WRP Technical Note SD-EV-4.1
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Collection of Undisturbed Bulk Wetland Sediment Samples

PURPOSE: This technical note describes how to collect bulk undisturbed sediment samples from wetland areas.

BACKGROUND: Certain sediment analysis procedures require the collection and sectioning of undisturbed bulk sediment samples. Techniques such as Cs^{137} dating of sediments are dependent upon the collection of a bulk sample. Also, analysis of samples for toxicants such as pesticides, herbicides, and heavy metals may require a bulk sample. In order to determine a depth profile for a substance the sample core must be undisturbed; that is, the core must retain its original size and shape until it is sectioned, or cut up, for analysis. Because of the high organic content of wetland sediments, collection of an undisturbed bulk sediment core can be difficult. In addition, many wetland areas are remote; therefore, sampling equipment must be simple, rugged, and lightweight enough to carry by foot or small craft for long distances.

EQUIPMENT: Though seemingly uncomplicated, the equipment used in the collection of the sample is extremely important. For the collection of bulk samples, a 10 cm (4 inch) pipe is used. In order to get an undisturbed sample, a very thin walled pipe is needed. The best pipe material is 10 cm diameter aluminum irrigation pipe, which is thin, light-weight, strong, and smooth walled. If thin walled aluminum pipe cannot be located, then PVC pipe can be substituted. If PVC must be used, drain pipe is superior to the thicker high pressure pipe. Because the aluminum pipe will penetrate the sediment easier than PVC, there is less chance for compaction of the core during collection. Also, samples are more easily removed from the aluminum pipe.

Regardless of the pipe material, the end of the pipe should be beveled with a file to enhance penetration. The sharper the end the better. The length of sampler is dependent upon the depth of water and the length of sample to be collected. For most applications a 2 - 3 meter section of pipe is adequate, though the pipe can be cut into any length necessary. Measuring marks should be placed along the outside of the corer, at 10 cm intervals, so that the length of the core can be determined in the field and compared to the length of the core once it is removed from the sampler.

In order to remove or "pull" a core from the sediment, some type of handle for the pipe is desirable. The hinged bracket, shown in Figure 1, works very well with the aluminum pipe. This design allows the bracket to be easily moved along the pipe and tightened with the wing nut during collection.

In addition to the bracket, caps or rubber stoppers are needed for each end of the corer. The stopper or cap for the top end of the bracket should be fitted with a screw-in stem valve. A small hand-operated or battery-operated air pump is needed in conjunction with rubber stoppers fitted with screw-in valve stems, in order to remove the core from the sampler.

Loose organic cores will also need support while they are being sectioned. A good core holder can be constructed from a 1 meter section of 10 cm diameter PVC pipe by slicing the pipe down the middle and gluing caps on the ends of the half pipe. Holes should be drilled at the ends of the pipe

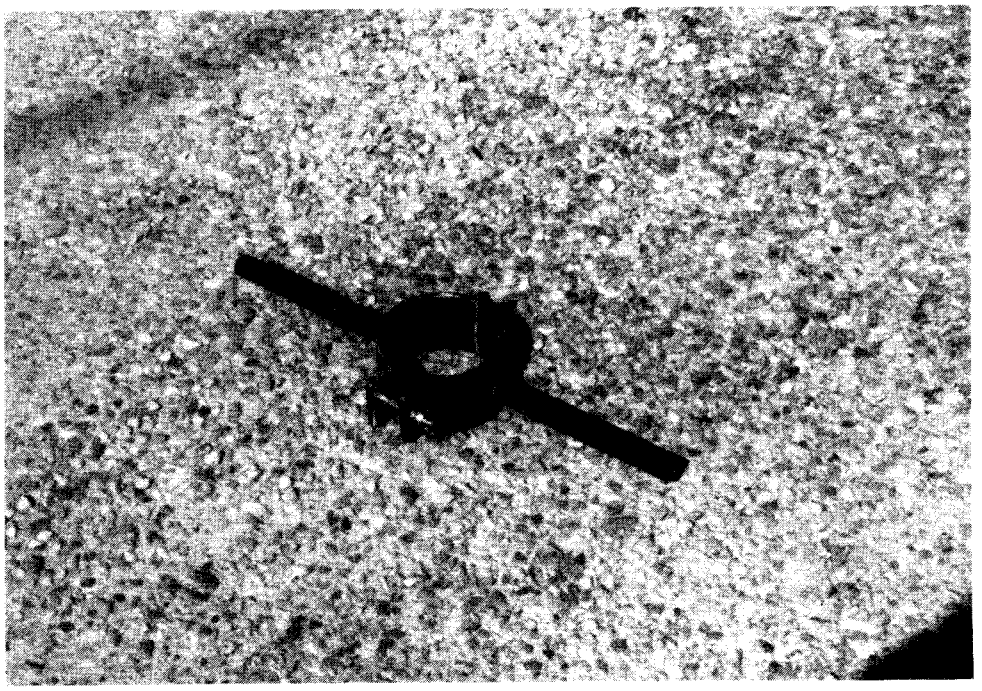

Figure 1. Bracket for sample extraction

to allow excess water to run off the sample. This trough, as shown in Figure 2, will support the sample and hold it in its original form while it is being sectioned.

