides accurate maps. He cleans data clusters with colour coded well defined groups and this technique illustrates reef and pleistocence areas on the map. He discusses the merging of high densities of fauna with both systems. Acoustic sensors will be replaced optically if funding arrives. Leader of that project is Sam Purkis.

4.15pm Sam Purkis: Current Ikonos Project - Satellite remote sensing provides a cost-effective means of mapping coral reef habitats in shallow clear waters. He has tested a strategy whereby water column correction is implemented using an independently collected measure of bathymetry combined with radioative transfer modelling, to process the satellite imagery to units of substrate reflectance. Image classification is subsequently driven using statistics derived from *in situ* optical

measurements and therefore independent from the imagery. A principal advantage of this strategy is that the *in situ* spectra can be used retrospectively to train alternative remote sensing instruments of differing spectral resolution without the need for a repeat field campaign to collect ground-truth data.

The geospatial characteristics of modern shoal-water carbonate depositional environments was investigated through the relationship between reef facies groups on the Jebel Ali carbonate ramp, Dubai, U.A.E. A map of substrate distribution derived from high-resolution IKONOS satellite imagery was combined with a bathymetric digital elevation model (DEM) to facilitate a fully three-dimensional model of the seafloor. Not only does this allow a detailed understanding of how topography and water depth influence facies distribution, but it is also evident that the spatial expression of facies patches display qualities that can be quantified using fractal concepts.

Since large areas of important coral resources are situated outside the shallow areas of passive optical resolution, Purkis and Riegl are investigating active remote sensing technologies that are capable of resolving the seabed regardless of depth and water clarity. Their results from the Arabian Gulf show that the acoustic systems can complement optical data sets despite the fact that classification is implemented on the basis of seabed rugosity as opposed to spectral diversity.

4.20pm Bernardo Vargas-Ángel: Spent the past three years trying to develop a tissue-based stress indicator to be used to monitor stress in corals during dredging activities in Broward country. He is now developing an experimental diagnostic tool to distinguish between healthy and unhealthy corals using a histopathology-based series of experiments with 3 target species: *Montastraea cavernosa, Siderastrea siderea*, and *Solenastrea bournoni*.

He has found several basic trends with regards to the integrity of the tissue in the later stages of stress. There is an observed decrease in the number of mucus secretory cells, high granularity of the tissue, and apparent reduction of cilia on the outer epidermis of the corals. Several techniques utilized were micrograph pictures, observed changes in the color of mucus secretions within the coral which indicates changes in the pH level. He also looked at the external attributes of experimental corals as they changed with increasing stress. Changes were noted in the appearance of the oral disk, swelling, bleaching and color changes. By combining the external, morphological changes with the histology, he has produced an index where divers can look at corals in the field and collect samples of visually stressed corals which are then validated with the histology in the lab.

The diagnostic index includes swelling of the mucus secretory cells, accumulation of cell debris, changes in zooxanthellae density, degradation of zooxanthellae, swelling of membranes and epidermis, and swelling of the callicoblastic epithelium and decreased calcification properties. He has observed these characteristics in the field. He will be further looking at gene expression profiling in corals during dredging operations. His group will couple with Terry Snell of GA Tech to do this research.

8. 4:30 p.m. Fred McManus and Ken Banks led the discussion on LBSP Projects 1 and 2. Phil Dustan brought up that CSA already (for EPA) did contributing sources in the Keys. (Discussed further by Alina and Fred.) Brian LaPointe commented that there is a lot of data from the Water Management District, to which Linda Horne and Ken Banks also commented. Judy asked for definitions. Mike Risk remarked that sewage and sediment break down into source and non-source; what it will take to get organics; affect on gorgonians; sediment from coral skeleton, CO_2, usually look at oxygen for temperature; effect of shade on massive corals; lesser endocrine disruption. Dick opined that it's not so direct. Phil asked what other LAS groups are doing.

9. 4:50 p.m. Fred, as leader, reviewed Project 3. He had been tasked with contacting other agencies, programs, projects, and activities that address LBSP and with compiling a report. He drafted the survey form, presented it to SEFCRI in August, then went back to Atlanta and distributed it. He brought copies of the letter and the survey form. Emphasis was on public works, city engineers, and others who had an LBSP focus. FDEP gets $millions of Section 319 for non-point source, so that person is on the list. Chantal mentioned the importance of proper use of fertilizer and pesticides. *[Note: good point to share with Awareness and Appreciation focus team.]* It was also mentioned that in the Keys, the importance of this really hit home in economic impact when the beaches were closed. Richard Harvey suggested that you really get people's attention when the public gets irate over situations like that. Discussion closed with agreement that best management practices (BMP) are just as important for front yard and backyard homeowner as anyone else.

