TAXONOMIC CLASSIFICATION OF THE SOILS OF PUERTO RICO, 2017

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We dedicate this Bulletin to
Dr. Friedrich Beinroth and Agronomist Gilberto Acevedo
for their achievements and commitment to soil taxonomy.

Because a horizon in a soil profile is as beautiful and fascinating as a horizon to the sky

Porque un horizonte en el suelo es tan hermoso y fascinante como un horizonte en el cielo

Friedrich H. Beinroth

1937 - 2016

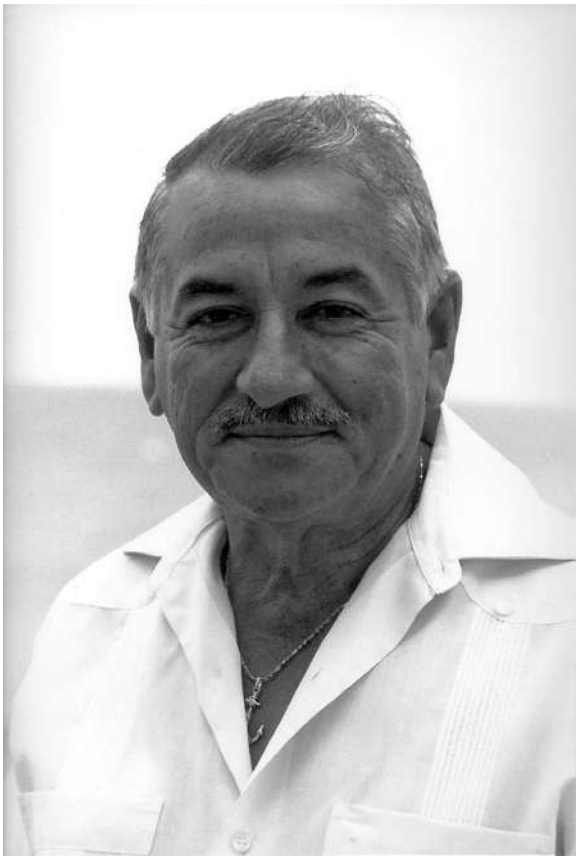
Friedrich H. Beinroth discovered Puerto Rico as a postdoctoral fellow with the USDA Soil Conservation Service. That event marked a watershed in the career of the young German. A graduate of the University of Stuttgart, Stuttgart, Germany, Beinroth earned a Bachelor of Science degree in geology in 1961, his master's degree in geology in 1963 and Ph.D. in soil science in 1965. During a brief period, 1963 to 1964, he worked as soil surveyor at Wad Medani and Nuba Mountains, Republic of Sudan. In 1966, Dr. Beinroth landed a USDA Soil Conservation Service postdoctoral fellowship, which took him to California, Iowa, New Mexico, New York, North Carolina, Texas, Washington DC, and Puerto Rico.

The Agricultural Experiment Station in Río Piedras, Puerto Rico, recruited Dr. Beinroth as an assistant soil scientist in 1967, and in 1971, he joined the soil science faculty at the University of Puerto Rico, Mayagüez Campus, as an associate professor.

In 1976, he became a full professor, a position he held until retiring on May 19, 2006. For many years, Dr. Beinroth taught *Soil Genesis, Morphology and Classification*, and *Soils of Puerto Rico*. As a professor, he impacted many students in the Agronomy and Soil Science Programs of the College of Agricultural Sciences of the University of Puerto Rico at Mayagüez. Several students who took his courses in Soil Science described his classes as inspirational.

One of Dr. Beinroth's major accomplishments was obtaining the approval of a $2.0 million research project on agrotechnology transfer in the tropics with fieldwork in Brazil and Puerto Rico. Through this project he organized several international workshops on soil classification in countries such as Brazil, Malaysia and Thailand, Syria and Lebanon, Rwanda, Sudan, Chile, Ecuador and Japan. He served as Associate Principal Investigator for the USAID-funded International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT), and he was Principal Investigator on three USDA-funded projects related to computer systems for enhancing agricultural decision-making in the Caribbean.

Throughout his distinguished career Dr. Beinroth, known to colleagues as Fred, received prestigious honors and awards. In 1984, he was granted the Research Award by the Gamma Sigma Delta Puerto Rico Chapter, and the International Honor Award from the U.S. Department of Agriculture, Office of International Cooperation and Development. In 1992, the Gamma Sigma Delta Puerto Rico Chapter gave him its Teaching Award. Two years later, he received the International Soil Science Award from the Soil Science Society of America, in recognition of his scientific contributions to soil science in the international sector. In 1995, the island's Gamma Sigma Delta chapter presented him with the Distinguished Service to Agriculture Award. In 1997, the American Society of Agronomy awarded Dr. Beinroth a Certificate of Excellence under its Educational Materials Program for his slide set on the Properties, Classification and Management of Oxisols. He authored or co-authored more than 75 professional papers, books, bulletins and book chapters.



Gilberto Acevedo
1931 - 2012

Gilberto Acevedo, born in Mayagüez, Puerto Rico, played a key role in the fieldwork investigation and mapping of the soil surveys of Puerto Rico. In 1952, Acevedo earned his degree in agronomy and soils at the University of Puerto Rico, Mayagüez Campus. He continued studying at Texas A&M University where he obtained his master's degree in soil sciences in 1954.

Returning to Puerto Rico, he accepted a position as research assistant at the Agricultural Experiment Station of the University of Puerto Rico at Río Piedras, a post he held for seven years. During the late 1950s, collaborating with Drs. Miguel Lugo López and Juan A. Bonnet, Acevedo participated in several soil science studies at the Lajas Valley and the Guánica Lagoon. This research was related to the irrigation-drainage infrastructure project that converted the Lajas Valley into prime farmland. Among the scientific publications from that period are:

- Lugo-López, M. A. and G. Acevedo, 1956. Effects of tractor-traffic compaction on the physical properties of an irrigated soil in southwestern Puerto Rico. *J. Agric. Univ. P.R.* 40 (4): 235-244.

- Lugo-López, M. A., E. Hernández-Medina and G. Acevedo, 1958. Response of some tropical soils and crops of Puerto Rico to applications of lime. Est. Exp. Agric., Univ. P.R. Tech. Paper 28.
- Acevedo, G., M. A. Lugo-López and J. Ortiz-Vélez, 1959. Occurrence of soil tumors northeast of the Guánica Lagoon, Lajas Valley, P.R. *J. Agric. Univ. P.R.* 43 (2): 103-115.
- Lugo-López, M. A., R. Pérez-Escolar, G. Acevedo and J. Juárez, Jr., 1959. Nature and properties of major soils of Lajas Valley. Est. Exp. Agric., Univ. P.R. Bull. 149.

Acevedo's career in the USDA Soil Conservation Service, today known as the Natural Resources Conservation Service, began in 1962 at Mayagüez. He was part of a group of soil scientists who worked on the mapping of the Soil Survey of Mayagüez. In 1966, he did similar work for the Soil Survey of Ponce. In 1971 he was promoted to Soil Scientist Party Leader, supervising the Soil Survey of Arecibo and soil correlation studies. He was a key player in the fieldwork and mapping of all the soil surveys conducted in Puerto Rico at that time.

In 1979, Acevedo was designated Assistant State Soil Scientist at the state office in San Juan and in 1980 was promoted to State Soil Scientist, a position he held until his retirement in 1992. As state soil scientist he was responsible for leading the NRCS Caribbean Area Soils Division and for all activities related to the development, maintenance and updating of soil surveys in Puerto Rico. He was also responsible for providing soil information and technical assistance to land users at state, federal and public agencies, ensuring the proper distribution and interpretation of soil data. Outside of Puerto Rico, Acevedo took part in soil studies in Bolivia, Uruguay, Cuba, Haiti and other Latin American countries; along with other soil scientists and researchers, he co-authored several scientific papers.

After retirement, he worked as a private soil consultant.

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TAXONOMIC CLASSIFICATION OF THE SOILS OF PUERTO RICO, 2017

Miguel A. Muñoz[1], Wanda I. Lugo[1], Carmen Santiago[2], Manuel Matos[3], Samuel Ríos[4] and Jorge Lugo[5]

ABSTRACT

The ecological diversity of Puerto Rico is reflected in the diversity of its soils. Ten of the 12 soil orders established by *Soil Taxonomy*, the official system of soil classification of the United States National Cooperative Soil Survey, are present in Puerto Rico. This report updates a previous publication on the taxonomic classification of the soils of Puerto Rico. It incorporates new categories of soils not recognized at the time of the previous publication, including Aridisols and soils with perudic moisture regimes. Several new soil series have been identified, and others have been eliminated or renamed responding to new data that has become available. The current revised publication is presented in a similar format as the previous one, incorporating tables that are easy to follow, and which conform to different user needs. The Spanish meaning of formative elements for orders and suborders was added to this publication, complementing the English counterpart. A new section has been added containing photos of soil profiles and associated landscapes representing the different soil orders on the Island, providing users with a vivid and appealing view of the diversity of Puerto Rican soils. Two maps of soil orders are included, one representing a previous (1960-1982) classification and another representing the current classification. The new map incorporates recently recognized Aridisols and new Oxisols, which were formerly mapped as Ultisols. The Aridisols in the current map are restricted to the southwest part of the Island, but it is believed that other Aridisol pockets may exist along the south coastal zone. *Soil Taxonomy* is a dynamic system, constantly in revision to incorporate new knowledge stemming from field and laboratory research. Thus, future revisions are expected to emerge down the road.

Key words: soil orders, soil taxonomy, soil classification, soil series

RESUMEN

Clasificación taxonómica de los suelos de Puerto Rico, 2017

La diversidad ecológica de Puerto Rico se refleja en la diversidad de sus suelos. Diez de los 12 órdenes de suelos establecidos por el *Soil Taxonomy*, el sistema oficial de clasificación de suelos del *United States National Cooperative Soil Survey*, están presentes en Puerto Rico. Este reporte actualiza una publicación previa de la clasificación taxonómica de los suelos de Puerto Rico. En este se incorporan nuevas categorías de suelos que no habían sido reconocidas al momento de la anterior publicación, incluyendo el orden Aridisol y suelos con régimen de humedad perúdico.

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Se identificaron nuevas series de suelos y otras series se eliminaron o se renombraron de acuerdo a nuevos datos recopilados. La presente publicación revisada se presenta en un formato similar al de la publicación anterior, incorporando cuadros fáciles de interpretar y que se ajustan a las diferentes necesidades de los usuarios. En esta publicación también se incluye el significado en español de los elementos formativos para los órdenes y subórdenes, complementando el significado en inglés, que también se incluye. Además, se añadió una sección con fotos de los perfiles de suelos y de los paisajes asociados, representativos de los diferentes órdenes presentes en Puerto Rico. Esta sección provee a los usuarios una vista vívida y atractiva de la diversidad de los suelos de Puerto Rico. Se incluyen dos mapas de los órdenes de suelos, uno representando una clasificación anterior (1960-1982) y otro representando la clasificación actual. El nuevo mapa incorpora los Aridisoles, recientemente reconocidos, y algunos Oxisoles que anteriormente se clasificaron como Ultisoles. Los Aridisoles en el mapa actual se limitan a la parte suroeste de la isla, pero se cree que existen bolsillos de Aridisoles en la zona costera del sur. El sistema de *Soil Taxonomy* es uno dinámico, constantemente en revisión para incorporar nuevos conocimientos que se derivan de la investigación en el campo y en el laboratorio. Siendo así, se espera que nuevas revisiones sigan emergiendo en el futuro.

