

Corals Bioassessment Workshop

The Florida Department of Environmental Protection held a workshop to identify what types of data would be useful for implementation in a state-wide Bioassessment program using corals to indicate level of human impairment. Direct links between coral organisms and human impairment have not been established by the scientific community except for cases of gross physical damage (ship groundings), allowing the group to brainstorm on a hypothesis-based level. The statewide bioassessment program is also developing measurements for fish, submerged aquatic vegetation (SAV), plankton, and macroinvertebrates. The program may be able to link the change in coral community structure with level of human impact by connections from these other groups.

As part of selecting candidate indicators, several preliminary steps must be taken. These include:

1. Identify the exact question(s) to be answered as a result of the assessment.
2. Review previous literature and studies to see if the questions have previously been answered.
3. Determine which candidate indicators will answer the question(s).
4. Determine if there is a scientific understanding of the indicator's role in the ecosystem. If not, is that indicator of sufficient potential importance to warrant undertaking needed research?
5. Examine the sensitivity of the indicator. How large of a perturbation is required for the indicator to distinguish between anthropogenic and natural changes?
6. Determine how much collecting and analyzing expertise is required to use the indicator.
7. Using the above information, estimate the cost effectiveness of indicator. Does it provide the necessary detail of information to distinguish impaired sites from minimally-impaired sites at an acceptable level of sensitivity, and at a reasonable cost?

Project History

The first workshop was held on April 28–29, 1998 at Florida Marine Research Institute in St. Petersburg. The first day provided an opportunity for the workshop organizers and any other interested parties to hear speakers from various federal, state, and local organizations presently involved in marine bioassessment activities. These speakers provided attendees with an understanding of the scope of ongoing efforts and how our efforts to select or develop sets of methods for different marine habitats for use in FDEP programs should be beneficial to many of the other programs. The second half-day helped the workshop organizers (Chairpersons and Core Groups) with their efforts to put on the first series of technical workshops. If we are to accomplish the initial part of the effort, we must focus only on those aspects relating to methods development. Of course, all other questions need to remain on everyone's mind since they obviously influence how the methods are developed, but they will need to be addressed in detail at a later date by the various programs. The workshops focused on the nuts and bolts of what data is needed to make the determination of human impairment, how data is collected, and analyzed to provide reliable conclusions. Field studies are expected to compare the various candidate methods to help us select the suite of methods for sampling as many habitats as may be necessary while achieving a balance between information received and the cost of gathering that information. It is also likely that some methods may need to be developed for habitats where few presently exist (e.g., sampling invertebrates in mangrove systems).

Coral Bioassessment Methods Workshop

The workshop was held at the Florida Marine Research Institute on October 13 and 14, 1998. This workshop was the first of five to provide a list of candidate methods for coastal and estuarine bioassessment. Attendees included

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The meeting began with an introduction of the program to the group and reviewed the preliminary survey results by Matt Patterson. The survey provided a list of measurements currently collected that were then used later to generate the candidate measures. Additional survey topics discussed were areas currently studied and type of sampling/monitoring used. After the survey results were reviewed, Gil McRae provided a brief overview of the statewide program plan.

Delineation of habitat types throughout the state was the first topic tabled. This was met with opposition by many members of the group due to the 70-year battle regarding habitat classification. The main reasons for difficulty seemed to be specifics such as reef building or not, relief level, number of spp., and where the program boundaries were (FKNMS boundary or state waters). The habitat question was shelved until later. The discussion moved to the question of what to measure?

Steve Wolfe and Alex Stone made the case that we were focusing on developing methods, which looked at only stony coral taxa without using any other reef occurring spp. such as gorgonians, sponges, etc. The group then spent some time trying to ascertain how this workshop needed to look at the question posed to them. It was discussed and we were to have methods that would be applicable to corals that could provide an assessment value. We then spent time discussing impacts that we should be cognizant of when thinking about coral "health". This list was started on the premise of human impact, but

became diluted with natural impacts as well. The list included:

Grounding
Dredging
Water Management
Beach Renourishment
Sedimentation
Turbidity
Storm
Over-fishing
Nutrient Enrichment
Upwelling
Climate change
Spills
Temperature
Salinity
Ultraviolet radiation
Bacterial contamination
Description of current flow
Upper nutricline increase from Mississippi River

Discussion established a need for these to be measured in a cost-effective manner, with current techniques instead of lengthy research requirements, and then ranked by usefulness.

