13.5 Indian River, Florida - *Field Verification of Marine Metrics Developed For Benthic Habitats: Indian River Lagoon, Florida Pilot Studies*

13.5.1 Study Objectives

A research program was developed for Florida estuaries to promote the identification of benthic marine parameters indicative of relative water resource quality (Nelson et al. 1993, Nelson and Spoon 1994 a, b). The development of these parameters or metrics was ultimately intended to help quantify the diverse attributes and interrelationships of the community to: enhance documentation of possible resource impairment from point and non-point sources; evaluate aquatic life use attainment; and to be incorporated in the biological criteria process.

13.5.2 Study Methods

The process of developing benthic biota community parameters (or metrics) indicative of Florida estuarine resource quality was initiated in 1993 with Indian River Lagoon pilot studies (Figure 13-1). The initial study involved the collection and analysis of samples taken from six stations, including two within the main Indian River Lagoon and four at the mouth of tributaries. Benthic samples were collected by a diver using 8.2-cm diameter Lexan cores which were sectioned into 0-5-cm and 5-15-cm depth fractions. Study sites were selected with the primary criterion of a presumed difference in pollution impact, with secondary emphasis on similarity of sediment type and tertiary emphasis on similarity in salinity. Three sites were designated impaired and three were designated low impairment sites. The small scale or smaller number of stations limited the bottom salinity types sampled to mesohaline, polyhaline, and euhaline locations.

The nature of pollution impacts in the Indian River Lagoon presented a major problem in sample selection. Maximum impacts of pollution input (primarily from urban runoff) are felt within the small lagoonal tributaries as compared to the lagoon proper. Non-impaired tributary sites are generally not available, which forces most reference sites to be in the lagoon proper. This sometimes resulted in a difference in salinity between the impaired and non-impaired sites. For example, during winter sampling, mean salinity at impaired sites was 13-ppt (mesohaline), and was 25.3-ppt (euhaline) at non-impaired sites. However, these spatial salinity differences appeared to be seasonal in the lagoon. Samples taken in June had a mean bottom salinity of 25.3-ppt (euhaline) at impaired sites compared to 29.6-ppt (euhaline) at non-impaired sites.

13.5.3 Study Results

The benthic data were summarized in terms of: the mean percent of biomass contained in the top five centimeters of the sediment profile at each of the stations; and the mean weight per individual compared among sites and between the 0-5-cm and 5-15-cm depth segments. There was no clear difference in mean percent biomass (contained in the top 5-cm) between the two sets; i.e., impaired, non-impaired of sites. There was also no clear difference in mean weight per individual based on presumed differences in pollution impact either for the surface sediments or for the deeper sediments. Biomass differences with differing salinities also showed no clear differences, in that mean values of the percent total biomass above 5-cm ranged from 68% to 89% in

mesohaline areas, and 69% to 81% in euhaline areas. The value in the single polyhaline area was 94%.

Sediment types within the study area were classified as sand (>70% sand), mixed (30-70% sand), and mud (<30% sand). Both the impaired and non-impaired sites had all sediment types represented. There were no apparent trends in biomass data among the sediment types. There was no indication that sand sites had less biomass in surface sediments than mixed sediments, or that mean weight per individual differed among sediment types.

During the initial studies, benthic data were also summarized in terms of total individual and total species metrics. The mean percentage of total individuals present above 5-cm ranged from 96 to 99.6% at the study sites. The differences in this metric between sites of different pollution impact was thus very low; therefore, this metric did not clearly distinguish Indian River Lagoon sites. Mean percentage of species above 5-cm in the sediments was calculated from the data by dividing the total number of species in the 0-5-cm fraction by the sum of this value plus the total number of species recorded in the 5 -15-cm fraction for each site. There was no clear separation between the sites based on this metric.

The initial Indian River Lagoon pilot study and previous studies of the area have examined the following metrics:

- Mean total number of individuals;
- Mean total number of species;
- Percentage of amphipods;
- Percentage of spionids;
- Spionidae/capitellidae ratio;
- Apparent color RPD depth.