Palabras clave: órdenes de suelos, taxonomía de suelos, clasificación de suelos, series de suelos

INTRODUCTION

The soil is a complex system, incorporating hundreds or thousands of chemical, physical, mineralogical and biochemical reactions. It is constantly undergoing transformation processes influenced by climate, topography, parent material, living organisms and time. The USDA-Soil Taxonomy classification system has been devised in a way that systematically classifies soils according to their measurable properties and at the same time facilitates understanding of the soil forming factors giving rise to the different soils. Once a soil is classified, we have a valuable tool to determine land use and soil condition.

The present publication compiles information on the major soil series existing in Puerto Rico and their respective classifications within *Soil Taxonomy*. It represents an update of the previous publication *Updated Taxonomic Classification of the Soils of Puerto Rico, 2002* (Beinroth et al., 2003). An update was necessary to reflect the recently recognized existence of aridic and perudic moisture regimes in certain areas of Puerto Rico, to re-classify existing soil series and to add new ones.

An additional objective in the revised document is to provide readers with a more illustrative publication, including photos of representative soil profiles of the existing soil orders and associated landscapes. The user of this publication will perceive the variability and richness of soils in Puerto Rico. Ten of the twelve recognized soil orders (all except Gelisols and Andisols) are present on the Island, a diversity that will captivate soil scientists, students, farmers, environmentalists and other parties interested in soil sciences and related fields.

Users will find excellent examples of soils of prime quality for agriculture, young fertile soils, and very old soils that express clearly the forces of nature, geological processes, the wonder of weathering as well as the genesis of new soils. Readers will recognize the beauty and richness of a San Antón series, a Mollisol, considered the best agricultural soil in Puerto Rico; and the beauty of the Bayamón series, an Oxisol of great agricultural potential, where good management and conservation practices overcome low fertility problems. The fact is that there are no poor soils and no unhealthy or valueless soils, if we manage them properly.

This publication is also intended as an educational tool that will increase awareness of the need to preserve one of the best natural resources that a country may have, namely its soil. By knowing our soils, we will better appreciate their beauty and the need to preserve and protect them for future generations.

Soil orders of Puerto Rico

Soil Taxonomy has recognized twelve soil orders: Alfisols, Andisols, Aridisols, Entisols, Gelisols, Histosols, Inceptisols, Mollisols, Oxisols, Spodosols, Ultisols, and Vertisols. Ten of these orders have been recognized in Puerto Rico. The tropical climate of the Island precludes the formation of Gelisols, soils that must have permafrost. The Andisols are also not present because Puerto Rico, although largely of volcanic origin, lacks the recent volcanic materials that are a prerequisite for their formation since active volcanism ceased about 70 million years ago.

Aridisols were not included in the previous publication since their presence had not yet been officially recognized in 2002. In 2005, Aridisols were officially recognized along the southwest coast of Puerto Rico (Lugo-Camacho, 2005) and are included in this publication.

Following is a brief description of the ten soil orders present in Puerto Rico.

Alfisols are formed on relatively stable landscape positions and have a subsurface horizon of clay accumulation, the argillic horizon. A kandic or natric horizon may also be present. Quite often they are referred to as high base status soils, having a base saturation higher than 35% in the lower part or below the argillic or kandic horizon. Alfisols are found mainly in the limestone region of northwestern Puerto Rico, but are also found along the southern coast. The Tanamá series (Lithic Hapludalfs) and Guayama series (Typic Haplustalfs) are typical examples.

Aridisols are soils with an aridic moisture regime. The moisture control section of these soils is dry more than 50% of the time in most years, and is always dry for at least 90 consecutive days when the soil is warm enough (>8 °C) for plant growth. Evapotranspiration greatly exceeds precipitation during most of the year, and in most years, no water percolates through the soil. In Puerto Rico, Aridisols are found in the southwest coastal region. The Altamira series (Typic Haplocalcids) and Parguera series (Typic Calciargids) are typical examples.

Entisols are soils with little or no evidence of pedogenic development and diagnostic horizons, although weakly developed ochric epipedons and/or albic horizons may be present. Plant growth is evidence enough that the unconsolidated parent material is functioning as soil and undergoing soil-forming processes. Entisols include soils with one or both horizons mentioned, or featureless, and life supporting material of natural origin, somewhere between nonsoil and horizonated soil. In Puerto Rico, these soils occur in recent deposits along streams, in coastal floodplains or on steep slopes where active erosion prevails. The Cataño series (Typic Udipsamments) and Reilly series (Mollic Udifluvents) are typical examples.

Histosols are soils mostly composed of organic materials. The organic soil materials are saturated with water for at least 30 days during most years under natural conditions and, even if artificially drained, contain ≥12 to 18% organic carbon by weight excluding live roots. If saturated under natural conditions for fewer than 30 days, organic soil material must contain 20% or more organic carbon. In Puerto Rico, Histosols occur mainly in association with mangrove swamps, marshes and lagoons along the coast. The largest area of Histosols in Puerto Rico is Caño Tiburones,

located east of Arecibo. The area is currently designated as a natural reserve. The Tiburones series (Typic Haplosaprists) and Vigía series (Terric Haplosaprists) are typical examples.

Inceptisols are soils in the initial stages of pedological development. No significant evidence of illuviation, leaching or advanced weathering is present. However, diagnostic B horizons, such as cambic, calcic, petrocalcic and placic; and epipedons, such as mollic, umbric and histic, may be present. Virtually all pedogenic processes are active to some extent in Inceptisols, but none predominates. Inceptisols develop in a variety of climates, excluding arid regions. In Puerto Rico, Inceptisols are the most extensive order, occurring in young geomorphic surfaces in the interior mountains and on alluvial floodplains along the coasts. The Múcara series (Vertic Eutrudepts) and Caguabo (Typic Eutrudepts) are typical examples.

Mollisols are considered the most fertile soils. This order has a thick, dark-colored surface horizon with a high organic carbon content and high base saturation. This surface horizon is designated as a mollic epipedon. The mollic designation of the epipedon indicates a soft, friable consistency. In Puerto Rico, there are two main areas of Mollisols: in the Tertiary limestone belts to the north and south of the central mountain range (Cordillera Central), and in alluvial floodplains of interior valleys or coastal zones, mainly along the south coast of the Island. The San Antón series (Cumulic Haplustolls) and Toa series (Fluventic Hapludolls) are examples of a Mollisol from the semiarid southern region and the humid northern region, respectively.

Oxisols are soils unique to the tropics and represent the ultimate stages of soil development. The main diagnostic feature is the presence of an oxic or kandic horizon. The mineralogy of these horizons is composed of a mixture of iron and aluminum oxides, such as goethite, hematite and gibbsite; and 1:1 lattice clays, such as kaolinite and halloysite. Non-weatherable minerals such as quartz and zircon are present. Oxisols generally occupy old, stable geomorphic surfaces. In Puerto Rico, we can find three developing scenarios: old stable geomorphic surfaces, preweathered oxidic sediments and ultrabasic rocks that weather rapidly. The series that represent those three scenarios are Catalina (Typic Hapludox), Bayamón (Typic Hapludox) and Nipe (Typic Acrudox). The Catalina series occurs on old remnants of the Miocene St. John Peneplain in central Puerto Rico, the Bayamón series is found on blanket deposits along the northern coast, and the Nipe series is formed on weathering serpentinite outcrops near Mayagüez.

Spodosols are soils that have a subsurface horizon of illuvial accumulation of amorphous organic matter mixed with aluminum with or without iron, the spodic horizon. These soils are probably the clearest expression of pedogenic processes in soils. The profile is characterized by a clearly defined, eluvial, light color horizon of coarse texture, over the spodic illuvial horizon of dark brown or black color. This order is of the least extension in Puerto Rico, occupying about 1,733 ha (4,281 acres) on the northern coast, near the municipalities of Arecibo, Barceloneta, Vega Baja and Vega Alta. The series Algarrobo (Entic Alorthods) and Corozo (Typic Alorthods) are typical examples.

Ultisols are soils that have either an argillic horizon or a kandic B horizon with low base saturation. Weathering of the solum has reached advanced stages, and soil pH is usually acid throughout the profile. Ultisols can be extremely acidic due to the presence of high levels of exchangeable Al^{3+}. Most of these soils require liming to correct acidity problems and increase their agricultural productivity. Ultisols are extensive on the Island, particularly in the western region. The series Humatas (Typic Haplohumults) and Río Arriba (Vertic Paleudults) are typical examples.

Vertisols are dark-colored soils with significant amounts of 2:1 clay minerals, such as vermiculites and smectites, which swell and shrink in alternate periods of wetting and drying. During the dry season extensive cracks are formed that may reach a depth of 100 cm. A wavy surface horizon is common, resulting from the mixing of surface soil material that enters through cracks. Slickensides formation is present in the subsoil and a microtopography known as gilgai relief, may be present. The Vertisols mostly occur in the subhumid and semiarid areas along the south coast of the Island. The Fraternidad series (Typic Haplusterts) and Mabí series (Aquic Hapluderts) are typical examples.

Understanding *Soil Taxonomy*

The first *Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys* was published in 1975 and the second edition was published in 1999. The Soil Survey Staff, through the National Cooperative Soil Survey program and the international community, have made significant contributions to the improvement of the taxonomic system. All changes up to the twelfth edition of *Keys to Soil Taxonomy, 2014* are taken into consideration in this publication.

Categories in Soil Taxonomy

Soil Taxonomy has six categories of decreasing generality and increasing specificity: order, suborder, great group, subgroup, family and series.

The **order** category groups soils based on the results of major soil forming processes (additions, removals, transformations and translocations). At the **suborder** level, factors that control the major soil forming processes are considered, mainly the soil temperature and soil moisture regimes. **Great groups** reflect notable expressions of certain soil forming processes such as a high degree of weathering or cementation of soil layers. **Subgroups** subdivide the great groups in one of four kinds of subgroups: 1) soils representing the central concept of that great group, e.g. "typic" soils; 2) soils that have properties of other soils; 3) soils that have non-soil properties, such as rock at shallow depth forming "lithic" soils; and 4) soils with specific properties that differentiate the subgroup from the typic. In the **family** category, subgroups are differentiated on the basis of physical, chemical, mineralogical and climatic properties that affect the growth of plants and engineering uses. The **series** category is the lowest category in the system. A given family may have more than one series, so long as each series in that family has properties that conform to all the criteria listed for the family and higher categories. Two soils within a family are classified as different series when the soil scientist identifies certain distinctive minor properties (such as thickness of a particular horizon, color, etc.) that are consistently identified over a large enough area. The name of a series is generally taken from a place near the original location where the soil was first identified, for example, Bayamón series, Aibonito series and Cataño series.

Nomenclature of the categories in Soil Taxonomy

The names of **orders** always end in the formative element *sol* (from the latin *solum* or "soil"). Examples are the order names Oxisol, Vertisol and Inceptisol. The formative elements and their connotations are shown in Table 1. The Spanish meaning, whenever applicable, is a new inclusion in this updated publication of soils of Puerto Rico.

The **suborders** have exactly two syllables, the first connotes something about the diagnostic properties of the soils and the second is the formative element from the name of the order. For

example, the suborder Udox conveys an Oxisol with udic moisture regime. The suborder Argid means an Aridisol with an argillic horizon. Table 2 lists 11 elements used in the names of suborders of the soils of Puerto Rico.

The name of the **great groups** consists of the name of the suborder and a prefix that has one or two formative elements indicating diagnostic properties. For example, Petrocalcids is an Aridisol with a cemented horizon of calcium carbonate. The formative elements in the names of great groups that occur in Puerto Rico are presented in Table 3.

