SOIL SURVEY HORIZONS

Volume 34, Number 2
Pages 39-60
Summer 1993

Soil Survey Staff. 1975. Soil taxonomy: A basic system for soil classification for making and interpreting soil surveys. USDA-SCS Agric. Handb. 436. U.S. Gov. Print. Office, Washington, DC.

Soil Survey Staff. 1992. Keys to soil taxonomy 5th ed. SMSS Tech. Monogr. 19. Pocahontas Press, Blacksburg, VA.

Soil Conservation Service. 1992. Soil Survey Investigations Rep. 42. Soil survey laboratory methods and procedures for collecting soil samples. SCS, Washington, DC.

Submerged Soils: A New Frontier in Soil Survey

G.P. Demas[1]

Through my assignments to four soil survey projects on the Atlantic Coastal Plain in Maryland and Delaware, I have become increasingly aware of situations where information about soils could go a long way towards providing the supporting data needed to make intelligent environmental management decisions. A major area of environmental concern, especially on the Delmarva Peninsula, is the deteriorating quality of both subsurface and surface water. Among the myriad of negative effects caused by poor water quality is the decrease in health and populations of aquatic organisms. Regulatory and voluntary programs are presently in place on the Delmarva Peninsula that address such items as nonpoint source pollution, on-site sewage disposal, sediment and erosion control, wetland protection and restoration, and the restoration and enhancement of aquatic plant and animal populations. Soil survey information is playing a key role in many of these programs through the gathering, interpretation, and dissemination of previously unavailable soil data directly related to environmental issues.

Although there is much to be proud of in our soil survey efforts to assist in solving some environmental and water quality problems, there is still at least one area in which we have not fully addressed the situation, have not answered the questions, and have not provided the information that many environmentalists have indicated could be significant. In what area are we lacking? We lack understanding the characteristics of soils in shallow water areas and the relationship between soil characteristics and aquatic plants and animals.

Historically, submerged soils have generally been neglected except in certain situations where information was needed for a specific use. An example of this was the mapping and analysis of the Dutch polder soils prior to the building of dikes (Dr. Roy W. Simonson, 1993, personal communication). In the USA, an area of submerged soils was mapped along the eastern edge of the Florida Everglades in the early part of this century (Baldwin and Hawker, 1915), when drainage and development were important issues. Since then, there has been little, if any, mapping of submerged soils. There have also been previous efforts in Europe to include submerged soils in systems

[1] Soil survey project leader, USDA-SCS, 301 Bank St., Snow Hill, MD 21863.

of classification. In Germany, for example, materials under water have been included as "subaqueous" soils (Muchenhausen, 1965). It would appear the main reason that submerged soils were classified or mapped in the above situations may have been the soil scientists' desire to include as much of the world of soils as possible.

I more fully realized the neglect by soil science in addressing submerged soils in the USA during the course of the soil survey project mapping here in Worcester County, Maryland. In the summer of 1992, we examined some of the soils in the tidal marsh and on small islands within Chincoteague and Sinepuxent Bays. In some areas, it was necessary to get out and push the boat along while walking in knee- to waist-deep water. While walking along, we noticed significant changes in the characteristics of the material underfoot. In some areas, it was a soft, muddy sediment, whereas in others, it was a hard, sandy substrate. We also noted that the presence of clams and submerged aquatic vegetation, dominantly eelgrass (*Zostera marina*), seemed to be related to the type of material under our feet.

Because we were only in knee-deep water, it was easy to see the abundance of the vegetation. The thought then occurred, since these materials supported vegetation, could they be considered soil in our present system of classification? If so, wouldn't the morphological, physical, and chemical nature of such soils be significant in water quality improvement efforts such as those underway in the Chesapeake Bay, especially in projects involving the restoration or protection of submerged aquatic vegetation? So, we bored a hole and took samples of each horizon of a submerged soil. A description of that submerged soil follows:

Ag—0 to 3 in.; dark olive gray (5Y 3/2) sand; single grain; nonsticky; few fine and very fine roots; moderately alkaline (pH 8.2); moderately saline; 5% shell fragments; clear boundary.

Cg1—3 to 18 in.; very dark gray (5Y 3/1) fine sand; single grain; nonsticky; moderately alkaline (pH 8.2); moderately saline; clear boundary.

2Cg2—18 to 38 in.; very dark gray (5Y 4/2) silt loam; massive; nonsticky; moderately alkaline (pH 8.3); moderately saline; gradual boundary.

3Cg3—38 to 60 in.; very dark gray (N 3/) very fine sandy loam; massive; slightly sticky; moderately alkaline (pH 8.3); moderately saline.