Of the seven metrics, separation between impaired and low impairment sites was good for mean number of species, percentage of amphipods, percentage of spionids, spionidae/ capitellidae ratio, and apparent color RPD depth. The percentage amphipod, percentage spionid, and spionidae/capitellidae ratio metrics require separation of individual specimens which requires greater time than simple counts of total individuals or total biomass. However, these metrics seemed to offer much greater powers of resolution than measures of total individuals or biomass.

Limitations on the generality of the conclusions of the initial pilot study were imposed by the limited number of sampling sites (6) and by the fact that samples were obtained at only one point in time. Seasonal variation in benthic systems can be substantial; therefore, it was essential to verify the temporal generality of initial conclusions. Similarly, spatial variations in salinity regime have been demonstrated to influence metric values. Therefore, more extensive spatial and temporal sampling was warranted to verify the utility of the proposed metrics. To provide temporal verification of metrics, the six sites originally sampled in January 1993 were resampled, and two new sites were added to the sampling plan to represent additional spatial coverage of the Indian River Lagoon. The two additional sites were located near Cocoa, Florida, with one presumed to be an impaired; i.e., located near a sewage outfall pipe, and the other a low impairment site. Core samples were collected by divers (as in the initial pilot study) during June, July and August 1993. All organisms collected were

subsequently identified to the lowest feasible taxon, counted, oven dried, and weighed in the laboratory. Surface water temperatures and salinity, and bottom salinity measurements were made in the field, and sediment samples were collected by skin diving. One of the proposed metrics was to involve visual determination of the apparent color RPD depth. It was difficult to measure a visual RPD with any degree of confidence since the surface layers of sediment were often flocculent and were therefore disturbed by the coring process. Attempts to measure the apparent visual RPD were therefore abandoned during the second phase of pilot studies.

A total of 64 benthic cores and 128 core fractions were collected and processed during the second phase of pilot studies. There was no clear distinction for the 0-5-cm sediment fraction in mean number of individuals per core recorded at low impaired versus impaired stations. Mean number of benthic taxa recorded per core from the 0-5-cm fraction also failed to show clear differences between the two sets of stations. Clear distinctions were observed, however, between the impaired and low impaired sites with respect to mean abundance per core for benthic organisms in the 5-15-cm fractions. Abundances in the 5-15-cm fractions differed by a factor of at least 4 between the two sets of stations; i.e., mean equaled 0-1.3 at impact stations and 5-10 at low impact stations. Impaired and low impaired sites also showed clear separation based on the mean number of taxa per core in the 5 - 15-cm fraction.

The total species richness of amphipod crustaceans was seven at both the impaired and low impact sites, and the species recorded were similar. The metric based on the percentage abundance of amphipod crustaceans; i.e., percent of total, failed to clearly distinguish the two types of sites. Comparisons of amphipod total abundance; i.e., amphipod total count, also failed to clearly distinguish impaired versus low impact sites, ranging from 4-1789 at low impact sites and 27-62 at impaired sites. The 1993 summer results contrast strongly with the winter results for the amphipod metrics. Winter data showed clear separation of impact versus low impact stations with respect to both percent abundance and total number of amphipods, whereas summer data did not.

The ratio of spionid polychaete abundance to capitellid polychaete abundance showed only partial separation between station types in the summer samples. There was a decreased degree of separation with this metric in summer versus winter samples. The differences in the ratio were generated both by reduced numbers of spionids and by increased numbers of capitellid polychaetes at the low impact sites for winter samples. In contrast, differences in summer samples for the low impact sites were mainly caused by high values for capitellids. Therefore, a total capitellid metric was examined for both seasons. Clear separation between impaired and low impact sites was given for this metric for both summer and winter data. Examination of a total annelid abundance metric also demonstrated separation of impaired and low impact sites (for summer data).

Total faunal biomass showed no separation of stations for either the 0-5-cm or 5-15-cm core fractions. Expression of the biomass values above 5-cm were modified by subtracting biomass for the occurrence of a few large organisms (e.g., large bivalves). The adjusted surface biomass metric also failed to

clearly separate the impaired and low impact sites.