The name of the **subgroups** consists of the name of the great group modified by one or more adjectives. Four major categories of subgroups are identified: 1) Typic or Haplic – represents the central concept or the most representative concept of the great group. For example, Typic Argiudolls, a Mollisol with an udic moisture regime and an argillic horizon. 2) Intergrades – soils in a great group that have one or more characteristics of another order, suborder or great group. For example, Inceptic Hapludox, an Oxisol with an udic moisture regime, having some characteristics of an Inceptisol. 3) Extragrades – soils in a great group that have properties common to soils in several categories but are not transitional to any other kind of soil, or that have material not considered soil. For example, Lithic Dystrudepts, an Inceptisol with an udic moisture regime, low base saturation and presence of a shallow lithic contact. 4) Intragrades – identify specific properties that differentiate a subgroup from the Typic category. For example, Cumulic Haplustolls, a Mollisol with an ustic moisture regime and a thick mollic horizon. Table 4 shows the adjectives used in the names of extragrades and intragrades in Puerto Rico soils.

The nomenclature of the **family** category or taxa was intended to be useful for making major interpretations for growing plants and engineering purposes (Smith, 1986; Buol et al., 2011). This category includes soil properties not easily modified by human technology. The user of *Soil Taxonomy* will obtain a great deal of information from the family category, such as particle-size classes, mineralogy classes, cation exchange capacity (CEC) classes, calcareous and reaction classes, soil temperature classes, soil depth classes, rupture resistance, presence of coatings and cracks formation. For example, Jacaguas series is classified at the family level as: Loamy-skeletal, mixed, superactive Fluventic Haplustolls. This is a Mollisol formed in alluvial plains, under an ustic moisture regime, having high CEC, mixed mineralogy and a loamy texture with rock fragment content of 35% or more by volume.

The soil **series** is the most homogeneous grouping of soils in *Soil Taxonomy*. Each series must have properties that conform to all the criteria of higher categories (Buol et al., 2011). Two soils can be classified the same from order through family, but be a different series if the soil scientist identifies certain distinctive minor properties that are consistently identified over a large enough area. The name of the series is generally taken from a place near the original location where the soil was identified. In Puerto Rico you will find series names such as Coloso, Igualdad, San Antón and Caguabo. The first two are names of former sugar mills and the last two are names of communities. The series name per se has no meaning to the user, but in soil taxonomy when a series is mentioned, the classification to family level is usually included. For example, the Caguabo series is identified as "Caguabo (Loamy, mixed, active, isohyperthermic, shallow Typic Eutrudepts)."

Soil series of Puerto Rico

A total of 213 soil series have been recognized in Puerto Rico (Table 5). Inceptisols, the most abundant soil order, has the most soil series. The number of series per order are as follows: 45 Inceptisols, 36 Mollisols, 29 Ultisols, 24 Oxisols, 19 Vertisols, 17 Alfisols, 17 Entisols, 15

Aridisols, 8 Histosols and 3 Spodosols. In the previous publication, only nine soil orders were recognized in Puerto Rico (Beinroth et al., 2003). In this publication, the order Aridisols was added, as documented by Lugo-Camacho (2005) and USDA NRCS (2008).

New soil series have been recognized, some have been renamed and others have been deleted since the 2003 publication. New data on climatic conditions and the emergence of new and revised soil data on chemical, physical and mineralogical properties are the major factors contributing to these changes. The occurrence of the aridic moisture regime in Puerto Rico was confirmed by Lugo-Camacho (2005), who identified an area of approximately 25,540 ha (63,084 acres) with aridic conditions. The Aridisols series were reported in the *Soil Survey of the San Germán Area, 2008*. Also, an area in the northwest corner of Puerto Rico, previously recognized as having an udic moisture regime, was identified as having an ustic moisture regime. Perudic conditions were established for approximately 160,082 ha (395,402 acres) located over 750 meters of elevation in the mountain region of Puerto Rico.

More specific data have also been compiled on soil temperature (Lugo-Camacho et al., 2009). These authors identified the 750-m elevation as the limit between the isohyperthermic and isothermic soil temperature regimes in the perudic soil moisture regime in Puerto Rico. This update in soil temperature regime resulted in the recognition of eight new soil series, reported in the *Soil Survey of San Germán Area* (2008). In the area with an isothermic soil temperature regime, four soil series were classified as Oxisols (Haploperox and Kandiperox), two soil series as Inceptisols (Eutrudepts) and two soil series as Mollisols (Argiudolls). The Haploperox and Kandiperox soil great groups had not been recognized previously.

Since the main objective of this publication is to update the publication of 2003, the original sequence of tables was preserved as close as possible to benefit the user already familiar with the 2003 bulletin. Table 5 presents soil series grouped under the corresponding soil order, and Table 6 shows all categories of *Soil Taxonomy* pertaining to a particular series. The user can easily follow the order, suborder, great group, subgroup and family of each soil series. Table 7 provides an alphabetical listing of soil series and their classification at the family level. A user familiar with *Soil Taxonomy* and knowledge of the different taxa can obtain from Table 7 the same information as from Table 6 for any particular soil series, pertaining to order, suborder, great group, subgroup and family.

Extent and distribution of soil orders and suborders of Puerto Rico

The area and relative distribution of the 10 soil orders and 32 suborders currently recognized in Puerto Rico are presented in Table 8. Since the previous publication, seven suborders have been recognized: in the Aridisols the suborders Argids, Calcids and Cambids; in the Histosols the suborders Folists and Hemists; in the Oxisols the suborder Perox, and in the Vertisols the suborder Torrerts. A decrease occurred in the areas occupied by Entisols, Inceptisols, Mollisols and Oxisols. Besides the newly included Aridisols, an increase occurred in areas designated as Alfisols, Histosols, Ultisols and Vertisols. The largest decrease in soil area (5,984 ha; 14,781 acres) was observed for the Entisols and the largest increase (3,423 ha; 8,456 acres) was observed for the Alfisols.

The land areas occupied by individual soil series, sorted by soil orders, are listed in Table 9. The Quebrada series was reclassified from Inceptisol to Alfisol, which contributed significantly to the increase in extent of the Alfisols and the decrease in extent of the Inceptisols. This series occupies an extension of 9,014 ha (22,265 acres). The Tuque series, with an extent of 3,138 ha (7,750 acres), was reclassified as an Aridisol, decreasing the extension of Mollisols. On the other

hand, the San Germán series, which occupies an area of 7,004 ha (17,301 acres), was reclassified from Entisol to Mollisol increasing the area of the latter order. The extent of Histosols increased from 3,636 ha (8,982 acres) to 4,387 ha (10,836 acres) with the addition of three new series, Manglillo (Fluvaquentic Haplohemists), Joyuda (Hydric Haplohemists) and Los Peñones (Lithic Udifolists).

Trends of the Caribbean Area National Cooperative Soil Survey update

The United States Federal Government, under the National Cooperative Soil Survey (NCSS), began soil surveys in the Caribbean Region with its first published survey in 1902. Today, over 100 years later, the Caribbean Area Soil Science Division and its Mayagüez Major Land Resource Area (MLRA) Soil Survey Office manage eight Soil Survey Areas (SSA) and four distinct MLRAs. The USDA Soil Science Division (SSD) with the NCSS works continuously to improve soil survey tabular and spatial data. Today's work focusses on the evaluation of map units to create continuous coverage within the attribute database and soil maps. These initiatives improve soil interpretations while providing an opportunity to document decisions and identify future projects. New tools and data available such as Geographic Information System (GIS) and digital models have helped accelerate the evaluation and updating processes.

Historically, soil survey information was published in manuscripts. Since 2005, this information has been available to the public in a digital format through the interactive application called Web Soil Survey (WSS). The WSS is the official source for current soils information, providing both tabular and spatial data that allow users to create custom soil resource reports and interpretations for specific areas of interest. To get the most current soil survey data, classification and soil resource reports, visit the online Web Soil Survey at https://websoilsurvey.nrcs.usda.gov/.

TABLE 1. ***Formative elements in the names of soil orders***

Order	Formative Element	Derivation	English Meaning	Spanish Meaning
Alfisols	Alf	From Al and Fe content	Al and Fe content	Contenido de Al y Fe
Andisols	And	J. *ando*	Volcanic ash	Ceniza Volcánica
Aridisols	Id	L. *aridus*	Dry	Árido
Entisols	Ent		Recent	Reciente
Gelisols	El	L. *gelare*	To freeze	Gélido
Histosols	Ist	Gr. *Histos*	Tissue	Tejido
Inceptisols	Ept	L. *inceptum*	Beginning	Incepción
Mollisols	Oll	L. *molli*s	Soft	Mullido
Oxisols	Ox	F. *oxide*	Oxide	Óxido
Spodosols	Od	Gr. *Spodos*	Wood ash	Ceniza
Ultisols	Ult	L. *ultimus*	Last	Último
Vertisols	Ert	L. *verto*	Turn	Vertir

TABLE 2. ***Formative elements in the names of suborders of Puerto Rico soils***

Formative Element	Derivation	English Meaning	Spanish Meaning	Connotation
Aqu	L. *aqua*	Water	Agua	Aquic conditions
Arg	L. *argill*a	Clay	Arcilla	Argillic horizon
Camb	L. *cambiar*e	To exchange	Cambiar	Cambic horizon
Fluv	L. *fluvius*	River	Fluvial	Floodplain
Hum	L. *humus*	Earth	Humus	Organic matter
Orth	Gr. *orthos*	True	Verdadero	The common ones
Psamm	Gr. *psammos*	Sand	Arena	Sandy texture
Rend	Modified from Rendzina	Carbonates	Carbonatos	High carbonate content
Sapr	Gr. *saprose*	Rotten	Podrido	Most decomposed stage
Ud	L. *udus*	Humid	Húmedo	Udic moisture regime
Ust	L. *ustus*	Burnt	Calcinado	Ustic soil moisture regime

TABLE 3. ***Formative elements in the names of great groups of Puerto Rico soils***

Formative element	Derivation	Connotation
Acr	Modified from Gr. *akros*, at the end	Extreme weathering
Al	Modified from aluminum	High aluminum, low iron
Alb	L. *albus*, white	Presence of an albic horizon
Argi	Modified from argillic horizon; L. *argilla*, white clay	Presence of argillic horizon
Calci, calc	L. *calcis*, lime	A calcic horizon
Dystr, dys	Modified from Gr. *dys*, ill	Low base saturation, dystrophic, infertile
Endo	Gr. *endon*, *endo*, within	Implying a ground water table
Epi	Gr. *epi*, on, above	Implying a perched water table
Eutr	Modified from Gr. *eu*, good; eutrophic, fertile	High base saturation
Fluv	L. *fluvius,* river	Floodplain
Hapl	Gr. *haplous*, simple	Minimum horizon development
Hum	L. *humus*, earth	Presence of organic matter
Kand, kan	Modified from kandite	1:1 layer silicate clays
Pale	Gr. *paleos*, old	Excessive development
Petr	Gr. comb. form of *petra* Rock	A cemented horizon
Psamm	Gr. *psammos*, sand	Sandy texture
Quartz	Ger. *quarz*, quartz	High quartz content
Rhod	Gr. base of *rhodon*, rose	Dark red color
Torr	L. *torridus*, hot and dry	Torric moisture regime
Ud	L. *udus*, humid	Udic moisture regime
Ust	L. *ustus*, burnt	Ustic moisture regime

TABLE 4. ***Adjectives in the name of extragrades and intragrades of Puerto Rico soils***

Formative element	Derivation	Connotation
Aeric	Gr. *aerios*, air	Aeration
Arenic	L. *arena*, sand	Sandy material between 50 and 100 cm thick
Calcic	L. *calis*, lime	Presence of a calcic horizon
Chromic	Gr. *chroma*, color	High croma
Cumulic	L. *cumulus*, heap	Thickened epipedon
Grossarenic	L. *grossus*, thick and L. *arena*, sand	Thick sandy layer
Humic	L. *humus*, earth	Presence of organic matter
Hydric	Gr. *hydor*, water	Presence of water
Limnic	Modified from Gr. *limn*, lake	Presence of limnic layer
Lithic	Gr. *lithos*, stone	Presence of a shallow lithic contact
Plinthic	Modified from Gr. *plinthos*, brick	Presence of plinthite
Rhodic	Gr. base of *rhodon*, rose	Dark red color
Sodic	Modified from sodium	Presence of sodium salts
Terric	L. *terra*, earth	A mineral substratum
Thapto(ic)	Gr. *thapto*, buried	A buried soil
Xanthic	Gr. *xanthos*	Yellow

