Moorings: An Interpretation from the Coastal Zone Soil Survey of Little Narragansett Bay, Connecticut and Rhode Island

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In the last decade, the boating population has exploded, and moorings are increasing in number. The demand for mooring locations in Connecticut has grown, while the number of vessels most harbors can accommodate is fairly fixed. A mooring refers to a structure or anchor used to hold secure a boat in a certain area, with a float or buoy attached. Years ago, only *inner* harbors were used for mooring areas. Now, *outer* harbors and even bays and ocean-front properties have moorings that are very exposed (INAMAR, 2000). Safety of a boat on a mooring depends on a number of elements—one of them is the type of bottom or soil surface layer materials.

The Subaqueous Soil Survey

Traditional soil mapping is conducted by a field soil scientist trained to understand the interaction of soil forming processes and soil–landscape relations. Mapping soil typically involves field work with the soil scientist traversing the landscape and digging many holes to observe the soil condition and classify the soil. Subaqueous soil mapping is performed in much the same way, except the soil is under water. Instead of topographic maps to provide landscape position, subaqueous soil mapping uses bathymetric maps to identify landscapes and landforms. Shovels are replaced by augers and special tools such as peat corers and vibracores to obtain the soil samples.

Soil samples are described to depths up to 200 cm. If the soils are very soft and fluid (high *n* value soils) or high in organic material, the peat sampler or push tubes are used. The *n* value is a measure of the amount of water a soil can hold relative to the clay and organic matter content. It was originally applied to very young alluvial marine or fluvial soils in the Netherlands and derived as a measure of soil "ripening" (Pons and Zonneveld (1965). Its application in *Soil Taxonomy* (Soil Survey Staff, 1999) is for a prediction of load support or degree of subsidence once a soil is drained. On the basis of these descriptions, representative soils are sampled for laboratory analysis from each land-

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Fig. 1. Photograph of a boat mooring area in Little Narragansett Bay. In the last decade, the boating population has exploded and moorings are increasing in number.

form unit using a vibracore. Field observations and laboratory analyses indicate significant differences in such characteristics as particle size class, organic carbon content, pH, and fluidity (*n* value). The boundaries of these soils are drawn on aerial photos and digitized for use with multiple types of data.

Moorings

After Hurricanes Gloria (1997) and Bob (1991), studies made it painfully evident that present moorings are inadequate. In New England, prevailing winds set the anchors in the westerly direction. A roaring northeaster or hurricane opposite the westerly set spins the anchor around 180° and it rolls out of the bottom. Away goes the vessel—mooring and all (INAMAR, 2000).

One fact that stood out about these particular storms is that a significant number of mooring failures are vessels driven ashore with their moorings. Why then do these vessels drag their moorings ashore fully intact? Is the wrong type of anchor used for the soil type? Without knowledge of what type of anchor is used and what type of soil material it is set in, the holding capacity of the mooring is compromised. The type of soil material in the surface layers has a great deal to do with the holding power of anchors.

There are two primary classes of anchors—temporary and permanent. A permanent anchor is often called a mooring, and is rarely moved. It is quite possible the vessel cannot hoist it aboard, but must hire a service to move or maintain it (Fig. 1). The anchor needs to hold the vessel in all weathers, including the most severe storms, but only occasionally, or never, needs to be lifted (Answers, 2007). Two common types of permanent anchors are the mushroom and deadweight anchors. These two types are the focus of this soil interpretation.

Mushroom Anchors

A mushroom anchor is shaped like an inverted mushroom; the head becoming buried in the soil (Fig. 2). These anchors work best in loamy to organic soils with high *n* value surface layers or soft bottom types of material when they are left in and allowed to set. These anchors work on the principle of surface area and suction effect. Cohesion of the bottom material is very important. Rocks, gravel, or coarse sand lack good cohesive properties and allow the anchor to pull free. Mushroom anchors in sand will not bury completely. They will only sink to displace an equal weight of sand. Their large round dish design is not well-suited to penetrating the bottom. A rocky or coarse sand bottom is not a good place for mushroom anchors (INAMAR, 2000).