The question of what to measure for each impact was expressed. The general reply was that the measures should not be impact driven, but generalized for any bioassessment use throughout the state. This was met with some controversy because most experts felt the methods were determined depending on the question. The new question became how do you assess corals at site x with little or no a priori knowledge. We developed a list of methods and then decided how well they adhered to the following criteria:

Absolute	Does the data provide useful information without a baseline to compare to
Relative	Does the data depend on baseline data for decisions of change to be made
Consumptive	Do coral samples need to be removed from the site for testing
Ready for use	Is the method currently accepted by the scientific community
Needs much lab work	Does this method require intensive lab work to derive results
Expensive	\$\$\$
Needs further research	Method is not quite ready for use
Only spatial	Provides information on a spatial scale but not very useful for time series analysis

The list of what to measure was as follows:

Measure	Absolute	Relative	Consumptive	Ready for use	Needs Requires much lab work	Expensive	Needs further research	Only spatial
% recent death/loss of tissue	Y	Y	N	Y	N	N	N	N
% Algal abundance	Y	Y	N	Y	N	N	N	N
Growth rate-extension/ Calcification	Y	Y	Y	Y	Y	N	N	N
Growth rate – productivity	Y	Y	N	Y	N	Y	N	N
% Disease	Y	Y	N	Y	N	N	N	N
Qualitative coral assessment	Y	Y	N	Y	Y	N	N	N
Physical damage	Y	Y	N	Y	N	N	N	N
Zooxanthellae Density	Y	Y	Y	Y	N	N	N	N
C:N:P-Lipid:Protein	Y	Y	Y	Y	N	N	N	N
Presence/ Absence of Stony coral target taxa**	N	Y	N	Y	N	N	N	N
% Coral cover	N	Y	N	Y	?	?	N	N
Diversity	N	Y	N	Y	N	N	N	N
Size Freq. Distribution	N	Y	N	Y	N	N	N	N
Relative spp. Abundance	N	Y	N	Y	N	N	N	N
Bioaccumulation of metals and Phosphorous in Tissue/Skeleton	N	Y	Y	Y	Y	Y	N	N
Larval Survival	N	Y	Y	Y	Y	Y	N	Y
Fecundity/Recruitment-Larval Development, Settlement, Metamorphosis	N	Y	Y	Y	Y	Y	N	Y
Stable C:N ratio – Tissue	N	Y	Y	Y	Y	N	N	N
Stable C:O ratio-Skeleton	N	Y	Y	Y	Y	N	N	N
N Isotope for sewage	N	Y	Y	Y	Y	N	N	N
Coral activity state-extended/closed	N	Y	N	Y	N	N	N	N

The group determined that a subset of easily identifiable, common target species should be used to ease training and include the following genera:

Acropora
Colpophyllia
Diploria
Montastraea
Siderastrea

The group decided that sampling should be done during Summer-late Summer-early Fall because of the increases in bleaching, disease, and algal cover.

Other measurements that were discarded for one reason or another were :

Fluorescence – Tissue/Skeleton
Presence of bioeroders
Fish population/density/composition

Further workshops will be used to determine the most cost effective methods to be used for the various measurements proposed. Clarke spent some time on sampling design, random vs. permanent transects, sampling power, BACI (before, after, control, impacted) with random before/after using t-tests; permanent before/after using paired t-tests, and BACI using ANOVA for both random and permanent. Using multivariate analysis with a species list, permanent transects can have similarity/dissimilarity values determined, then a paired t-test can show amount of change from year to year.

Discussion continued in the reef/hardbottom arena. A decision was made that “coral” measurements were not going to be used unless two criteria were met:

5-10+% coral cover
2 or more target genera were on the sampling site.

Any other habitat should be thought of as not being suitable to use corals as bioindicators. It was highly recommended that the dominant sessile reef invertebrates (Porifera/Gorgonia) should be included in the invertebrate workgroup to ensure these important organisms are included.

To conclude, the final list of measurements were

% recent death
% Algal abundance
% disease
Quantitative/qualitative coral assessment
Physical damage
Larval survival
 Development
 Recruitment
 Success

And with baseline data or control sites;
% cover
presence/absence for target genera
species diversity
size-frequency distribution
relative species abundance
coral activity state
growth rate-x Ray densitometry
zooxanthellae density
C:N:P; Protein:lipid
Bioaccumulation of metals + P in tissues/skeleton
Stable isotope C:O – skeleton
Stable isotope C:N – tissue

For method selection and survey design, I propose that the following members be included in future workgroups:

Matt Patterson
Walt Jaap
Pam Hallock-Muller
Alex Stone
Dick Dodge

The workshop was successful in developing a list of candidate indicators using corals for assessment of the “health” of an estuarine or marine location. Future work shall allow for these indicators to be linked to values for bioassessment.