Chapter 8
Tier 1

The Tier 1 assessment is just one way of completing a minimal biological assessment or simple field screening. Specific agency needs will ultimately decide the components of any state monitoring program. The time period of sampling should be selected to allow states to answer the question: "What information do we want to obtain from a single site visit?" For example, it could be conducted from a single field visit during late summer when low dissolved oxygen concentration, due to stratification and eutrophication, is most likely to occur or during some other chosen index period, depending on the monitoring purpose. It builds on the information compiled in the desktop screening assessment and consists of sampling one or more biological assemblages and collecting data on water column and bottom characteristics (Chapters 5 and 6). Tier 1 might roughly identify whether an estuary or coastal marine waters are nutrient enriched and can distinguish among broad probable causes if the nutrient state is different from expectations (reference conditions). This assessment tier enables:

- coarse identification of nutrient state based on chlorophyll *a* concentration, and identification of point and nonpoint probable cause if stations are carefully selected and spaced;
- detection of emergent wetlands and shore zone fish habitat loss from shore zone survey and macrophyte assessment;
- detection of loss of submerged aquatic macrophytes;
- detection of potential impairment of benthic macroinvertebrate and fish assemblages;
- detection of oxygen stress.

The Tier 1 assessment will not allow separation of multiple probable causes. It can establish the initial habitat classification scheme and identify several possible causes of impairment, including point sources, nearfield nonpoint sources (in the immediate shore zone of the coast or estuary), and farfield nonpoint sources (from land use in the drainage). It cannot, however, identify the most probable from among several possible causes. It should also help establish the most likely sites to use in developing the reference condition and test their candidacy for this preliminary phase of biocriteria development. Table 8-1 gives an overview of the components, data collection methods, and indicators for Tier 1.

8.1 Benthos

Sampling and analysis of benthic infaunal macroinvertebrates in Tier 1 is intended to provide a rapidly obtained snapshot of the condition of the benthic assemblage. It is recognized that this assemblage, and the methods presented, will be most appropriate for sites with soft sediments (e.g., mud, silt, sand). For sites with hard bottom substrates, other biological assemblages (e.g., fish, macrophytes, phytoplankton) could be selected to provide information on the biological condition of the target waters.

The sampling strategy presented here consists of collecting replicate grab

Table 8-1. Tier 1 Assessment. Requires single field visit in spring or summer index period.

Component	Data Collection	Indicator of	Uses
Biological Assemblages			
Benthic Infauna	*3 replicate grabs *x-section of Smith-McIntyre or Young grab *measure RPD depth *brief description of classes & families of benthos present in grab *record faunal presence/absence of benthos above and below the RPD depth in sediment x- section	DO stress, toxicity, low productivity, nutrient enrichment, habitat impairment	-Identification of nutrient state based on chlorophyll *a* concentration & identification of point and nonpoint probable causes (if stations are carefully selected & spaced) -Detection of emergent wetland & shorezone fish habitat loss from shorezone survey and macrophyte assessment -Detection of loss of submerged aquatic macrophytes
Fish	*3 trawls *3 seines *species counts *measure standard lengths *record external abnormalities	DO stress, toxicity, habitat impairment	
Macrophytes	*aerial photos (if possible - or estimate from shorezone survey *% cover estimate *record dominant taxa	Nutrient enrichment, sediment loading	
Phytoplankton	*chlorophyll *a* *record blooms *identify dominant species	Nutrient enrichment	
Water Column Characteristics			
	*salinity/conductivity *temperature *DO *pH *Secchi depth *depth *TSS for seagrass	DO stresses, eutrophication, stratification, turbidity	-Detection of potential impairment of benthic macroinvertebrate & fish assemblages
Bottom Characteristics			
	*grain size estimate & description *RPD layer depth *TVS *sediment toxicity	Habitat modification, DO stress, sediment toxicants	-Detection of oxygen stress

samples at each sampling site, taking a vertical cross-section of the sample, and measuring the RPD layer depth to record the presence/absence of benthos above and below the RPD depth in the sediment cross-section. In addition to the actual presence of organisms, evidence of their presence, such as bivalve siphons, siphon impressions in clay/mud, or polychaete burrows, should also be noted. The investigator may also wish to sort and identify the organisms found above and below the RPD depth for additional information relative to Tier 2. The method presented here is a simplification of the Benthic Assessment Method developed by Diaz and Nelson (1993). Functional attributes of the benthic infaunal community that can be evaluated using these procedures include:

- *Species Life Histories* The presence of relatively large and long-lived species, especially those found deeper in the sediments, indicate higher quality habitat than does the presence of small and short-lived taxa;

- *Major Taxa Abundance* High abundance of only a few taxa, usually pollution tolerant ones, indicates a degraded environment;

- *Major Taxa Biomass Distribution* Larger organisms, hence a higher biomass per individual, are more prevalent in better quality habitats;

- *Vertical Distribution of Biomass* Organisms living below 5-cm in soft substrates indicate a relatively high quality habitat.