Soils rated for mooring type using the mushroom anchors are either "not limited" or "very limited" (Table 1, Fig. 3). Not limited means the soil is a soft bottom type of material in which the mushroom anchor works the best. Very limited means the soil is a hard bottom type of material in

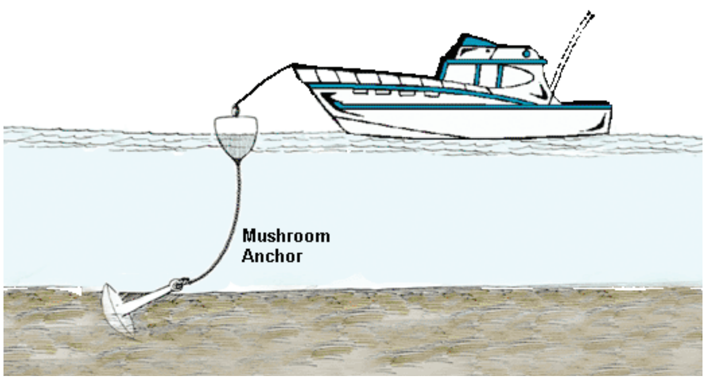

Fig. 2. Mushroom anchors work best in soft bottom materials, loamy to organic soils characterized by high *n* value soil surface layers.

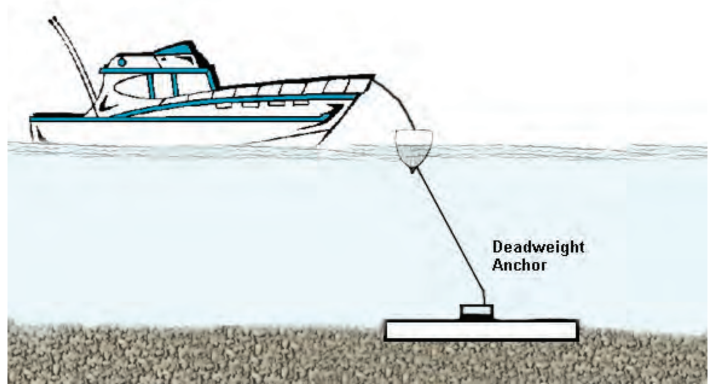

Fig. 4. Deadweight anchors work best in hard bottom materials such as gravel and coarse sands, low *n* value soil surface layers.

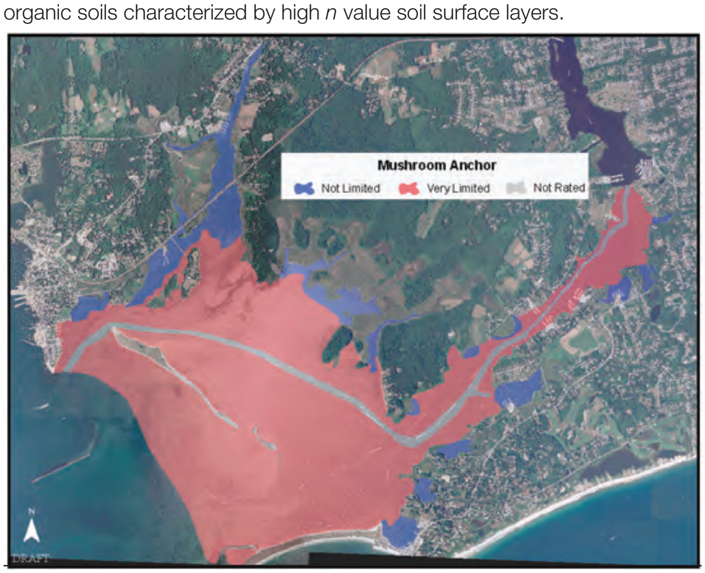

Fig. 3. A map of the mooring interpretation for mushroom anchors in Little Narragansett Bay based on the bottom type of soil material.

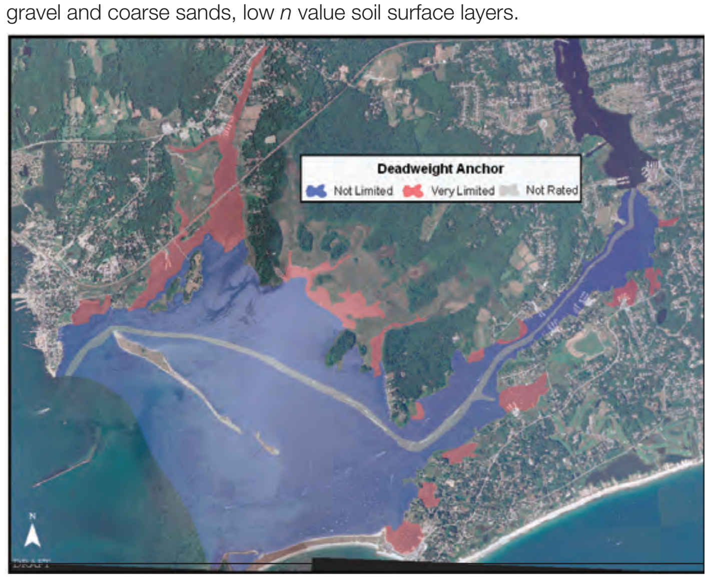

Fig. 5. A map of the mooring interpretation for deadweight anchors in Little Narragansett Bay based on the bottom type of soil material.

which the use of a mushroom anchor is not suitable. Navigational channels are not rated because boats cannot anchor in a channel unless circumstances require the boat to anchor, such as being broken down.