10. 5:20 p.m. Chantal led a discussion about the needed frequency of the LBSP TAC meetings, whether annual or biannual would be more helpful. After much discussion, early April and early November were determined to be the best dates for twice yearly meetings.

11. 5:30 p.m. Meeting adjourned until 9 a.m. the next morning.

12. 9.00a.m. Vladimir Kosmynin welcomed everyone to the second day of the TAC meeting. He explained that the aim for the TAC during today's meeting was to: assist projects that already exist; develop scopes of work for other projects; look for money and grants. This will require collaboration and co-operation from principal investigators. The TAC members split up into 2 groups. Group 1 developed the scope of work for the mass balance program. Group 2 considered the links between ground water and pollution in coastal waters.

13. 9.15a.m. Before the groups split there was a discussion concerning the fundamentals of coral mortality. Mike Risk re-iterated the importance of comparable projects and studies, e.g. the Hawaii LBSP / TAC groups and the research that they have carried out and their methodologies. The biologists' response is still 'we need to find the signal'. The LBSP group hopes that the mass balance project will start to address the relative contributions of the contaminants. The group argued that temperature increase does indeed cause mass mortality. Major eutrophication from the Everglades is arguably also a contributory factor. Disease as an effect of bleaching and temperature affect some corals and not others. Florida is a good environment for research as there are limited species. There is a need to prove a direct cause / effect relationship. There was consensus that corals die because they are stressed and this stress is multifaceted. The two big inputs to Florida's corals are seasonal; in summer there is an increase in temperature, increased sediment and rainfall; in winter there is increased tourism and therefore pollution.

14. 10.15 a.m. John Proni, a senior consultant from FACE (Florida Atlantic Coastal Environmental Initiative) presented the FACE concept and its potential to provide substantial and significant research funding for LBSP projects. The projects he is looking for are high quality science, to be funded over a decades. This is inter-agency work funded mostly through a co-operative partnership between utility companies, the Corps of Engineers, NOAA and EPA. Individuals questioned the motives of the initiative, (i.e. for infrastructure development) and the problems associated with the SeaFlow program, which was funded through utility companies. Examples of projects that would be of interest include: ultra long range traceability, (e.g. the injection of sulphur hexafluoride (g) as a tracer); identifying vertical mixing and source contributions. He is also interested in the effects of septic systems. He confirmed that the utility companies have supplied funding of $2m.

15. 11.00 a.m. The groups then spilt up to talk about the details of the new scopes of work.

16. Group 1: Discussed Issue 3, Objective 1: to identify the suspected links between pollution and the coral reef ecosystems. The group put together their ideas schematically as shown in figure 1. On the bottom left of figure 1, the sources of pollution were identified: sewage; muck; agriculture; chemical run off; atmosphere; sea. The potential, detectable chemical pollutants from these sources were identified and where these pollutants could potentially be isolated within the ecosystem. The processes which would cause these sinks are represented in the centre of the schematic. To the far right are the impending human impacts: Human health; fisheries; eco goods/services; beauty; sports/recreation; commerce. Once the links have been identified, the signals for these pollutants need to be detected. These