TABLE 5. ***Classification of the soil series of Puerto Rico by orders of Soil Taxonomy***

Alfisols

Amelia	Guerrero	Quebrada	Vega Baja
Bejucos	Juncal	Río Lajas	Vía
Candelero	Junquitos	Santa Marta	
Cayagua	Machete	Sosa	
Guayama	Parcelas	Tanamá	

Aridisols

Altamira	El Papayo	Llanos Costa
Bahía	Guayabo	Maguayo
Bermeja	Guayacán	Parguera
Casabe	La Covana	Seboruco
Cerro Mariquita	La Luna	Tuque

Entisols

Aguadilla	Carrizales	Martín Peña	Reparada
Arenales	Cataño	Meros	Talante
Atolladero	Costa	Olivares	
Bahía Salinas	Espinal	Pitahaya	
Boquerón	Jareales	Reilly	

Histosols

Garrochales	Manglillo	Tiburones
Joyuda	Palmar	Vigía
Los Peñones	Saladar	

Inceptisols

Alonso	Fortuna	Mayo	Santa Clara
Anones	Guamaní	Morado	Serrano
Caguabo	Guayabota	Múcara	Sonadora
Callabo	Icacos	Palm	Tejas
Chiquito	Igualdad	Pandura	Utuado
Ciales	Juana Díaz	Pellejas	Vieques
Coloso	Luquillo	Picacho	Vives
Córcega	Machuelo	Piñones	Viví
Cuchillas	Malaya	Plata	Yunes
Dique	Maní	Prieto	
El Duque (T)	Maragüez	Rubias	
El Verde (T)	Maunabo	Sabana	

(T)- indicates tentative soil series

TABLE 5. (Cont.) ***Classification of the soil series of Puerto Rico by orders of Soil Taxonomy***

Mollisols

Aguilita	Cortada	Guanábano	Pozo Blanco
Annaberg	Cuyón	Hoconuco	San Antón
Bajura	Descalabrado	Humacao	San Germán
Camp Santiago	Duey	Jacaguas	San Sebastián
Caracoles	Durados	Jácana	Santoni
Cintrona	El Cacique	La Taína	Soller
Coamo	El Descanso	La Tea	Toa
Colinas	Ensenada	Maresúa	Vayas
Constancia	Estación	Naranjo	Yauco

Oxisols

Adjuntas	Cotito	Limones
Agüeybaná	Coto	Los Guineos
Aljibe	Cristal	Matanzas
Almirante	Daguey	Nipe
Bayamón	Delicias	Rosario
Catalina	Dwarf	Sabana Seca
Cerro Gordo	Guamá	Yunque
Consejo	Indiera	Zarzal

Spodosols

Algarrobo	Arecibo	Corozo

Ultisols

Aceitunas	Guanajibo	Maleza	Río Arriba
Aibonito	Humatas	Mariana	Río Piedras
Cabo Rojo	Ingenio	Maricao	Torres
Cidral	Islote	Moca	Vega Alta
Consumo	Jagueyes	Moteado	Voladora
Corozal	Jobos	Naranjito	
Daguao	Lares	Palmarejo	
Espinosa	Lirios	Patillas	

Vertisols

Aguirre	Fraternidad	Mabí	Perchas
Camagüey	Guánica	Melones	Ponceña
Cartagena	Gurabo	Montalva	Santa Isabel
Fajardo	Juncos	Montegrande	Teresa
Fe	Llanos	Paso Seco	

TABLE 6. Classification of the soil series of Puerto Rico in all categories of Soil Taxonomy

Order	Suborder	Great Group	Subgroup	Family	Series
Alfisols	Aqualfs	Albaqualfs	Aeric Albaqualfs	Fine, mixed, semiactive, isohyperthermic	Cayagua
			Typic Albaqualfs	Fine-loamy, mixed, active, isohyperthermic	Candelero
	Udalfs	Hapludalfs	Aquic Hapludalfs	Fine, mixed, active, isohyperthermic	Vega Baja
			Aquic Hapludalfs	Very-fine, mixed, active, isohyperthermic	Junquitos
			Lithic Hapludalfs	Clayey, mixed, active, isohyperthermic	Tanamá
			Typic Hapludalfs	Fine-loamy, mixed, subactive, isohyperthermic	Bejucos
			Typic Hapludalfs	Fine, mixed, active, isohyperthermic	Juncal
			Typic Hapludalfs	Fine, magnesic, isohyperthermic	Santa Marta
			Typic Hapludalfs	Clayey, mixed, active, isohyperthermic, shallow	Quebrada
			Vertic Hapludalfs	Fine, mixed, superactive, isohyperthermic	Parcelas
		Paleudalfs	Arenic Plinthic Paleudalfs	Loamy, siliceous, subactive, isohyperthermic	Guerrero
			Psammentic Paleudalfs	Mixed, isohyperthermic	Río Lajas
			Typic Paleudalfs	Fine-loamy, mixed, semiactive, isohyperthermic	Vía
	Ustalfs	Haplustalfs	Aridic Haplustalfs	Fine, kaolinitic, isohyperthermic	Sosa
			Typic Haplustalfs	Fine, mixed, semiactive, isohyperthermic	Amelia
			Typic Haplustalfs	Clayey, mixed, active, isohyperthermic, shallow	Guayama

Order	Suborder	Great Group	Subgroup	Family	Series
		Paleustalfs	Aridic Paleustalfs	Very-fine, mixed, active, isohyperthermic	Machete
Aridisols	Argids	Calciargids	Typic Calciargids	Fine-loamy, mixed, active, isohyperthermic	La Luna
			Typic Calciargids	Clayey-skeletal, carbonatic, isohyperthermic	Parguera
			Typic Calciargids	Fine-loamy, mixed, superactive, isohyperthermic	Seboruco
			Vertic Calciargids	Fine, mixed, superactive, isohyperthermic	Maguayo
		Haplargids	Typic Haplargids	Clayey, mixed, active, isohyperthermic, shallow	Cerro Mariquita
			Typic Haplargids	Fine, mixed, semiactive, isohyperthermic	Llanos Costa
			Ustic Haplargids	Clayey, magnesic, isohyperthermic, shallow	Casabe
		Paleargids	Arenic Paleargids	Mixed, superactive, isohyperthermic	Guayabo
			Typic Paleargids	Sandy, kaolinitic, isohyperthermic	Bahía
	Calcids	Haplocalcids	Typic Haplocalcids	Coarse-loamy, carbonatic, isohyperthermic	Altamira
			Typic Haplocalcids	Fine-loamy, mixed, superactive, isohyperthermic	Guayacán
		Petrocalcids	Calcic Lithic Petrocalcids	Clayey-skeletal, carbonatic, isohyperthermic,	La Covana
			Calcic Lithic Petrocalcids	Clayey, carbonatic, isohyperthermic	Tuque
	Cambids	Haplocambids	Typic Haplocambids	Loamy, mixed, active, isohyperthermic, shallow	Bermeja
			Typic Haplocambids	Clayey, mixed, superactive, isohyperthermic, shallow	El Papayo

Order	Suborder	Great Group	Subgroup	Family	Series
Entisols	Aquents	Endoaquents	Typic Endoaquents	Fine, mixed, superactive, nonacid, isohyperthermic	Olivares
		Fluvaquents	Aeric Fluvaquents	Coarse-loamy over sandy or sandy-skeletal, mixed, subactive, acid, isohyperthermic	Talante
			Humaqueptic Fluvaquents	Fine, mixed, superactive, nonacid, isohyperthermic	Martín Peña
			Mollic Fluvaquents	Fine, mixed, superactive, nonacid, isohyperthermic	Reparada
			Thapto-Histic Fluvaquents	Fine, mixed, superactive, nonacid, isohyperthermic	Jareales
			Vertic Fluvaquents	Fine, mixed, superactive, nonacid, isohyperthermic	Boquerón
		Psammaquents	Typic Psammaquents	Carbonatic, isohyperthermic	Atolladero
	Fluvents	Udifluvents	Mollic Udifluvents	Sandy-skeletal, mixed, isohyperthermic	Reilly
	Orthents	Torriorthents	Typic Torriorthents	Clayey, carbonatic, isohyperthermic, shallow	Costa
			Typic Torriorthents	Clayey-skeletal, mixed, superactive, nonacid, isohyperthermic, shallow	Pitahaya
	Psamments	Quartzipsamments	Typic Quartzipsamments	Isohyperthermic, uncoated	Carrizales
		Torripsamments	Typic Torripsamments	Carbonatic, isohyperthermic	Bahía Salinas
		Udipsamments	Typic Udipsamments	Mixed, isohyperthermic	Aguadilla
			Typic Udipsamments	Carbonatic, isohyperthermic	Cataño
			Typic Udipsamments	Mixed, isohyperthermic	Espinal

Order	Suborder	Great Group	Subgroup	Family	Series
		Ustipsamments	Aridic Ustipsamments	Mixed, isohyperthermic	Arenales
			Typic Ustipsamments	Mixed, isohyperthermic	Meros
Histosols	Folists	Udifolists	Lithic Udifolists	Euic, isohyperthermic	Los Peñones
	Hemists	Haplohemists	Fluvaquentic Haplohemists	Euic, isohyperthermic	Manglillo
			Hydric Haplohemists	Euic, isohyperthermic	Joyuda
	Saprists	Haplosaprists	Limnic Haplosaprists	Marly, euic, isohyperthermic	Garrochales
			Terric Haplosaprists	Clayey, mixed, euic, isohyperthermic	Vigía
			Typic Haplosaprists	Euic, isohyperthermic	Palmar
			Typic Haplosaprists	Euic, isohyperthermic	Saladar
			Typic Haplosaprists	Euic, isohyperthermic	Tiburones
Inceptisols	Aquepts	Endoaquepts	Aeric Endoaquepts	Fine-loamy, mixed, semiactive, acid, isothermic	Icacos
			Fluvaquentic Endoaquepts	Fine-loamy over sandy or sandy-skeletal, mixed, semiactive, nonacid, isohyperthermic	Córcega
			Fluvaquentic Endoaquepts	Fine, mixed, active, acid, isohyperthermic	Fortuna
			Fluvaquentic Endoaquepts	Fine, mixed, superactive, calcareous, isohyperthermic	Machuelo
			Fluvaquentic Endoaquepts	Fine, mixed, superactive, acid, isohyperthermic	Piñones
			Typic Endoaquepts	Clayey over sandy or sandy-skeletal, mixed, superactive, nonacid, isohyperthermic	Igualdad
			Typic Endoaquepts	Clayey over loamy, mixed, semiactive, acid, isohyperthermic	Maunabo