Differences in the values of benthic community parameters were apparent in summer samples as compared to the winter samples from the same study sites. The seasonal changes in abundance were anticipated given previous knowledge of seasonal abundance patterns of macrobenthos in the Indian River Lagoon. Some proposed metrics were consistent in their performance in both winter and summer samples (Table 13-12). Both abundance and taxa richness in the deep sediment fraction were metrics which gave clear separation in the sets of stations in both winter and summer. Abundance of capitellids also consistently separated the station types during both seasons.

The performance of some of the metrics which appeared promising in the winter samples was somewhat altered in summer. For example, taxa richness in the 0-5-cm fraction, percent amphipod abundance, total amphipod abundance, and spionid/capitellid ratio metrics discriminant stations in the winter, but did not do so (or gave unclear results) in the summer. Explanations for this change in performance may be complex.

The biomass measurements used in the pilot studies were made on specimens separated into lowest identified taxonomic units, which required considerable time and effort. Had the biomass measures provided clear separation of station types, it would have been warranted to suggest that all specimens be pooled to obtain a single biomass value. However, it did not appear that biomass values for either depth fraction were useful as a benthic metric for the Indian River Lagoon.

The pilot study results clearly indicate that the season during which sampling takes place may influence the ability of a given metric to distinguish among sites. Overall, clearer separation was seen among sets of stations for winter sampling than for summer sampling. This appeared to be related to the fact that highest organism density in Indian River Lagoon benthos is seen during late winter, rather than in the summer as is the case at other locales. This clearly points out the need to evaluate seasonality at specific geographic areas.

Relatively few of the proposed metrics consistently separated sites in the Indian River Lagoon. The mean abundance of organisms and mean species richness in the 5-15-cm depth fraction, and capitellid abundance metrics all provided consistent separation of station types. The relatively small sample size in terms of number of stations appeared to result in ambiguous interpretation; i.e., clear station separation ability in winter and marginal in summer, for the total amphipod abundance and spionid/capitellid ratio metrics. The natural temporal variability in the benthos may be sufficiently extreme to affect the performance of these metrics; therefore, the best way to minimize the influence of the variation may be to sample as many stations as possible.

In the most recent phase of pilot studies, two amphipod metrics - mean number of amphipods per site and the ratio of Corophiidae/(Ampeliscidae + Phoxocephalidae) - were assessed at a total of ten stations within the Indian River Lagoon. The original eight pilot sites were resampled and two additional sites were sampled during May and June 1994, using techniques as described for the earlier pilot studies. A total of 80 benthic cores were collected and processed.

Table 13-12. Comparison between winter and summer samples of the ability of the various metrics tested to discriminate between impaired and low impairment sites.

METRIC	WINTER	SUMMER
0-5 cm abundance	NO	NO
5-15 cm abundance	YES	YES
0-5 cm taxa richness	YES	NO
5-15 cm taxa richness	YES	YES
percentage amphipods	YES	NO
total amphipod abundance	YES	?
spionid/capitellid ratio	YES	?
capitellid abundance	YES	YES
total annelid abundance	NO	YES
total biomass	NO	NO
total biomass (excluding large bivalves)		?
mean percent biomass above 5 cm	NO	NO

NOTE: ? indicates marginal utility of metric due to inconsistent discrimination of impaired and low impairment sites.

Results of collection analyses showed that the simplest amphipod metric, mean total abundance, clearly separated impaired from low impact sites in the late winter samples taken in 1993. However, summer 1993 and 1994 results indicated that the response of this metric was not satisfactory. Available water quality information suggests a division of the set of 10 stations into three groups: high impact, moderate impact, and low impact. Use of the mean number of amphipod metric did not provide a similar separation of sites for summer 1994 sampling data. However, the outcome of the Corophiidae/ Ampeliscidae metric calculations was most consistent with the high impact, moderate impact, low impact division of sites, and therefore appeared to reasonably reflect water quality conditions of the Indian River Lagoon.

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