SOIL SURVEY HORIZONS

Mapping Our "New Frontier"

Fall 2009 | Volume 50, Number 3 | Pages 77–108

SOIL SURVEY HORIZONS

Table of Contents

Review: *Dirt! The Movie*
Matthew Ballmer 78

High-Intensity Soil Survey and Hydropedologic Functional Map Units
S.J. Indorante, J.A. Doolittle, H.S. Lin, M.A. Wilson, and B.D. Lee 79

Evaluation of Loss On Ignition Method for Determining Organic Matter of South Georgia Soils
John K. Luke, Eric C. Brevik, and Gary L. Wood 83

In Memoriam—Raymond B. Daniels

Mapping the "New Frontier" of Soil Survey: Rhode Island's MapCoast Partnership
Maggie K. Payne and Jim Turenne 86

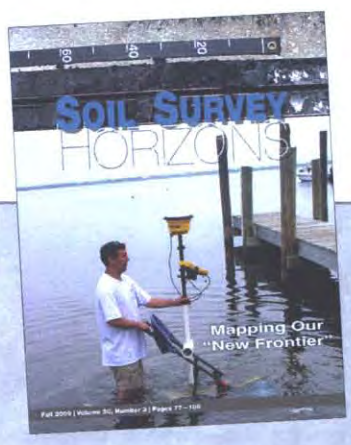
Land Capability Evaluation in Newly Reclaimed Areas: A Case Study in Bustan 3 Area, Egypt
N. Bakr, M.H. Bahnassy, M.M. El-Badawi, G.W. Ageeb, and D.C. Weindorf . . . 90

Occurrence of Relatively Acid Vertisols in Dadra and Nagar Haveli, India
O. Challa and Jagdish Prasad 96

Within-Field Spatial Variability of Surface Soil Properties at Three Dairies in North-Central Texas
Yuanda Zhu, David C. Weindorf, and Anil Somenahally 98

Writing the Basin & Range Landforms Bulletin
F.F. Peterson 105

Profiles in History 108



COVER PHOTO: Jim Turenne (Assistant State Soil Scientist, RI) surveys a coastal lagoon using Real Time Kinematic (RTK) GPS and the "Turenne Terrain Navigator". Acquiring accurate bathymetric data is often the first step in a subaqueous soil survey. Upper photo: A subaqueous soil sample collected with a vibracore shows a subaqueous histosol with freshwater organic material buried below marine silts.

Mapping the "New Frontier" of Soil Survey: Rhode Island's MapCoast Partnership

Maggie K. Payne and Jim Turenne

In the Summer 1993 edition of *Soil Survey Horizons*, the late Dr. George Demas articulated his initial thoughts and ideas on "Submerged Soils: A New Frontier in Soil Survey." George was a soil survey party leader in eastern Maryland and posed the question: "Why do we stop mapping soils at the water's edge?" He postulated that just as terrestrial soil survey data provide interpretations used in planning and environmental conservation, soil data for shallow water areas may be equally useful for coastal planners. Under the direction of Dr. Martin Rabenhorst at the University of Maryland, Demas began studying and mapping the substrates of permanently submerged areas of a Maryland estuary. The results of his dissertation research (Demas, 1998) suggested that permanently submerged estuarine substrates undergo pedogenic processes and can best be studied and mapped as subaqueous soils. As a result of Demas' studies, the definition of soil was modified to include these subaqueous soils, opening up the possibility for shallow water soil mapping and data collection by the National Cooperative Soil Survey.