Order	Suborder	Great Group	Subgroup	Family	Series
			Typic Endoaquepts	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, nonacid, isohyperthermic	Serrano
		Epiaquepts	Vertic Epiaquepts	Very-fine, mixed, semiactive, nonacid, isohyperthermic	Prieto
		Humaquepts	Aeric Humaquepts	Fine-loamy, isotic, acid, isothermic	Ciales
			Aquandic Humaquepts	Clayey-skeletal, isotic, acid, isothermic	Palm
			Typic Humaquepts	Fine, mixed, subactive, acid, isothermic	El Duque (T)
			Typic Humaquepts	Fine, mixed, subactive, acid, isothermic	Guayabota
	Udepts	Dystrudepts	Aquic Dystrudepts	Fine-loamy, mixed, subactive, isothermic	Picacho
			Aquic Humic Dystrudepts	Coarse-loamy, mixed, active, isothermic	Utuado
			Fluvaquentic Dystrudepts	Fine, mixed, semiactive, isohyperthermic	Luquillo
			Fluventic Dystrudepts	Clayey-skeletal, mixed, semiactive, isohyperthermic	El Verde (T)
			Fluventic Dystrudepts	Coarse-loamy over sandy or sandy-skeletal, mixed, active, isohyperthermic	Viví
			Humic Dystrudepts	Fine, parasesquic, isohyperthermic	Anones
			Humic Dystrudepts	Coarse-loamy, mixed, active, isohyperthermic	Mayo
			Humic Dystrudepts	Loamy-skeletal, mixed, superactive, isohyperthermic, shallow	Yunes

Order	Suborder	Great Group	Subgroup	Family	Series
			Humic Lithic Dystrudepts	Loamy-skeletal, mixed, subactive, isohyperthermic	Teja
			Lithic Dystrudepts	Clayey, mixed, active, isohyperthermic	Sabana
			Typic Dystrudepts	Loamy, mixed, active, isothermic, shallow	Cuchillas
			Typic Dystrudepts	Fine-loamy over sandy or sandy-skeletal, mixed, subactive, isohyperthermic	Pellejas
			Vertic Dystrudepts	Fine, mixed, active, isohyperthermic	Coloso
		Eutrudepts	Dystric Eutrudepts	Fine-loamy, mixed, superactive, isohyperthermic	Morado
			Dystric Eutrudepts	Loamy, mixed, active, isohyperthermic, shallow	Pandura
			Dystric Eutrudepts	Clayey-skeletal, smectitic, isohyperthermic	Plata
			Fluvaquentic Eutrudepts	Fine, mixed, semiactive, isohyperthermic	Maní
			Fluventic Eutrudepts	Fine-loamy, mixed, active, isohyperthermic	Dique
			Humic Eutrudepts	Fine, mixed, active, isothermic	Rubias
			Lithic Eutrudepts	Clayey-skeletal, mixed, active, isothermic	Chiquito
			Typic Eutrudepts	Loamy, mixed, active, isohyperthermic, shallow	Caguabo
			Typic Eutrudepts	Clayey, mixed, superactive, isohyperthermic, shallow	Malaya
			Typic Eutrudepts	Fine-loamy, mixed, superactive, isohyperthermic	Maragüez

Order	Suborder	Great Group	Subgroup	Family	Series
			Typic Eutrudepts	Fine, mixed, active, isohyperthermic	Santa Clara
			Vertic Eutrudepts	Fine-loamy, smectitic, isohyperthermic	Múcara
			Vertic Eutrudepts	Fine, smectitic, isohyperthermic	Sonadora
		Humudepts	Oxic Humudepts	Very-fine, parasesquic, isohyperthermic	Alonso
	Ustepts	Dystrustepts	Typic Dystrustepts	Clayey, mixed, superactive, isohyperthermic, shallow	Callabo
			Typic Dystrustepts	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, isohyperthermic	Vieques
		Haplustepts	Fluventic Haplustepts	Fine-loamy, mixed, superactive, isohyperthermic	Vives
			Torrifluventic Haplustepts	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, isohyperthermic	Guamaní
			Typic Haplustepts	Loamy, mixed, superactive, isohyperthermic, shallow	Juana Díaz
Mollisols	Aquolls	Calciaquolls	Aeric Calciaquolls	Fine, smectitic, isohyperthermic	Constancia
			Typic Calciaquolls	Fine, mixed, superactive, isohyperthermic	Cintrona
		Endoaquolls	Vertic Endoaquolls	Very-fine, mixed, superactive, isohyperthermic	Bajura
			Vertic Endoaquolls	Fine, mixed, superactive, isohyperthermic	Santoni
			Vertic Endoaquolls	Fine, smectitic, isohyperthermic	Vayas
	Rendolls	Haprendolls	Inceptic Haprendolls	Fine, carbonatic, isohyperthermic	Naranjo
			Typic Haprendolls	Coarse-loamy, carbonatic, isohyperthermic	Colinas

Order	Suborder	Great Group	Subgroup	Family	Series
			Typic Haprendolls	Clayey, mixed, active, isohyperthermic, shallow	Soller
	Udolls	Argiudolls	Calcic Argiudolls	Clayey-skeletal, carbonatic, isohyperthermic	San Sebastián
			Lithic Argiudolls	Clayey-skeletal, magnesic, isothermic	El Descanso
			Typic Argiudolls	Clayey, magnesic, isohyperthermic, shallow	El Cacique
			Typic Argiudolls	Fine, magnesic, isothermic	Hoconuco
			Typic Argiudolls	Clayey-skeletal, magnesic, isohyperthermic, shallow	La Taína
			Typic Argiudolls	Clayey, vermiculitic, isohyperthermic, shallow	La Tea
			Typic Argiudolls	Clayey-skeletal, magnesic, isohyperthermic	Maresúa
		Hapludolls	Fluventic Hapludolls	Sandy, mixed, isohyperthermic	Durados
			Fluventic Hapludolls	Fine-loamy over sandy or sandy-skeletal, mixed, active, isohyperthermic	Estación
			Fluventic Hapludolls	Fine, mixed, active, isohyperthermic	Toa
			Typic Hapludolls	Fine-loamy, mixed, superactive, isohyperthermic	Humacao
	Ustolls	Argiustolls	Calcidic Argiustolls	Clayey-skeletal, mixed, superactive, isohyperthermic	Ensenada
			Calcidic Argiustolls	Fine, smectitic, isohyperthermic	Guanábano
			Typic Argiustolls	Fine-loamy, mixed, superactive, isohyperthermic	Camp Santiago

Order	Suborder	Great Group	Subgroup	Family	Series
			Typic Argiustolls	Fine, mixed, superactive, isohyperthermic	Coamo
		Calciustolls	Aridic Calciustolls	Coarse-loamy, carbonatic, isohyperthermic	Aguilita
			Aridic Calciustolls	Fine-loamy, mixed, superactive, isohyperthermic	Pozo Blanco
			Typic Calciustolls	Fine-silty, carbonatic, isohyperthermic	Yauco
		Haplustolls	Cumulic Haplustolls	Fine, smectitic, isohyperthermic	Cortada
			Cumulic Haplustolls	Fine-loamy, mixed, superactive, isohyperthermic	San Antón
			Fluventic Haplustolls	Loamy-skeletal, mixed, superactive, isohyperthermic	Jacaguas
			Lithic Haplustolls	Loamy-skeletal, mixed, superactive, isohyperthermic	Annaberg
			Lithic Haplustolls	Loamy, mixed, superactive, isohyperthermic	Caracoles
			Lithic Haplustolls	Clayey-skeletal, mixed, superactive, isohyperthermic	San Germán
			Torrifluventic Haplustolls	Sandy-skeletal, mixed, isohyperthermic	Cuyón
			Typic Haplustolls	Clayey, mixed, superactive, isohyperthermic, shallow	Descalabrado
			Typic Haplustolls	Clayey-skeletal, mixed, superactive, isohyperthermic, shallow	Duey
			Vertic Haplustolls	Fine, mixed, superactive, isohyperthermic	Jácana

Order	Suborder	Great Group	Subgroup	Family	Series
Oxisols	Aquox	Haplaquox	Humic Haplaquox	Very-fine, kaolinitic, isothermic	Dwarf
			Plinthic Haplaquox	Very-fine, kaolinitic, isohyperthermic	Sabana Seca
	Perox	Haploperox	Humic Haploperox	Very-fine, kaolinitic, isothermic	Los Guineos
			Plinthaquic Haploperox	Very-fine, kaolinitic, isothermic	Yunque
			Rhodic Haploperox	Clayey, ferruginous, isothermic, shallow	Aljibe
			Rhodic Haploperox	Very-fine, ferruginous, isothermic	Guamá
			Typic Haploperox	Fine-loamy, mixed, isothermic	Cerro Gordo
			Typic Haploperox	Very-fine, ferruginous, isothermic	Indiera
		Kandiperox	Typic Kandiperox	Very-fine, ferruginous, isothermic	Agüeybaná
	Udox	Acrudox	Typic Acrudox	Very-fine, ferruginous, isohyperthermic	Nipe
		Eutrudox	Lithic Eutrudox	Clayey, kaolinitic, isohyperthermic	Matanzas
		Hapludox	Aquic Hapludox	Very-fine, parasesquic, isohyperthermic	Cristal
			Inceptic Hapludox	Very-fine, kaolinitic, isohyperthermic	Adjuntas
			Inceptic Hapludox	Very-fine, kaolinitic, isohyperthermic	Dagüey
			Inceptic Hapludox	Clayey, ferruginous, isohyperthermic, shallow	Rosario
			Plinthic Hapludox	Very-fine, kaolinitic, isohyperthermic	Almirante
			Rhodic Hapludox	Fine, ferruginous, isohyperthermic	Delicias

Order	Suborder	Great Group	Subgroup	Family	Series
			Typic Hapludox	Very-fine, kaolinitic, isohyperthermic	Bayamón
			Typic Hapludox	Very-fine, ferruginous, isohyperthermic	Catalina
			Typic Hapludox	Very-fine, kaolinitic, isohyperthermic	Coto
			Typic Hapludox	Very-fine, kaolinitic, isohyperthermic	Zarzal
			Xanthic Hapludox	Fine, kaolinitic, isohyperthermic	Consejo
		Kandiudox	Lithic Kandiudox	Clayey, ferruginous, isohyperthermic	Cotito
			Typic Kandiudox	Fine, kaolinitic, isohyperthermic	Limones
Spodosols	Orthods	Alorthods	Entic Alorthods	Coarse-loamy over clayey, siliceous over mixed, subactive, isohyperthermic	Algarrobo
			Entic Grossarenic Alorthods	Sandy, siliceous, isohyperthermic	Arecibo
			Typic Alorthods	Sandy over clayey, aniso, siliceous over kaolinitic, isohyperthermic	Corozo
Ultisols	Aquults	Kanhaplaquults	Aeric Kanhaplaquults	Very-fine, kaolinitic, isothermic	Moteado
	Humults	Haplohumults	Plinthic Haplohumults	Very-fine, mixed, active, isohyperthermic	Voladora
			Typic Haplohumults	Very-fine, mixed, semiactive, isohyperthermic	Aibonito
			Typic Haplohumults	Fine, mixed, semiactive, isohyperthermic	Consumo
			Typic Haplohumults	Very-fine, parasesquic, isohyperthermic	Corozal
			Typic Haplohumults	Fine, mixed, semiactive, isohyperthermic	Daguao

