13.3 Tampa Bay - *Development of a Community-Based Metric for Marine Benthos: A Tampa Bay Pilot Study*

13.3.1 Study Objectives

State biological criteria in Florida have been set at a 25% decrease in Shannon-Wiener diversity of benthic communities in test versus reference sites. Input data have been the sum of three ponar grab samples per site; however, evidence has suggested that these methods and criteria are not sensitive enough. Pilot studies in the Tampa Bay area (Figure 13-1) have tested a process of classifying organisms according to their sensitivity or tolerance to pollution, and developing an index (the Farrell Epifaunal Index) value for test and reference sites (Farrell 1993a). The pilot study used biological data from areas surrounding treatment plant outfalls in the index calculations, in order to detect differences between test and reference sites that were not evident using the state criterion of a 25% decrease in diversity.

13.3.2 Study Methods

Water quality and benthic data were developed from a 1992 short-term study of the effects of three small package plants on the seagrass communities at Fort Desoto Park in Tampa Bay, Florida. Three control stations were located on Joe Island on the southern shore of Tampa Bay, and an additional station was located on a small island adjacent to Fort Desoto (that was presumably under the potential influence of the farfield effects). Two sampling sites were located at each station, one on the shoreline (end of pipe) and a second 50-m offshore. Four petite ponar replicates were collected at each site; however, only three were analyzed for macroinvertebrates. This process was consistent with Florida's biological integrity standard as defined in the Florida Administrative Code. After the ponar samples were collected, macroinvertebrates were also sampled at each location using a modified Renfro Beam Trawl towed for a distance of 4-m.

The Renfro Beam Trawl is a conical net, open at the large end, which is normally towed over the surface of the substrate. The net is maintained in an open position by attaching it to a rigid pole or beam. The body of the net is constructed of nylon bolting cloth (50 openings/cm^2, which tapers to a plankton net fitted with a removable bucket. The effective swath width of the custom trawl used for the pilot study was 1.25-m. By towing the net over a uniform measured distance, the results were comparative (semiqualitative) and relative abundances of the various species were maintained. The standardized tow length of 4-m effectively sampled approximately 5-m^2 of bottom. Some advantages and disadvantages of using the epibenthic beam trawl are listed in Table 13-8.

In advocating the use of the beam trawl, which predominantly samples the epifaunal and facultative infaunal communities, one basic assumption was made. Provided that the recruitment potential for the individual community components existed, it was assumed that within a given set of natural environmental parameters an expected community of organisms would inhabit any predetermined environmental segment. In estuaries and many other marine environments, populations of different species vary significantly over the seasons and from year to year; however, these variations follow predictable patterns. In Florida, numerical dominance may vary among annual cycles; however, species

Table 13-8. Advantages and disadvantages to using the epibenthic Renfro beam trawl for the sampling of benthos.

ADVANTAGES	DISADVANTAGES
• The epibenthic assemblage is very sensitive to anthropogenic stressors, and this method can be used in both a nearfield and farfield context with equal facility. • Since this method is limited to level bottoms, the total number of common species will be limited (thereby greatly simplifying training). [NOTE: Time required for analysis of three ponar samples was approximately 20-hours, whereas the time required to analyze a pilot study trawl sample was a little less than 10-hours]. • This method lends itself to subsampling which will reduce processing hours and increase cost-effectiveness. • Once initial training is completed, field efforts can be relatively rapid and analytical time can be reduced. • Samples can be sorted qualitatively, and a nonparametric analysis can be applied to provide a method of quick screening.	• The method is restricted to level bottoms. Hard substrates cobble, and emergent vegetation tend to invalidate the method. • In areas of abundant seagrasses or macroalgae beds, sample bulk can be a hindrance and some rough field sorting may be required. • The epifauna tend to be seasonally abundant; therefore, this factor would have to be calibrated into the method if multi-seasonal sampling events are utilized.

composition generally remains stable. Benthic macroinvertebrates, in terms of both density and diversity, reach their peak in Florida during the late winter to early spring (or earlier in the southern part of the state). Population minima for most species occur during the summer months. While they are dramatic, these seasonal cycles can be factored into efforts to establish biocriteria. It is important to consider seasonality because the species which are most sensitive to environmental stress are those which tend to reach their population peaks during periods when water quality factors are both stable and optimal.