Deadweight Anchors

Deadweight anchors work on the principle of being heavy. Whether the anchor is a block of stone, concrete, or iron, its holding power is weight (Fig. 4). Deadweight anchors provide the greatest reliability. They are the best choice for rocky, gravelly, or sandy soils with low *n* value soil surface layers or hard bottom types of material. If they are dragged, they will resist with constant force. By contrast, once a mushroom anchor breaks free, it will not reset and will simply skip along the bottom. Granite is a common choice of material for deadweight anchors in the Northeast because it is readily available and inexpensive. It is a bit awkward to handle, but once in position, it will not move. The further one travels south from northern New England, concrete and iron become more common (INAMAR, 2000).

Deadweight anchors are used where mushroom anchors are unsuitable. An advantage of a deadweight anchor over a mushroom is that if it does become dragged, it continues to provide its original holding force. The disadvantage of using deadweight anchors in conditions where a mushroom anchor could be used is that it needs to be around ten times the weight of the equivalent mushroom anchor (Answers, 2007).

Soils rated for mooring type using deadweights are either “not limited” or “very limited” (Table 1, Fig. 5). Not limited means the soil is sandy with low *n* value surface layers or a hard bottom type of material in which deadweights work the best. Very limited means the soil is loamy with high *n* value surface layers or a soft bottom type of material in which the use of deadweights is not suitable.

Table 1. Moorings (Surabian, 2007).

Map symbol and soil name	Mooring type	
	Mushroom anchor	Deadweight
301		
Beaches	–	–
Udipsamments	–	–
800		
Wamphassuc	Not limited	Very limited soft bottom
Wequetequock	Not limited	Very limited soft bottom
810		
Napatree	Very limited hard bottom	Not limited
820	Not limited	Very limited soft bottom
Quanaduck		
830		
Anguilla	Not limited	Very limited soft bottom
840		
Rhodesfolly	Very limited hard bottom	Not limited
850		
Sandy, mixed, mesic Haplic Sulfaquents (bay bottom)	Very limited hard bottom	Not limited
860		
Histosols (submerged tidal marsh)	Not limited	Very limited soft bottom
880		
Typic Psammaquents (shore complex)	Very limited hard bottom	Not limited
900		
Navigational Channel	Not rated	Not rated
910		
Sandy, mixed, mesic Haplic Sulfaquents (river bottom)	Very limited hard bottom	Not limited

Summary and Conclusions

Soil surveys have much to offer the coastal zone community and boating enthusiasts. Our ability to describe, classify, and compare soil details enables us to recognize the need for and how to develop specific soil interpretations such as moorings. Over the years, demand for this type of soil interpretation, and others such as the presence of sulfidic materials and potential for submerged aquatic vegetation restoration, will increase in the coastal states.

The need for coastal zone mapping to inform policymakers and management is widely recognized as critical for mitigating hazards, creating resource inventories, and tracking environmental changes (National Research Council, 2004). Developing soil interpretations for these areas will encourage new partnerships and assist all of us in making wise decisions concerning our natural resources.

References

Answers. 2007. Anchor: Definition, synonyms, and much more from Answers.com. Available at http://www.answers.com/topic/anchor (verified 15 Nov. 2007).

INAMAR. 2000. Moorings: Important recommendations for safe moorings from INAMAR. p. 1–8.

National Research Council. 2004. A geospatial framework for the coastal zone national needs for coastal mapping and charting. National Research Council, Washington, DC.

Pons, L.J., and I.S. Zonneveld. 1965. Soil ripening and soil classification: Initial soil formation in alluvial deposits and a classification of the resulting soils. Publ. 13. Int. Inst. Land Reclamation and Improvement, Wageningen, The Netherlands.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd ed. USDA-NRCS Agric. Handb. 436. U.S. Gov. Print. Office, Washington, DC.

Surabian, D. 2007. Coastal zone soil survey of Little Narragansett Bay, Connecticut and Rhode Island. USDA-NRCS.