Order	Suborder	Great Group	Subgroup	Family	Series
			Typic Haplohumults	Very-fine, parasesquic, isohyperthermic	Humatas
			Typic Haplohumults	Fine, mixed, active, isohyperthermic	Mariana
			Typic Haplohumults	Very-fine, mixed, subactive, isothermic	Maricao
			Typic Haplohumults	Fine, mixed, semiactive, isohyperthermic	Naranjito
		Kandihumults	Typic Kandihumults	Very-fine, kaolinitic, isohyperthermic	Aceitunas
		Palehumults	Plinthic Palehumults	Fine, kaolinitic, isohyperthermic	Torres
	Udults	Hapludults	Aquic Hapludults	Very-fine, mixed, semiactive, isohyperthermic	Lares
			Typic Hapludults	Fine, kaolinitic, isohyperthermic	Ingenio
			Typic Hapludults	Fine, mixed, subactive, isohyperthermic	Lirios
			Typic Hapludults	Loamy, mixed, superactive, isohyperthermic, shallow	Patillas
			Typic Hapludults	Fine, kaolinitic, isohyperthermic	Río Piedras
			Typic Hapludults	Fine, parasesquic, isohyperthermic	Vega Alta
		Kandiudults	Plinthic Kandiudults	Very-fine, mixed, isohyperthermic	Guanajibo
			Typic Kandiudults	Fine, mixed, isohyperthermic	Espinosa
		Kanhapludults	Typic Kanhapludults	Fine-loamy, kaolinitic, isohyperthermic	Jagüeyes
		Paleudults	Plinthaquic Paleudults	Fine, kaolinitic, isohyperthermic	Jobos
			Typic Paleudults	Fine, mixed, semiactive, isohyperthermic	Cidral
			Typic Paleudults	Fine, parasesquic, isohyperthermic	Maleza
			Vertic Paleudults	Fine, mixed, semiactive, isohyperthermic	Cabo Rojo

Order	Suborder	Great Group	Subgroup	Family	Series
			Vertic Paleudults	Very-fine, mixed, semiactive, isohyperthermic	Moca
			Vertic Paleudults	Fine, mixed, subactive, isohyperthermic	Río Arriba
		Rhodudults	Typic Rhodudults	Fine, mixed, semiactive, isohyperthermic	Islote
	Ustults	Haplustults	Typic Haplustults	Fine, mixed, semiactive, isohyperthermic	Palmarejo
Vertisols	Aquerts	Calciaquerts	Typic Calciaquerts	Fine, smectitic, isohyperthermic	Guánica
		Dystraquerts	Chromic Dystraquerts	Fine, smectitic, isohyperthermic	Perchas
		Epiaquerts	Aeric Epiaquerts	Clayey over loamy, mixed, active, isohyperthermic	Gurabo
			Chromic Epiaquerts	Fine, mixed, active, isohyperthermic	Fajardo
			Sodic Epiaquerts	Very-fine, smectitic, isohyperthermic	Aguirre
	Torrerts	Calcitorrerts	Chromic Calcitorrerts	Fine, smectitic, isohyperthermic	Melones
		Haplotorrerts	Typic Haplotorrerts	Fine, mixed, superactive, isohyperthermic	Montalva
	Uderts	Hapluderts	Aquic Hapluderts	Fine, smectitic, isohyperthermic	Camagüey
			Aquic Hapluderts	Very-fine, mixed, active, isohyperthermic	Mabí
			Chromic Hapluderts	Fine, smectitic, isohyperthermic	Juncos
			Chromic Hapluderts	Very-fine, mixed, superactive, isohyperthermic	Montegrande
	Usterts	Calciusterts	Typic Calciusterts	Fine, mixed, superactive, isohyperthermic	Ponceña
		Haplusterts	Entic Haplusterts	Fine, smectitic, isohyperthermic	Llanos
			Entic Udic Haplusterts	Fine, mixed, superactive, isohyperthermic	Paso Seco

Order	Suborder	Great Group	Subgroup	Family	Series
			Sodic Haplusterts	Fine, mixed, superactive, isohyperthermic	Cartagena
			Sodic Haplusterts	Fine, smectitic, isohyperthermic	Fe
			Sodic Haplusterts	Very-fine, smectitic, isohyperthermic	Teresa
			Typic Haplusterts	Fine, smectitic, isohyperthermic	Fraternidad
			Typic Haplusterts	Fine, smectitic, isohyperthermic	Santa Isabel

Table 7. Taxonomic classification of soil series of Puerto Rico

Soil Series	Classification
Aceitunas	Very-fine, kaolinitic, isohyperthermic Typic Kandihumults
Adjuntas	Very-fine, kaolinitic, isohyperthermic Inceptic Hapludox
Aguadilla	Mixed, isohyperthermic Typic Udipsamments
Agüeybaná	Very-fine, ferruginous, isothermic Typic Kandiperox
Aguilita	Coarse-loamy, carbonatic, isohyperthermic Aridic Calciustolls
Aguirre	Very-fine, smectitic, isohyperthermic Sodic Epiaquerts
Aibonito	Very-fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Algarrobo	Coarse-loamy over clayey, siliceous over mixed, subactive, isohyperthermic Entic Alorthods
Aljibe	Clayey, ferruginous, isothermic, shallow Rhodic Haploperox
Almirante	Very-fine, kaolinitic, isohyperthermic Plinthic Hapludox
Alonso	Very-fine, parasesquic, isohyperthermic Oxic Humudepts
Altamira	Coarse-loamy, carbonatic, isohyperthermic Typic Haplocalcids
Amelia	Fine, mixed, semiactive, isohyperthermic Typic Haplustalfs
Annaberg	Loamy-skeletal, mixed, superactive, isohyperthermic Lithic Haplustolls
Anones	Fine, parasesquic, isohyperthermic Humic Dystrudepts

Soil Series	Classification
Arecibo	Sandy, siliceous, isohyperthermic Entic Grossarenic Alorthods
Arenales	Mixed, isohyperthermic Aridic Ustipsamments
Atolladero	Carbonatic, isohyperthermic Typic Psammaquents
Bahía	Sandy, kaolinitic, isohyperthermic Typic Paleargids
Bahía Salinas	Carbonatic, isohyperthermic Typic Torripsamments
Bajura	Very-fine, mixed, superactive, isohyperthermic Vertic Endoaquolls
Bayamón	Very-fine, kaolinitic, isohyperthermic Typic Hapludox
Bejucos	Fine-loamy, mixed, subactive, isohyperthermic Typic Hapludalfs
Bermeja	Loamy, mixed, active, isohyperthermic, shallow Typic Haplocambids
Boquerón	Fine, mixed, superactive, nonacid, isohyperthermic Vertic Fluvaquents
Cabo Rojo	Fine, mixed, semiactive, isohyperthermic Vertic Paleudults
Caguabo	Loamy, mixed, active, isohyperthermic, shallow Typic Eutrudepts
Callabo	Clayey, mixed, superactive, isohyperthermic, shallow Typic Dystrustepts
Camagüey	Fine, smectitic, isohyperthermic Aquic Hapluderts
Camp Santiago	Fine-loamy, mixed, superactive, isohyperthermic Typic Argiustolls
Candelero	Fine-loamy, mixed, active, isohyperthermic Typic Albaqualfs
Caracoles	Loamy, mixed, superactive, isohyperthermic Lithic Haplustolls
Carrizales	Isohyperthermic, uncoated Typic Quartzipsamments
Cartagena	Fine, mixed, superactive, isohyperthermic Sodic Haplusterts
Casabe	Clayey, magnesic, isohyperthermic, shallow Ustic Haplargids
Catalina	Very-fine, ferruginous, isohyperthermic Typic Hapludox
Cataño	Carbonatic, isohyperthermic Typic Udipsamments
Cayagua	Fine, mixed, semiactive, isohyperthermic Aeric Albaqualfs
Cerro Gordo	Fine-loamy, mixed, isothermic Typic Haploperox

Soil Series	Classification
Cerro Mariquita	Clayey, mixed, active, isohyperthermic, shallow Typic Haplargids
Chiquito	Clayey-skeletal, mixed, active, isothermic Lithic Eutrudepts
Ciales	Fine-loamy, isotic, acid, isothermic Aeric Humaquepts
Cidral	Fine, mixed, semiactive, isohyperthermic Typic Paleudults
Cintrona	Fine, mixed, superactive, isohyperthermic Typic Calciaquolls
Coamo	Fine, mixed, superactive, isohyperthermic Typic Argiustolls
Colinas	Coarse-loamy, carbonatic, isohyperthermic Typic Haprendolls
Coloso	Fine, mixed, active, isohyperthermic Vertic Dystrudepts
Consejo	Fine, kaolinitic, isohyperthermic Xanthic Hapludox
Constancia	Fine, smectitic, isohyperthermic Aeric Calciaquolls
Consumo	Fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Córcega	Fine-loamy over sandy or sandy-skeletal, mixed, semiactive, nonacid, isohyperthermic Fluvaquentic Endoaquepts
Corozal	Very-fine, parasesquic, isohyperthermic Typic Haplohumults
Corozo	Sandy over clayey, aniso, siliceous over kaolinitic, isohyperthermic Typic Alorthods
Cortada	Fine, smectitic, isohyperthermic Cumulic Haplustolls
Costa	Clayey, carbonatic, isohyperthermic, shallow Typic Torriorthents
Cotito	Clayey, ferruginous, isohyperthermic Lithic Kandiudox
Coto	Very-fine, kaolinitic, isohyperthermic Typic Hapludox
Cristal	Very-fine, parasesquic, isohyperthermic Aquic Hapludox
Cuchillas	Loamy, mixed, active, isothermic, shallow Typic Dystrudepts
Cuyón	Sandy-skeletal, mixed, isohyperthermic Torrifluventic Haplustolls
Daguao	Fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Dagüey	Very-fine, kaolinitic, isohyperthermic Inceptic Hapludox

Soil Series	Classification
Delicias	Fine, ferruginous, isohyperthermic Rhodic Hapludox
Descalabrado	Clayey, mixed, superactive, isohyperthermic, shallow Typic Haplustolls
Dique	Fine-loamy, mixed, active, isohyperthermic Fluventic Eutrudepts
Duey	Clayey-skeletal, mixed, superactive, isohyperthermic, shallow Typic Haplustolls
Durados	Sandy, mixed, isohyperthermic Fluventic Hapludolls
Dwarf	Very-fine, kaolinitic, isothermic Humic Haplaquox
El Cacique	Clayey, magnesic, isohyperthermic, shallow Typic Argiudolls
El Descanso	Clayey-skeletal, magnesic, isothermic Lithic Argiudolls
El Duque (T)	Fine, mixed, subactive, acid, isothermic Typic Humaquepts
El Papayo	Clayey, mixed, superactive, isohyperthermic, shallow Typic Haplocambids
El Verde (T)	Clayey-skeletal, mixed, semiactive, isohyperthermic Fluventic Dystrudepts
Ensenada	Clayey-skeletal, mixed, superactive, isohyperthermic Calcidic Argiustolls
Espinal	Mixed, isohyperthermic Typic Udipsamments
Espinosa	Fine, mixed, isohyperthermic Typic Kandiudults
Estación	Fine-loamy over sandy or sandy-skeletal, mixed, active, isohyperthermic Fluventic Hapludolls
Fajardo	Fine, mixed, active, isohyperthermic Chromic Epiaquerts
Fe	Fine, smectitic, isohyperthermic Sodic Haplusterts
Fortuna	Fine, mixed, active, acid, isohyperthermic Fluvaquentic Endoaquepts
Fraternidad	Fine, smectitic, isohyperthermic Typic Haplusterts
Garrochales	Marly, euic, isohyperthermic Limnic Haplosaprists
Guamá	Very-fine, ferruginous, isothermic Rhodic Haploperox
Guamaní	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, isohyperthermic Torrifluventic Haplustepts