8.1.1 Sampling Procedure

The primary objective of benthic infaunal macroinvertebrate sampling in Tier 1 is to determine whether there are any large organisms below the RPD depth. The recommended sediment sampling procedure involves collecting three replicate grab samples at each station using a Smith-McIntyre or Young grab. The selection of sampling gear should be made to maximize compatibility with historic data. For example, the state of Texas uses an Ekman grab, and has an approximately 25-year data record using this gear type. The sediment sample is vertically bisected using a sheet metal partition. The RPD layer depth is noted and measured, if present, as the distance from the sediment surface to a noticeable change in color from brownish (oxidizing conditions) to gray (reducing conditions). The sediment above the RPD depth is removed and wet-sieved separately; the remaining portion of the sample is also wet-sieved. A sieve with mesh size appropriate for the region should be used. The presence or absence of benthic infauna in either subsample is noted. If present, the classes and families should be noted and recorded.

8.1.2 Index Period

Benthic infaunal macroinvertebrates are sampled once during an appropriate index period, the timing of which is driven by the goals of the Tier 1 assessment and regional considerations.

8.1.3 Analysis

Note the presence/absence of an RPD layer and any infauna (or evidence of infauna) below 5-cm depth in the sample. If present, identify benthic infauna to class and family and record abundance.

8.2 Fish

A Tier 1 assessment of the fish assemblage is intended to provide a rapid evaluation of its presence and overall composition. Fish sampling in Tier 1 can include shallow-water, pelagic, and demersal fish communities (Carmichael et al. 1992, Eaton and Dinnel 1994, Guillen 1995a).

8.2.1 Sampling Procedure

Various nets can be used to sample littoral and sublittoral areas. It is recommended that trap nets (gill or fyke nets) be set and fished twice a day for 2- to 5-days. Due to the risk of boating mishaps and vandalism, it is recommended that investigators stay with the nets while they are being fished. Fish sampling methods are detailed in Klemm et al. (1992).

- Gillnets are set in littoral areas at right angles to the shore or to

longshore fish movement. Gillnets usually extend into sublittoral areas. Smaller mesh size (0.5") is used in shallow areas and up to 2 to 2.5" mesh is used further away from shore. To reduce size selectivity, an experimental gillnet consisting of panels of five different mesh sizes is commonly used;

- Trawl nets and sonar can be used to sample pelagic and demersal areas. The length of the towline (warp) should be at least six times the depth of water and a trawl speed of about 2-knots over a 0.5-nautical mile distance is appropriate for coastal marine waters. These values of warp length and trawling distance can be reduced in estuaries. A 20-ft trawl (16-ft effective trawl mouth) is appropriate in marine waters, but an 8- or 10-ft trawl is easier to tow in restricted waters.

8.2.2 Sample Processing

Sampling duration and area or distance sampled (from DGPS) are recorded in order to determine sampling effort. Species are identified and enumerated. Fish should be carefully removed from the net to avoid undue handling and damage. The catch should be sorted by species, and length measurements made of each individual. This measurement is usually total length, but fork length or standard length can also be used. At the time of measurement, any deformities, ulcerations, bleeding, fin rot, bulging eyes or other disease indicators should be noted and those fish saved for histopathology. It is important to distinguish net damage from pre-existing conditions, if possible. Wet weights can be taken by species by weighing the fish either individually using a platform scale or collectively from tared hanging scales, depending on the number of fish caught. As a small matter of convenience, both scales should weigh in metric units. Those animals not saved for further

examination should be promptly returned to the water.

The investigator should consult with State and University fish pathologists of the region for those most appropriate sample preparation and preservation techniques. Usually iced or frozen specimens are inappropriate and in some cases formaldehyde or other tissue preservatives must be carefully used if meaningful samples are to be presented. Generally, small fish can be tagged and placed whole in 10% formalin. Larger fish will require dissection in the field and the tissue samples tagged and preserved in the same manner. Protocols for preservation and dissection should be obtained from the laboratory/fish pathologist that will receive the samples.

When collected, reference specimens of each species from each site are preserved in 10% formalin in a labeled jar and retained by the state ichthyological museum or other designated repository to constitute a biological record. This is especially important for uncommon species, for species requiring laboratory identification, and for documenting new distribution records. Later, all specimens should be transferred from formalin to 70% alcohol for long-term storage.

8.3 Macrophytes

Areal coverage and distribution of submerged aquatic macrophytes is estimated from aerial photographs, if available, and ground-truthed at the site. The dominant taxa may be field-identified from vegetation samples collected in shallow waters. Detailed

macrophyte monitoring and assessment procedures are included in USEPA (1992), Ferguson and Wood (1994), and Orth et al. (1993).

8.4 Phytoplankton

Phytoplankton standing stock is estimated by chlorophyll *a* measurements. A sample is collected at each station at one-half the Secchi depth using a Kemmerer or Van Dorn sampler. Chlorophyll *a* is determined using a fluorometer or spectrophotometer as discussed in APHA (1992). The presence of any phytoplankton blooms observed during the cruise should be noted. Dominant phytoplankton species should be identified.