The epifaunal and facultative infaunal community was targeted for the pilot study since components of the community appear to be both persistent and very sensitive to environmental stress. Within estuaries and adjacent near-shore areas, physiochemical parameters (e.g., temperature, salinity, dissolved oxygen) will vary significantly over an annual cycle. Sessile and relatively immobile organisms (including most of the infaunal components) have evolved either mechanisms which allow them to tolerate these varying conditions, or breeding cycles which allow them to avoid periods of high stress. The more motile members of the community (including the epifauna and facultative

infauna) have the option of avoidance. During periods of stress, these organisms can move to deeper water or to other areas where stressors are mollified, and then return when conditions improve. When an area is being affected by relatively low levels of anthropogenic stress, only the most sensitive members of the benthic community will respond, and these are found among the epifaunal and facultative infaunal components. It is apparent that a method which is truly sensitive to low levels of pollution must target these components of the benthic community, thereby advocating their use in the Tampa Bay pilot study.

13.3.3 Study Results

A bioassessment approach should be able to not only detect low levels of environmental stress, but it should also be able to detect those stress factors at the earliest possible stages. One approach which has been used successfully in freshwater environments has involved the assignment of the specific index values to various community components; i.e., species, and basing community assessment on the mean index value derived from sampling that community (Lenat 1993). The Farrell Epifaunal Index proposed in the Tampa Bay pilot study was specifically developed for the west coast of Florida, but it should be useful in adjacent areas. The index values represented a somewhat subjective evaluation of the relative tolerance or intolerance to environmental stress. The values were taken from an ongoing effort to assign tolerance values to all marine and estuarine macroinvertebrates identified from the coast of Florida. Information sources have included agency monitoring data, published records, gray literature, and anecdotal information. Wherever possible, all potential stressors including sensitivity to toxic substances was taken into account; however, the dominant factor for most of the species was the relative sensitivity to dissolved oxygen depression. As a result, the Farrell Epifaunal Index was probably most sensitive to organic pollution and eutrophication with associated wide swings in dissolved oxygen.

The tolerance criteria for the index in terms of dissolved oxygen requirements were as follows:

0 Insufficient data to make an evaluation.

1 Very tolerant. The identified species can withstand short periods of anoxia.

2 Tolerant. The identified species can withstand brief excursions to 1.0-1.5 mgL^{-1}.

3 Slightly tolerant - slightly sensitive. The identified species can withstand brief excursions to 2.5-3.0 mgL^{-1}.

4 Sensitive. The identified species can withstand brief periods below 4.0 mgL^{-1}.

5 Very sensitive. The identified species are basically intolerant of concentrations below 5.0 mgL^{-1}; however, some species may tolerate brief excursions below this provided no other stress factors are involved.

When the components from a sample had been identified, the predetermined tolerance values were assigned to the various species, and a sample Farrell Epifaunal Index value was calculated using the formula:

$$\textit{Farrell Epifaunal Index} = \Sigma \frac{n_i I_i}{N}$$

where: n_i = number of individuals of species i;
I_i = tolerance value for species i;

N = total individuals from all species used in the calculation.

In a strictly qualitative approach, an index value may be calculated using the formula:

$$\textit{Farrell Epifaunal Index (Qualitative)} = \Sigma \frac{I_s}{N_s}$$

where: I_s = index value for component species s;
N_s = number of species used in the calculation.

Pilot study calculations of Farrell Epifaunal Index values required that the appropriate tolerance value (0-5) be assigned to individual taxa in each sample. The values were then added, and the summation was divided by the total number of taxa utilized from the sample. Taxa with a value of zero were omitted from calculations. Pilot study results (Table 13-9) indicated that the index had been successful at detecting differences between test and reference sites. The resulting Farrell Epifaunal Index will not meet all needs, and is not the only metric that could be applied to beam trawl or similar samples; however, pilot study results indicate that at a minimum it should prove to be an effective screening method.

Primary Contact: Steven Kent, FLDEP,
3319 Maguire Blvd.
Orlando, FL 32803
407-894-7555, ext. 2227
kent_sl@orl1.dep.state.fl.us

Table 13-9. Farrell epifaunal index results for the Fort Desoto Park - Tampa Bay Pilot Study.

BEAM TRAWL SAMPLE RESULTS							
	Sources			Controls			
Stations	4	6	5	7	2	1	3
Number of Taxa	8	13	16	29	27	31	38
Index Total	15	27	35	69	72	84	106
Index	1.88	2.08	2.19	2.38	2.67	2.71	2.79