Soil Series	Classification
Guanábano	Fine, smectitic, isohyperthermic Calcidic Argiustolls
Guanajibo	Very-fine, mixed, isohyperthermic Plinthic Kandiudults
Guánica	Fine, smectitic, isohyperthermic Typic Calciaquerts
Guayabo	Mixed, superactive, isohyperthermic Arenic Paleargids
Guayabota	Fine, mixed, subactive, acid, isothermic Typic Humaquepts
Guayacán	Fine-loamy, mixed, superactive, isohyperthermic Typic Haplocalcids
Guayama	Clayey, mixed, active, isohyperthermic, shallow Typic Haplustalfs
Guerrero	Loamy, siliceous, subactive, isohyperthermic Arenic Plinthic Paleudalfs
Gurabo	Clayey over loamy, mixed, active, isohyperthermic Aeric Epiaquerts
Hoconuco	Fine, magnesic, isothermic Typic Argiudolls
Humacao	Fine-loamy, mixed, superactive, isohyperthermic Typic Hapludolls
Humatas	Very-fine, parasesquic, isohyperthermic Typic Haplohumults
Icacos	Fine-loamy, mixed, semiactive, acid, isothermic Aeric Endoaquepts
Igualdad	Clayey over sandy or sandy-skeletal, mixed, superactive, nonacid, isohyperthermic Typic Endoaquepts
Indiera	Very-fine, ferruginous, isothermic Typic Haploperox
Ingenio	Fine, kaolinitic, isohyperthermic Typic Hapludults
Islote	Fine, mixed, semiactive, isohyperthermic Typic Rhodudults
Jacaguas	Loamy-skeletal, mixed, superactive, isohyperthermic Fluventic Haplustolls
Jácana	Fine, mixed, superactive, isohyperthermic Vertic Haplustolls
Jagüeyes	Fine-loamy, kaolinitic, isohyperthermic Typic Kanhapludults
Jareales	Fine, mixed, superactive, nonacid, isohyperthermic Thapto-Histic Fluvaquents
Jobos	Fine, kaolinitic, isohyperthermic Plinthaquic Paleudults
Joyuda	Euic, isohyperthermic Hydric Haplohemists

Soil Series	Classification
Juana Díaz	Loamy, mixed, superactive, isohyperthermic, shallow Typic Haplustepts
Juncal	Fine, mixed, active, isohyperthermic Typic Hapludalfs
Juncos	Fine, smectitic, isohyperthermic Chromic Hapluderts
Junquitos	Very-fine, mixed, active, isohyperthermic Aquic Hapludalfs
La Covana	Clayey-skeletal, carbonatic, isohyperthermic Calcic Lithic Petrocalcids
La Luna	Fine-loamy, mixed, active, isohyperthermic Typic Calciargids
La Taína	Clayey-skeletal, magnesic, isohyperthermic, shallow Typic Argiudolls
La Tea	Clayey, vermiculitic, isohyperthermic, shallow Typic Argiudolls
Lares	Very-fine, mixed, semiactive, isohyperthermic Aquic Hapludults
Limones	Fine, kaolinitic, isohyperthermic Typic Kandiudox
Lirios	Fine, mixed, subactive, isohyperthermic Typic Hapludults
Llanos	Fine, smectitic, isohyperthermic Entic Haplusterts
Llanos Costa	Fine, mixed, semiactive, isohyperthermic Typic Haplargids
Los Guineos	Very-fine, kaolinitic, isothermic Humic Haploperox
Los Peñones	Euic, isohyperthermic Lithic Udifolists
Luquillo	Fine, mixed, semiactive, isohyperthermic Fluvaquentic Dystrudepts
Mabí	Very-fine, mixed, active, isohyperthermic Aquic Hapluderts
Machete	Very-fine, mixed, active, isohyperthermic Aridic Paleustalfs
Machuelo	Fine, mixed, superactive, calcareous, isohyperthermic Fluvaquentic Endoaquepts
Maguayo	Fine, mixed, superactive, isohyperthermic Vertic Calciargids
Malaya	Clayey, mixed, superactive, isohyperthermic, shallow Typic Eutrudepts
Maleza	Fine, parasesquic, isohyperthermic Typic Paleudults
Manglillo	Euic, isohyperthermic Fluvaquentic Haplohemists
Maní	Fine, mixed, semiactive, isohyperthermic Fluvaquentic Eutrudepts

Soil Series	Classification
Maragüez	Fine-loamy, mixed, superactive, isohyperthermic Typic Eutrudepts
Maresúa	Clayey-skeletal, magnesic, isohyperthermic Typic Argiudolls
Mariana	Fine, mixed, active, isohyperthermic Typic Haplohumults
Maricao	Very-fine, mixed, subactive, isothermic Typic Haplohumults
Martín Peña	Fine, mixed, superactive, nonacid, isohyperthermic Humaqueptic Fluvaquents
Matanzas	Clayey, kaolinitic, isohyperthermic Lithic Eutrudox
Maunabo	Clayey over loamy, mixed, semiactive, acid, isohyperthermic Typic Endoaquepts
Mayo	Coarse-loamy, mixed, active, isohyperthermic Humic Dystrudepts
Melones	Fine, smectitic, isohyperthermic Chromic Calcitorrerts
Meros	Mixed, isohyperthermic Typic Ustipsamments
Moca	Very-fine, mixed, semiactive, isohyperthermic Vertic Paleudults
Montalva	Fine, mixed, superactive, isohyperthermic Typic Haplotorrerts
Montegrande	Very-fine, mixed, superactive, isohyperthermic Chromic Hapluderts
Morado	Fine-loamy, mixed, superactive, isohyperthermic Dystric Eutrudepts
Moteado	Very-fine, kaolinitic, isothermic Aeric Kanhaplaquults
Múcara	Fine-loamy, smectitic, isohyperthermic Vertic Eutrudepts
Naranjito	Fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Naranjo	Fine, carbonatic, isohyperthermic Inceptic Haprendolls
Nipe	Very-fine, ferruginous, isohyperthermic Typic Acrudox
Olivares	Fine, mixed, superactive, nonacid, isohyperthermic Typic Endoaquents
Palm	Clayey-skeletal, isotic, acid, isothermic Aquandic Humaquepts
Palmar	Euic, isohyperthermic Typic Haplosaprists
Palmarejo	Fine, mixed, semiactive, isohyperthermic Typic Haplustults

Soil Series	Classification
Pandura	Loamy, mixed, active, isohyperthermic, shallow Dystric Eutrudepts
Parcelas	Fine, mixed, superactive, isohyperthermic Vertic Hapludalfs
Parguera	Clayey-skeletal, carbonatic, isohyperthermic Typic Calciargids
Paso Seco	Fine, mixed, superactive, isohyperthermic Entic Udic Haplusterts
Patillas	Loamy, mixed, superactive, isohyperthermic, shallow Typic Hapludults
Pellejas	Fine-loamy over sandy or sandy-skeletal, mixed, subactive, isohyperthermic Typic Dystrudepts
Perchas	Fine, smectitic, isohyperthermic Chromic Dystraquerts
Picacho	Fine-loamy, mixed, subactive, isothermic Aquic Dystrudepts
Piñones	Fine, mixed, superactive, acid, isohyperthermic Fluvaquentic Endoaquepts
Pitahaya	Clayey-skeletal, mixed, superactive, nonacid, isohyperthermic, shallow Typic Torriorthents
Plata	Clayey-skeletal, smectitic, isohyperthermic Dystric Eutrudepts
Ponceña	Fine, mixed, superactive, isohyperthermic Typic Calciusterts
Pozo Blanco	Fine-loamy, mixed, superactive, isohyperthermic Aridic Calciustolls
Prieto	Very-fine, mixed, semiactive, nonacid, isohyperthermic Vertic Epiaquepts
Quebrada	Clayey, mixed, active, isohyperthermic, shallow Typic Hapludalfs
Reilly	Sandy-skeletal, mixed, isohyperthermic Mollic Udifluvents
Reparada	Fine, mixed, superactive, nonacid, isohyperthermic Mollic Fluvaquents
Río Arriba	Fine, mixed, subactive, isohyperthermic Vertic Paleudults
Río Lajas	Mixed, isohyperthermic Psammentic Paleudalfs
Río Piedras	Fine, kaolinitic, isohyperthermic Typic Hapludults
Rosario	Clayey, ferruginous, isohyperthermic, shallow Inceptic Hapludox
Rubias	Fine, mixed, active, isothermic Humic Eutrudepts
Sabana	Clayey, mixed, active, isohyperthermic Lithic Dystrudepts

Soil Series	Classification
Sabana Seca	Very-fine, kaolinitic, isohyperthermic Plinthic Haplaquox
Saladar	Euic, isohyperthermic Typic Haplosaprists
San Antón	Fine-loamy, mixed, superactive, isohyperthermic Cumulic Haplustolls
San Germán	Clayey-skeletal, mixed, superactive, isohyperthermic Lithic Haplustolls
San Sebastián	Clayey-skeletal, carbonatic, isohyperthermic Calcic Argiudolls
Santa Clara	Fine, mixed, active, isohyperthermic Typic Eutrudepts
Santa Isabel	Fine, smectitic, isohyperthermic Typic Haplusterts
Santa Marta	Fine, magnesic, isohyperthermic Typic Hapludalfs
Santoni	Fine, mixed, superactive, isohyperthermic Vertic Endoaquolls
Seboruco	Fine-loamy, mixed, superactive, isohyperthermic Typic Calciargids
Serrano	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, nonacid, isohyperthermic Typic Endoaquepts
Soller	Clayey, mixed, active, isohyperthermic, shallow Typic Haprendolls
Sonadora	Fine, smectitic, isohyperthermic Vertic Eutrudepts
Sosa	Fine, kaolinitic, isohyperthermic Aridic Haplustalfs
Talante	Coarse-loamy over sandy or sandy-skeletal, mixed, subactive, acid, isohyperthermic Aeric Fluvaquents
Tanamá	Clayey, mixed, active, isohyperthermic Lithic Hapludalfs
Teja	Loamy-skeletal, mixed, subactive, isohyperthermic Humic Lithic Dystrudepts
Teresa	Very-fine, smectitic, isohyperthermic Sodic Haplusterts
Tiburones	Euic, isohyperthermic Typic Haplosaprists
Toa	Fine, mixed, active, isohyperthermic Fluventic Hapludolls
Torres	Fine, kaolinitic, isohyperthermic Plinthic Palehumults
Tuque	Clayey, carbonatic, isohyperthermic Calcic Lithic Petrocalcids
Utuado	Coarse-loamy, mixed, active, isothermic Aquic Humic Dystrudepts

Soil Series	Classification
Vayas	Fine, smectitic, isohyperthermic Vertic Endoaquolls
Vega Alta	Fine, parasesquic, isohyperthermic Typic Hapludults
Vega Baja	Fine, mixed, active, isohyperthermic Aquic Hapludalfs
Vía	Fine-loamy, mixed, semiactive, isohyperthermic Typic Paleudalfs
Vieques	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, isohyperthermic Typic Dystrustepts
Vigía	Clayey, mixed, euic, isohyperthermic Terric Haplosaprists
Vives	Fine-loamy, mixed, superactive, isohyperthermic Fluventic Haplustepts
Viví	Coarse-loamy over sandy or sandy-skeletal, mixed, active, isohyperthermic Fluventic Dystrudepts
Voladora	Very-fine, mixed, active, isohyperthermic Plinthic Haplohumults
Yauco	Fine-silty, carbonatic, isohyperthermic Typic Calciustolls
Yunes	Loamy-skeletal, mixed, superactive, isohyperthermic, shallow Humic Dystrudepts
Yunque	Very-fine, kaolinitic, isothermic Plinthaquic Haploperox
Zarzal	Very-fine, kaolinitic, isohyperthermic Typic Hapludox

Table 8. Approximate area and distribution of the soil orders and suborders of Puerto Rico