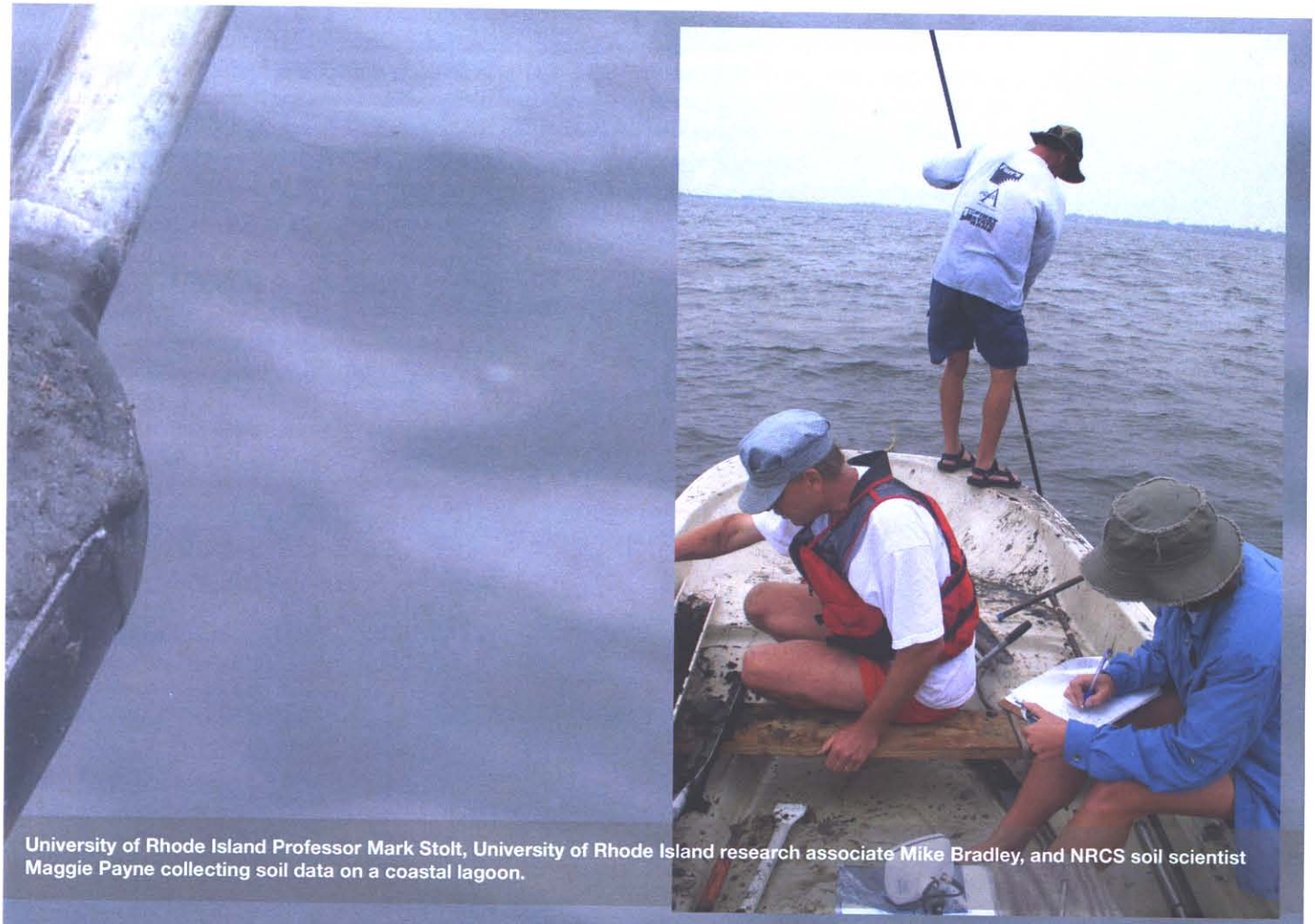
Subaqueous Soils in Rhode Island

Pedologists in Rhode Island recognized the value of a coastal subaqueous soil survey in the "Ocean State" as a result of expanding pressures on coastal resources, including interest in submerged aquatic vegetation restoration and shellfish farming and restocking. To investigate the feasibility of mapping soils underwater, a graduate thesis study was initiated by the University of Rhode Island's Department of Natural Resources Science (Bradley, 2001). The study investigated the subaqueous soil–landscape relationship in a 116-ha area of a micro-tidal coastal lagoon in southern Rhode Island. The study concluded that, in this lagoon, subaqueous soils followed a landscape model and could be mapped in a similar manner to terrestrial soils (Bradley and Stolt, 2003).