could be measured at the molecular, organism or community level. The signals will naturally be strongest at the molecular level, hence the need for biomarker studies.
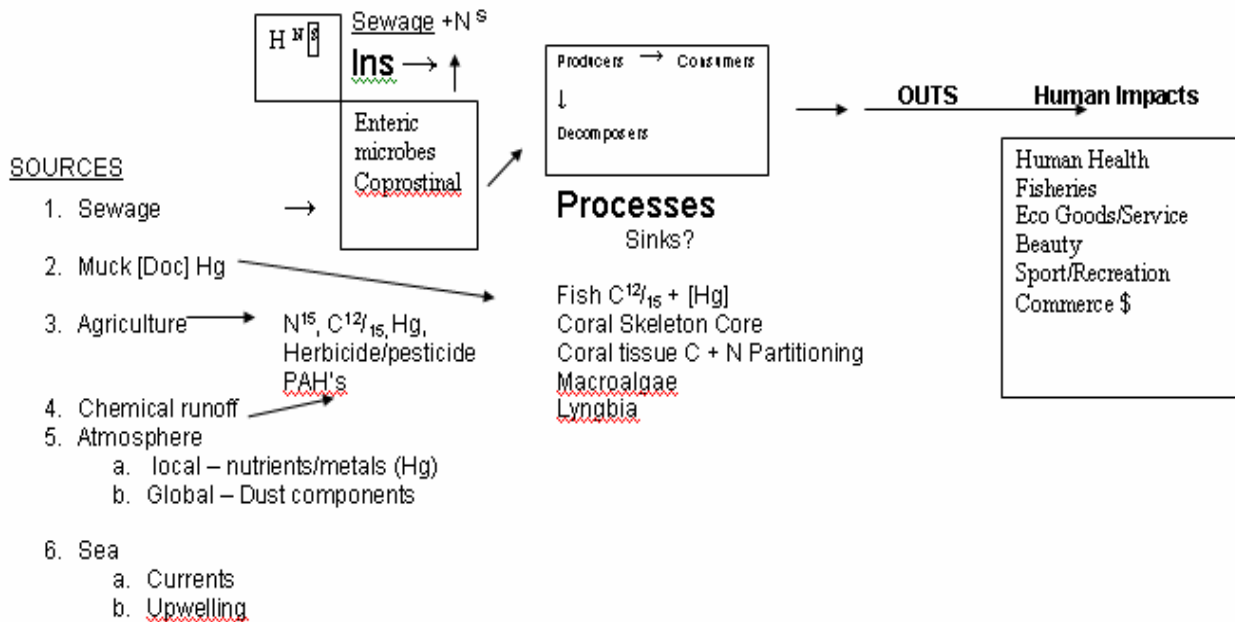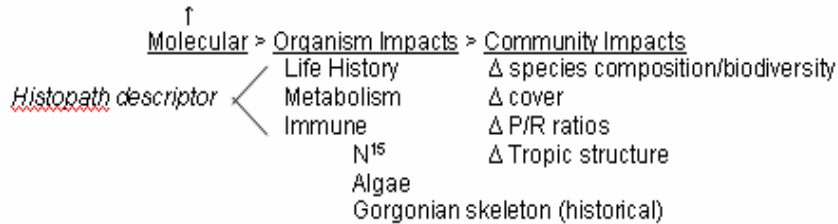
17. Group 2: Issue 2, Objective 2: Develop a mass balance budget for the geographic area of interest, including nutrients, other pollutants and carbon. (contributions from inlets, ground water and sewer outfalls) Possible projects and SOW for them. Following discussion, the group identified four separate areas of contribution and assigned a project scope to each of them. (1) Atmospheric contributions to coastal water quality, (2) Transport of pollutants by groundwater (3) Contributions of wastewater outfall pipes to offshore water pollution (4) Contributions of ocean inlets to coastal water quality.

    Project 1 requires the determination of the flux of pollutants from the atmospheric sources to the coastal waters. This can be achieved by collecting air and rainfall

samples and analyzing for potential pollutants. From this, the flux of each pollutant needs to be calculated.

The requirements of Project 2 involve quantifying the amount and flow rate of pollution transported by groundwater to the coastal waters. This can be achieved through the installation of groundwater monitoring wells (2 transects, 8 wells each). The depth of these wells will be determined by preliminary reconnaissance high resolution seismic surveys. Groundwater will be collected for constituent (pollutants and enterovirus) analysis and tracers will be injected to determine flow rates. Sampling will occur 2 times per year for 3 years to capture the seasonal periodicity. Nonetheless long term sampling is recommended to resolve decadal (and greater) cycles.

The aim of Project 3 is to determine the flux of pollutants exiting offshore wastewater outfall pipes and net flux to reef communities. Initially this needs to be carried out by collecting and analyzing for primary pollutants. Outfall flow rates need to be obtained from public utilities, from these data the flux of each pollutant can be determined. A dispersion study needs to be carried out in conjunction with this other research.

Project 4 required the determination of pollutants exiting ocean inlets and net flux to reef communities. This will be carried out by collecting and analyzing inlet ebb tidal water samples, obtaining ebb tide flow rates with an ADCP, calculating the flux for each pollutant and performing a dispersion study.

18. 4.00 p.m. The two groups presented their findings to the whole TAC. The meeting concluded with thanks from Vladimir Kosmynin. The next TAC meeting was to be scheduled for March / April 2005.