Preliminary lab analyses confirmed the particle-size determinations, salinity levels, and soil reaction. The results of a moist incubation study of materials from the Ag and Cg2 horizons showed that they were not sulfidic materials.

Later, we discussed the fact that *Soil Taxonomy* (Soil Survey Staff, 1975) does not include any classification for underwater areas. Currently, there are no soil series that occur on ocean, river, bay, or lake bottoms where water is always present. These statements do not apply to tidal areas, where water depth fluctuates and the surface of the mineral soil is frequently exposed to the atmosphere. The soils we examined are rarely, if ever, exposed to air (whether in fresh or brackish water).

The real question comes down to whether we define these materials as soils. *Soil Taxonomy* (Soil Survey Staff, 1975) defines soil as "the collection of natural bodies...supporting or capable of supporting plants out-of-doors." In the *Soil Survey Manual* (Soil Survey Staff, 1991) the definition is presented again. It states "Bodies of water that support floating plants, such as algae, are not soil, but the sediment below shallow water is soil if it can support bottom-rooting plants." After we asked many other soil scientists for their opinions on these two statements, it was obvious that most of them agreed with the classical concept of soil. In other words, they thought if the material had emergent vegetation on it and was exposed to the atmosphere occasionally, then it was soil. If it was permanently ponded or flooded (and thus unlikely to support emergent vegetation), it was not soil.

It is on this point that I believe we need to reconsider the definition of soil. Although I can see why some would not consider submerged mineral material soil, I think the present definition in *Soil Taxonomy* allows us to address permanent shallow water areas of lakes, rivers, bays, and even the oceans, where submerged aquatic vegetation exists. Although most submerged aquatic vegetation types are not emergent, the plants are bottom rooted. This is the key part of the definition of soil in the *Soil Survey Manual* (Soil Survey Staff, 1991) mentioned previously.

To justify fully the addition of submerged soils to *Soil Taxonomy*, there must also be a practical reason why to do so. We are living during a period in which the quality of our environment is being threatened. Our concern about the Chesapeake Bay and other coastal estuaries is due to the continuing loss of habitat and the dramatic decline in finfish and shellfish populations. Submerged aquatic vegetation has been reduced by up to 66% in parts of the Chesapeake Bay since the 1960s (Hurley, 1990). Efforts to restore submerged aquatic vegetation beds are presently being made on a limited scale.

Considering the importance of submerged aquatic vegetation as cover, feeding and spawning grounds, and the significant role in enhancing water quality, I think it is time that the U.S. system of soil taxonomy and soil science provide one of the missing links in the water quality information chain. What types of soils support submerged aquatic vegetation? Which ones don't (or can't)? Is the mineralogy of such soil important? What pedogenic processes are occurring in soil that is permanently saturated and under 3 or 4 ft of water? Does soil particle-size distribution (texture) play a minor or major role in the presence or absence of submerged aquatic vegetation? Has there been any pedogenic development in any of these soils? If so, how and to what degree?

Through the mapping, full characterization, and classifying of submerged soils, we may find correlations among submerged soil type, shellfish species, and submerged aquatic vegetation species. This could be valuable information in efforts to replant submerged aquatic vegetation beds and restock shellfish populations. We would also have available information about soils for wetland creation in shallow water areas that are presently being filled by sedimentation.

Obviously, there are many questions that can be raised, but there are few answers. Until we can answer these questions, we should not avoid the issue due to the technicality of a definition. It is time that soil science and the U.S. system of soil taxonomy address the need to classify, characterize, and map these soils. Let us take the step to boldly go where few soil scientists have gone before—and submerge ourselves in our own new frontier!

Acknowledgment

The author would like to thank Dr. Delvin S. Fanning, Professor, Dep. of Agronomy, Univ. of Maryland for his valuable thoughts and suggestions on this paper.

References

Baldwin, M., and H.W. Hawker. 1915. Soil survey of the Fort Lauderdale area, Florida. USDA, Adv. Sheets, 1915; map. U.S. Gov. Print. Office, Washington, DC.

Hurley, L.M. 1990. Field guide to the submerged aquatic vegetation of Chesapeake Bay. U.S. Fish and Wildlife Serv., Chesapeake Bay Estuary Program, Annapolis, MD.

Muckenhausen, E. 1965. The soil classification system of the Federal Republic of Germany. Pedologie (Belgium) Spec. Issue 3:57-74.

Soil Survey Staff. 1975. Soil taxonomy: A basic system for soil classification for making and interpreting soil surveys. USDA-SCS Agric. Handb. 436. U.S. Gov. Print. Office, Washington, DC.

Soil Survey Staff. 1991. Soil survey manual (draft). U.S. Gov. Print. Office, Washington, DC.