In response to a growing interest in subaqueous soils, the first National Workshop on Subaqueous Soils (2003) was held in Delaware, where interested participants were provided with an overview of subaqueous soils, coastal processes, and mapping techniques. During this time, the Northeast region of the National Cooperative Soil Survey (NCSS) began holding subcommittee meetings focused on subaqueous soils. Inspired by questions developed during these meetings, Dr. Mark Stolt from the University of Rhode Island focused his 2004 sabbatical leave efforts on cataloging the types of subaqueous soils and the methods used to map those soils in a range of estuaries between Maine and Texas. As a part of these efforts, and in cooperation with the NCSS, Stolt developed a glossary of soil landscape terms specifically for subaqueous landforms, which were added to the National Soil Survey Handbook (USDA-NRCS, 2007).

In 2004, the Rhode Island USDA-NRCS adopted a "Working Waters" approach and began in earnest to focus Farm Bill programs to restore estuarine, marine, and near-shore coastal habitats. As a part of this coastal restoration effort, federal funding was received by NRCS to conduct eelgrass restoration in Narragansett Bay. However, when the staff of Rhode Island NRCS began working on a site selection model in the coastal zone, a gap in the existing soil survey mapping was identified and deemed to be a crucial missing data set for successful planning of restoration efforts. The lack of information about the soil in the coastal zone led to the development of a

M.K. Payne (Maggie.payne@ri.usda.gov) and J. Turenne (jim.turenne@ri.usda.gov), USDA-NRCS, 60 Quaker Lane, Suite 46, West Warwick, RI 02886 60 Quaker Lane, Suite 46, Warwick, RI 02886.
Published in Soil Surv. Horiz. 50:86–89 (2009).



University of Rhode Island Professor Mark Stolt, University of Rhode Island research associate Mike Bradley, and NRCS soil scientist Maggie Payne collecting soil data on a coastal lagoon.

top-priority initiative in the Rhode Island soil survey program. Under the direction of the Rhode Island NRCS State Conservationist, the Assistant State Soil Scientist was directed to work internally within the framework of the National Cooperative Soil Survey to establish a subaqueous soil survey program and with outside interest groups to organize end-user conferences in the state.

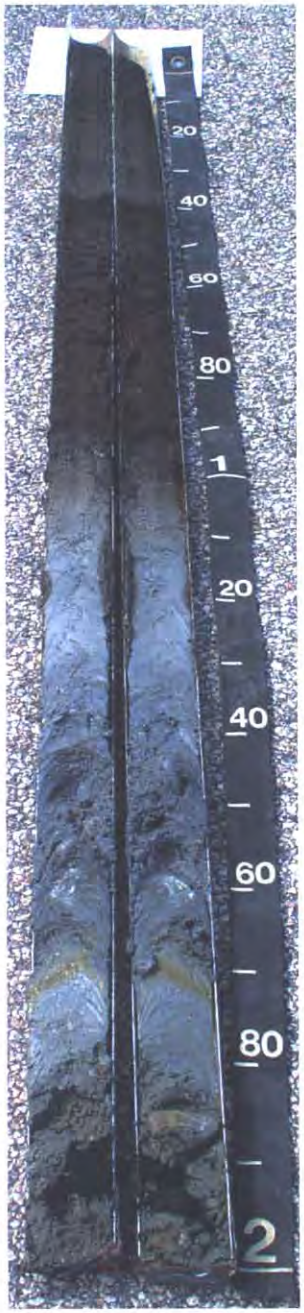
It was decided that the best route internally to begin a full-scale subaqueous soil survey was to work to establish a special project office in Rhode Island. The goal of this office would be to serve as a "Center of Excellence in Subaqueous Soils." The office would be responsible for not only production mapping, but would develop mapping protocol, develop and test tools and equipment, serve as a training location, and work on classification and interpretation issues.