SAMPLE COLLECTION: The techniques employed in the collection process are designed to collect an undisturbed sample of sediment with a minimum of water above the core. Cores may be collected by either wading or from a small boat. When collecting a core, the bottom cap should be removed and held close by. The bracket with handles is attached to the corer about chest high. The following procedure should be followed:

- Place the top cap tight on the corer. With the top cap tight, vertically lower the corer to the wetland bottom. Keep the top cap on during this step to prevent water from filling the corer. The corer should rest lightly on the bottom without penetrating.

- Remove or loosen the top cap so that air can fill the pipe. Once the cap is removed, quickly push the corer into the wetland sediment. Some water will enter the pipe, but this can be minimized by rapidly pushing the corer into the sediment. Once the corer is in the sediment, water will no longer enter the pipe. The corer should be pushed into the sediment until the bottom of the wetland is struck.

  The bottom is defined as the bottom of the wetland before the deposition of sediments. Normally, the bottom of the wetland will be difficult to penetrate, indicating that the bottom has been found. In wetlands that periodically become completely dry, hard pans may form in the sediment layers where the sediments were allowed to dry. These hard pans will be difficult to penetrate but are usually thin, only a few cm in depth. Once they are penetrated the underlying sediments are usually much softer. Often, if a hard pan is mistaken for the bottom the hard pan will not support the core above it and the core will be lost during extraction. If the material of the wetland bottom is known, then examining the soil at the bottom of the extracted core will help determine

Figure 2. Sectioning of sample in trough

if the real bottom has been reached. Wetlands often form above a clay layer of soil, thus mottled clay at the bottom of the core is a good indication that the wetland bottom has been reached.

- Once the bottom is found, push the corer an additional 10 - 15 cm to obtain a hard plug that will support the soft sediments above during extraction. Care should be taken during the coring process to keep the corer vertical.

- Once the corer has been pushed into the wetland bottom, rotate the corer 360 degrees to break the core loose from the bottom. It may be necessary to rotate the corer additional times. Generally, the corer is much easier to rotate once the core is broken loose.

- After the core is broken loose replace and tighten the top cap. This will provide a suction on the sample during removal and help hold the core in the sampler.

- Remove the sample from the bottom by pulling the corer out vertically. Depending on the sample, the core may be very difficult to remove. The bracket will greatly assist in the removal task.

- Once the bottom of the corer reaches the water surface, quickly cap the bottom to avoid losing the sample.

- Transport the samples in a near vertical position to their final location. This is necessary because the top few inches of the core are often in a near liquid form. Laying the core horizontally will cause this portion of the core to mix and it will no longer represent an undisturbed sample.

REMOVAL AND SECTIONING OF CORES: Samples must be extracted from the corer and sectioned without mixing, stretching, or compacting. Assuming that a good sample has been obtained, the first consideration is whether to section the sample in the field. Sectioning is generally easier in the laboratory but very soft samples may compact during transport. This decision should depend on

the consistency of the samples collected and the accuracy desired. Very soft organic mud samples should be removed from the cores and sectioned in the field.

Very consistent samples may be removed from the corer using a stick with a broad end, approximately the size of the core. According to Andrew Nyman of the Louisiana State University Wetland Laboratory for Wetland Soils and Sediments, this is generally adequate for samples obtained from coastal marshes where the sediments are firm and interlaced with roots from marsh grasses. These samples can be sectioned on a flat table using a serrated knife.

However, sediments found in many freshwater wetlands with high siltation rates are generally very soft and are easily compacted or stretched. Also, these samples may adhere to the inside of the sampler and be difficult to remove. These samples require special techniques and equipment for removal from the corer and sectioning. The following steps are recommended:

- Place the sectioning trough at an approximate 10 degree slope.

- Place the bottom of the corer in the middle of the trough and remove the bottom cap.

- Remove the top cap and replace it with a cap fitted with a screw-in valve stem.

- Use the pump to push the sample from the corer. With one person holding the sampler, another person can operate the pump. Pump the sampler full of air until the sample starts to move, then shut off the pump and allow the sample to slowly move into the trough.

- If the sample stops moving, pump in more air until the sample begins to move again. Most samples will slide down the trough as they are pumped out. However, if the sample starts to compact, or if it is longer than one half the trough length, the sampler may be moved back to remove the sample. Be sure not to move the pipe too quickly, as this may cause the sample to become elongated.

- Using a measuring stick, determine the length of the sample. Discard any sample that is significantly longer or shorter than originally measured in the field.

- Lay the measuring stick on the top of the sample and lightly mark the sample with a knife at the desired sectioning locations. The sample may be cut using a sharp, thin-bladed knife, such as a filet knife. A large spoon can be used to scoop up very soft sections.

  If the samples are to be transported for analysis, each section should be stored in a clearly marked, plastic ziplock bag. Each bag should identify the sample number, location, and depth of the slice. It is helpful to pre-number the bags before sectioning the core.

  For samples requiring small sections, 1 - 3 cm, the first one or two slices may be composed of an organic liquid ooze. It may be helpful to freeze these samples before pumping. If this not possible then it may be necessary to estimate the approximate line of demarcation for these top sections.

CONCLUSIONS: A methodology for collecting sediment cores has been developed that allows scientist to obtain bulk undisturbed cores of soft organic wetland sediments. Such a sample is often needed to determine sedimentation rates or perform other analyses that require a sediment profile. The equipment has been tested and proven effective in both fresh and salt water marshes. Because

the equipment is simple and lightweight it may be easily carried to remote wetlands by foot or small boat.

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