Partnering across the Land–Water Divide

Recognizing the need to broaden and develop new partnerships to meet the needs of the coastal community, the Rhode Island NRCS office organized a meeting with soil scientists, geologists, benthic ecologists, and oceanographers from the University of Rhode Island's Coastal Institute, Graduate School of Oceanography, Department of Natural Resources Science, and Department of Geosciences to discuss goals and solutions in mapping and understanding shallow coastal areas. Within 2 hours of first meeting, it was decided that all participants had similar goals of mapping and data collection, and the best way to proceed was to form a partnership. The Mapping Partnership for Coastal Soils and Sediment (MapCoast) was formed. A steering team was set up, within a day a memorandum of understanding was drafted, and MapCoast began seeking groups to join the partnership.

One of the primary goals of the MapCoast partnership was to create mapping products useful to a wide range of community users. Thus, as an initial step, a conference was organized to identify potential users and their needs. With an audience of 75 coastal professionals, the conference was the first introduction to subaqueous soils and the planned work of MapCoast. Participants were asked via breakout groups to provide the type of data that they needed and what products they would like to come from a Coastal Zone Soil Survey of the state. The results of this meeting are available at: http://nesoil.com/sas/MapCoast_2004_User_Conference_Report.pdf (verified 15 Sept. 2009).

In the spring of 2005 MapCoast hosted a second user conference to unveil the MapCoast website, which featured an internet mapping service and downloadable data, including complete soils, geology, benthic habitat, and bathymetry data sets for two major Rhode Island coastal lagoons. Additional information about the data and its use was presented, and users were asked for their input. In the winter of 2006 the third and final user conference was held, with 110 attendees. The conference featured talks from both of Rhode Island's U.S. Senators as well as Director Mike Golden and Deputy Chief William Puckett from the NRCS Soil Survey Division.



A soil core of a Billington silt loam soil. This core shows 4 major geologic events: glacial till (183–200 cm), loess (105–183 cm), freshwater organics (40–105 cm), and highly fluid marine silts (0–40 cm).

MapCoast currently consists of 16 partners that have been working to develop mapping protocols and collecting a wide array of data, including soil, geology, and biologic habitat information within the shallow (<5-m depth) water landscapes. MapCoast data products include detailed bathymetric maps and data, soil survey spatial and tabular data, acoustic data and benthic geologic habitat maps, along with a variety of imagery products (soil profiling images [SPI], video, and bottom photography). Examples of MapCoast data are provided at www.mapcoast.org (verified 15 Sept. 2009).

The Language of Subaqueous Soils

One of the major benefits of mapping subaqueous soils using NCSS standards is the ability to consistently name and describe what exists in various parts of the country and communicate this to others. U.S. Soil Taxonomy is one of the ways that we can communicate such information; however, as it currently stands, it has limited descriptive ability in subaqueous environments. During the past 5 yr, Dr. Mark Stolt, University of Rhode Island, in cooperation with the NCSS, has been working to develop the taxa to accommodate subaqueous soils in the orders of Entisols and Histosols. The suborders will be Wassents and Wassists, with appropriate great group and subgroup taxa included, and are to be included in the 11th edition of the *Keys to Soil Taxonomy*.

Soil Taxonomy is a great resource for soil scientists, but its use beyond the field of pedology has its limitations. Working in subaqueous environments, it is necessary to integrate naming conventions with other scientists that work in this area. The Coastal and Marine Ecological Classification Standard (CMECS) has been in development by NOAA for about 10 yr as a standard for mapping and naming marine habitats. MapCoast was invited to work with NOAA in the development of CMECS, resulting in the evolution of a soils component in this coastal classification standard. Current plans are for CMECS to reference the new subaqueous Soil Taxonomy terms, enabling Soil Taxonomy to become a more widely recognized standard naming convention.

The Future of Subaqueous Soil Mapping

Mapping has been completed for nearly all of the coastal lagoons in the state of Rhode Island—close to 7000 acres. Preliminary maps have been made available on the MapCoast website, and in 2010, data will be finalized and submitted to Soil Data Mart and Web Soil Survey. The MapCoast scientists are currently completing a two-year study to develop and outline mapping protocols for soils, geology, and benthic biology (Stolt et al., unpublished data; see MapCoast website for updates in the future).

Although documenting what types of soils and sediments are in these subaqueous areas is important, the major use of a soil survey is the interpretations that can be made based on a map. Interpretations are currently in development, including mooring type (Surabian, 2007), sulfidic soil dredge disposal concerns, shellfish habitat suitability, carbon storage capability (Jespersen and Osher, 2007), and eelgrass habitat and transplant suitability (Bradley and Stolt, 2006).

A second national workshop on subaqueous soils is planned for August of 2010 in Rhode Island at which MapCoast and NRCS will demonstrate sampling and mapping methods and discuss issues in description, classification, and interpretation. Also in development is a subaqueous soils methods manual that will outline methodologies specific to subaqueous soils; it is slated to be available by the time of the workshop.

Conclusions

The goal of National Soil Survey is to document the nation's soil resources and to provide detailed information on soil properties and their suitability, limitations, management, and production potential of the various soils. As coastal areas become more populated and agriculture, aquaculture, recreation, and development continue to place pressure on our oceans, it is important to provide the public with appropriate baseline data on the soil resources in these areas. Although some may continue to question whether these areas are truly "soils" as many have come to know the term, there is no doubt that there has been a lack in available maps of shallow water substrates, no consistent way to communicate what is mapped, and a large and increasing group of interested users for these data. Subaqueous soil mapping is a way to fill this gap. Through MapCoast and the efforts to map subaqueous soils in Rhode Island, we hope to continue making progress in this "New Frontier in Soil Survey."

References

Bradley, M.P. 2001. Subaqueous soils and subtidal wetlands in Rhode Island. M.S. thesis. Department of Natural Resources Science, University of Rhode Island, Kingston.

Bradley, M.P., and M.H. Stolt. 2003. Subaqueous soil–landscape relationships in a Rhode Island coastal lagoon. Soil Sci. Soc. Am. J. 67:1487–1495.

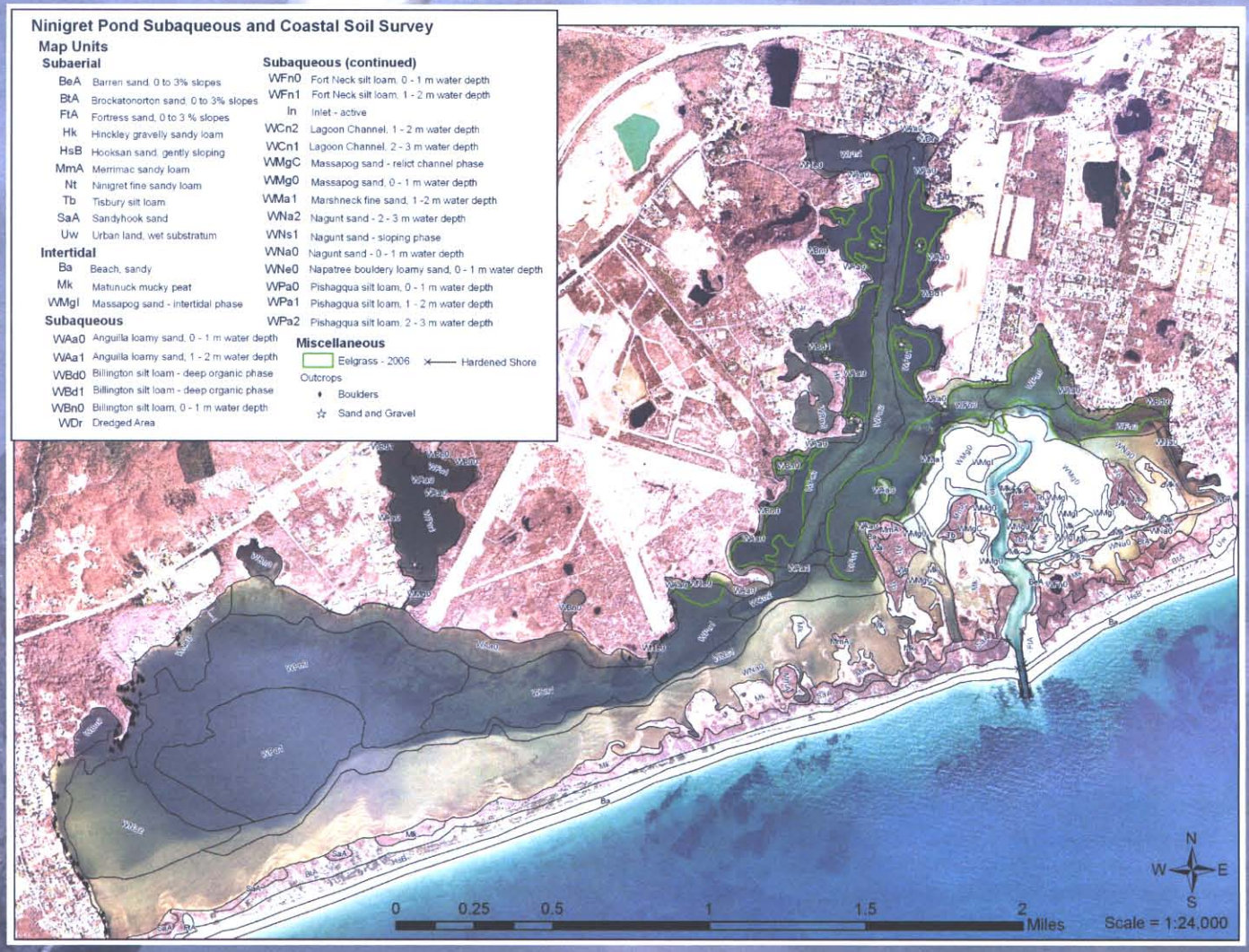
Bradley, M.P., and M.H. Stolt. 2006. Landscape-level seagrass–sediment relations in a coastal lagoon. Aquat. Bot. 84:121–128.

Demas, G.P. 1998. Subaqueous soil of Sinepuxent Bay, Maryland. Ph.D. diss. Department of Natural Resource Sciences and Landscape Architecture, University of Maryland, College Park.

Jespersen, J.L., and L.J. Osher. 2007. Carbon storage in the soils of a mesotidal Gulf of Maine estuary. Soil Sci. Soc. Am. J. 71:372–379.

Surabian, D.A. 2007. Moorings: An interpretation from the Coastal Zone Soil Survey of Little Narragansett Bay, Connecticut and Rhode Island. Soil Survey Horiz. 48:90–92.

USDA-NRCS. 2007. National soil survey handbook, title 430-VI. Available at http://soils.usda.gov/technical/handbook/ (verified 15 Sept. 2009).



(Top) Map showing a complete subaqueous and coastal soil survey for Ninigret Pond in Charlestown, RI. Remapping coastal soils is an important part of this mapping effort. Map is available online at http://www.ci.uri.edu/projects/mapcoast/maps/ninigret_soilsurvey.jpg (verified 19 Oct. 2009).

(Right) Making data available via multiple sources, MapCoast has begun posting data and maps on Google Ocean. Data are available at http://bbs.keyhole.com/ubb/ubbthreads.php?ubb=showflat&Number=1196193#Post1196193