Order/Suborder	Hectares	Acres	Percentage of Order	Percentage of Soil Area	Percentage of Total Land Area
Inceptisols	**262,680**	**648,818**		**34.3%**	**29.2%**
Udepts	229,728	567,425	87.5%		
Ustepts	25,476	62,925	9.7%		
Aquepts	7,476	18,468	2.8%		
Ultisols	**177,437**	**438,268**		**23.2%**	**19.7%**
Humults	138,117	341,147	77.9%		
Udults	38,364	94,758	21.6%		
Aquults	588	1,453	0.3%		
Ustults	368	910	0.2%		
Mollisols	**135,626**	**334,997**		**17.7%**	**15.1%**
Ustolls	58,235	143,842	42.9%		
Rendolls	34,421	85,018	25.4%		
Udolls	29,465	72,778	21.7%		
Aquolls	13,505	33,359	10.0%		
Oxisols	**69,005**	**170,439**		**9.0%**	**7.7%**
Udox	42,358	104,622	61.4%		
Perox	25,093	61,980	36.3%		
Aquox	1,554	3,837	2.3%		
Alfisols	**41,749**	**103,121**		**5.5%**	**4.6%**
Udalfs	30,213	74,626	72.3%		
Ustalfs	6,502	16,061	15.6%		
Aqualfs	5,034	12,434	12.1%		
Vertisols	**38,696**	**95,576**		**5.1%**	**4.3%**
Usterts	21,325	52,671	55.1%		
Uderts	9,976	24,640	25.8%		
Aquerts	6,072	14,999	15.7%		
Torrerts	1,323	3,266	3.4%		
Entisols	**20,294**	**50,126**		**2.7%**	**2.3%**
Psamments	7,096	17,524	34.9%		
Orthents	4,801	11,859	23.7%		
Aquents	4,701	11,613	23.2%		
Fluvents	3,696	9,130	18.2%		
Aridisols	**13,337**	**32,942**		**1.7%**	**1.5%**
Calcids	6,756	16,686	50.7%		
Argids	4,842	11,960	36.3%		
Cambids	1,739	4,296	13.0%		

Order/Suborder	Hectares	Acres	Percentage of Order	Percentage of Soil Area	Percentage of Total Land Area
Histosols	**4,387**	**10,836**		**0.6%**	**0.5%**
Saprists	3,637	8,982	82.9%		
Hemists	701	1,732	16.0%		
Folists	49	122	1.1%		
Spodosols	**1,733**	**4,281**			
Orthods	1,733	4,281	100.0%	**0.2%**	**0.2%**
Total soil area	764,944	1,889,404		100.0%	85.1%
Total non-soil area	134,078	330,404			14.9%
Total land area	899,022	2,219,808			100.0%

Table 9. Area of the established soil series of Puerto Rico by soil orders

Series	Hectares	Acres	Taxonomic Classification
Alfisols			
Amelia	1,687	4,168	Fine, mixed, semiactive, isohyperthermic Typic Haplustalfs
Bejucos	1,220	3,014	Fine-loamy, mixed, subactive, isohyperthermic Typic Hapludalfs
Candelero	2,161	5,337	Fine-loamy, mixed, active, isohyperthermic Typic Albaqualfs
Cayagua	2,873	7,097	Fine, mixed, semiactive, isohyperthermic Aeric Albaqualfs
Guayama	3,257	8,045	Clayey, mixed, active, isohyperthermic, shallow Typic Haplustalfs
Guerrero	1,724	4,257	Loamy, siliceous, subactive, isohyperthermic Arenic Plinthic Paleudalfs
Juncal	1,553	3,836	Fine, mixed, active, isohyperthermic Typic Hapludalfs
Junquitos	630	1,555	Very-fine, mixed, active, isohyperthermic Aquic Hapludalfs
Machete	885	2,187	Very-fine, mixed, active, isohyperthermic Aridic Paleustalfs
Parcelas	464	1,146	Fine, mixed, superactive, isohyperthermic Vertic Hapludalfs
Quebrada	9,014	22,265	Clayey, mixed, active, isohyperthermic, shallow Typic Hapludalfs
Río Lajas	807	1,993	Mixed, isohyperthermic Psammentic Paleudalfs

Series	Hectares	Acres	Taxonomic Classification
Santa Marta	119	294	Fine, magnesic, isohyperthermic Typic Hapludalfs
Sosa	673	1,661	Fine, kaolinitic, isohyperthermic Aridic Haplustalfs
Tanamá	13,027	32,177	Clayey, mixed, active, isohyperthermic Lithic Hapludalfs
Vega Baja	836	2,065	Fine, mixed, active, isohyperthermic Aquic Hapludalfs
Vía	819	2,024	Fine-loamy, mixed, semiactive, isohyperthermic Typic Paleudalfs
Total Area	**41,749**	**103,121**	
Aridisols			
Altamira	1,698	4,194	Coarse-loamy, carbonatic, isohyperthermic Typic Haplocalcids
Bahía	307	759	Sandy, kaolinitic, isohyperthermic Typic Paleargids
Bermeja	324	801	Loamy, mixed, active, isohyperthermic, shallow Typic Haplocambids
Casabe	241	595	Clayey, magnesic, isohyperthermic, shallow Ustic Haplargids
Cerro Mariquita	1,066	2,634	Clayey, mixed, active, isohyperthermic, shallow Typic Haplargids
El Papayo	1,415	3,495	Clayey, mixed, superactive, isohyperthermic, shallow Typic Haplocambids
Guayabo	174	430	Mixed, superactive, isohyperthermic Arenic Paleargids
Guayacán	1,186	2,930	Fine-loamy, mixed, superactive, isohyperthermic Typic Haplocalcids
La Covana	734	1,812	Clayey-skeletal, carbonatic, isohyperthermic Calcic Lithic Petrocalcids
La Luna	361	892	Fine-loamy, mixed, active, isohyperthermic Typic Calciargids
Llanos Costa	1,001	2,472	Fine, mixed, semiactive, isohyperthermic Typic Haplargids
Maguayo	611	1,510	Fine, mixed, superactive, isohyperthermic Vertic Calciargids
Parguera	221	545	Clayey-skeletal, carbonatic, isohyperthermic Typic Calciargids
Seboruco	860	2,123	Fine-loamy, mixed, superactive, isohyperthermic Typic Calciargids
Tuque	3,138	7,750	Clayey, carbonatic, isohyperthermic Calcic Lithic Petrocalcids
Total Area	**13,337**	**32,942**	
Entisols			
Aguadilla	1,230	3,038	Mixed, isohyperthermic Typic Udipsamments

Series	Hectares	Acres	Taxonomic Classification
Arenales	479	1,182	Mixed, isohyperthermic Aridic Ustipsamments
Atolladero	78	193	Carbonatic, isohyperthermic Typic Psammaquents
Bahía Salinas	194	478	Carbonatic, isohyperthermic Typic Torripsamments
Boquerón	343	847	Fine, mixed, superactive, nonacid, isohyperthermic Vertic Fluvaquents
Carrizales	1,054	2,603	Isohyperthermic, uncoated Typic Quartzipsamments
Cataño	3,143	7,763	Carbonatic, isohyperthermic Typic Udipsamments
Costa	1,952	4,821	Clayey, carbonatic, isohyperthermic, shallow Typic Torriorthents
Espinal	239	591	Mixed, isohyperthermic Typic Udipsamments
Jareales	785	1,939	Fine, mixed, superactive, nonacid, isohyperthermic Thapto-Histic Fluvaquents
Martín Peña	947	2,339	Fine, mixed, superactive, nonacid, isohyperthermic Humaqueptic Fluvaquents
Meros	757	1,869	Mixed, isohyperthermic Typic Ustipsamments
Olivares	134	332	Fine, mixed, superactive, nonacid, isohyperthermic Typic Endoaquents
Pitahaya	2,849	7,038	Clayey-skeletal, mixed, superactive, nonacid, isohyperthermic, shallow Typic Torriorthents
Reilly	3,696	9,130	Sandy-skeletal, mixed, isohyperthermic Mollic Udifluvents
Reparada	260	643	Fine, mixed, superactive, nonacid, isohyperthermic Mollic Fluvaquents
Talante	2,154	5,320	Coarse-loamy over sandy or sandy-skeletal, mixed, subactive, acid, isohyperthermic Aeric Fluvaquents
Total Area	**20,294**	**50,126**	
Histosols			
Garrochales	163	402	Marly, euic, isohyperthermic Limnic Haplosaprists
Joyuda	128	317	Euic, isohyperthermic Hydric Haplohemists
Los Peñones	49	122	Euic, isohyperthermic Lithic Udifolists
Manglillo	573	1,415	Euic, isohyperthermic Fluvaquentic Haplohemists
Palmar	391	966	Euic, isohyperthermic Typic Haplosaprists
Saladar	1,101	2,719	Euic, isohyperthermic Typic Haplosaprists
Tiburones	1,354	3,344	Euic, isohyperthermic Typic Haplosaprists

Series	Hectares	Acres	Taxonomic Classification
Vigía	628	1,551	Clayey, mixed, euic, isohyperthermic Terric Haplosaprists
Total Area	**4,387**	**10,836**	
Inceptisols			
Alonso	5,960	14,720	Very-fine, parasesquic, isohyperthermic Oxic Humudepts
Anones	3,540	8,743	Fine, parasesquic, isohyperthermic Humic Dystrudepts
Caguabo	61,638	152,246	Loamy, mixed, active, isohyperthermic, shallow Typic Eutrudepts
Callabo	17,281	42,683	Clayey, mixed, superactive, isohyperthermic, shallow Typic Dystrustepts
Chiquito	274	676	Clayey-skeletal, mixed, active, isothermic Lithic Eutrudepts
Ciales	230	567	Fine-loamy, isotic, acid, isothermic Aeric Humaquepts
Coloso	11,574	28,588	Fine, mixed, active, isohyperthermic Vertic Dystrudepts
Córcega	616	1,522	Fine-loamy over sandy or sandy-skeletal, mixed, semiactive, nonacid, isohyperthermic Fluvaquentic Endoaquepts
Cuchillas	3,504	8,654	Loamy, mixed, active, isothermic, shallow Typic Dystrudepts
Dique	1,129	2,789	Fine-loamy, mixed, active, isohyperthermic Fluventic Eutrudepts
El Duque (T)	61	151	Fine, mixed, subactive, acid, isothermic Typic Humaquepts
El Verde (T)	45	110	Clayey-skeletal, mixed, semiactive, isohyperthermic Fluventic Dystrudepts
Fortuna	1,229	3,036	Fine, mixed, active, acid, isohyperthermic Fluvaquentic Endoaquepts
Guamaní	1,860	4,594	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, isohyperthermic Torrifluventic Haplustepts
Guayabota	334	826	Fine, mixed, subactive, acid, isothermic Typic Humaquepts
Icacos	137	338	Fine-loamy, mixed, semiactive, acid, isothermic Aeric Endoaquepts
Igualdad	191	471	Clayey over sandy or sandy-skeletal, mixed, superactive, nonacid, isohyperthermic Typic Endoaquepts
Juana Díaz	292	720	Loamy, mixed, superactive, isohyperthermic, shallow Typic Haplustepts
Luquillo	367	906	Fine, mixed, semiactive, isohyperthermic Fluvaquentic Dystrudepts
Machuelo	1,081	2,670	Fine, mixed, superactive, calcareous, isohyperthermic Fluvaquentic Endoaquepts

Series	Hectares	Acres	Taxonomic Classification
Malaya	6,672	16,479	Clayey, mixed, superactive, isohyperthermic, shallow Typic Eutrudepts
Maní	539	1,331	Fine, mixed, semiactive, isohyperthermic Fluvaquentic Eutrudepts
Maragüez	5,130	12,672	Fine-loamy, mixed, superactive, isohyperthermic Typic Eutrudepts
Maunabo	1,815	4,485	Clayey over loamy, mixed, semiactive, acid, isohyperthermic Typic Endoaquepts
Mayo	236	584	Coarse-loamy, mixed, active, isohyperthermic Humic Dystrudepts
Morado	12,108	29,906	Fine-loamy, mixed, superactive, isohyperthermic Dystric Eutrudepts
Múcara	61,517	151,946	Fine-loamy, smectitic, isohyperthermic Vertic Eutrudepts
Palm	768	1,897	Clayey-skeletal, isotic, acid, isothermic Aquandic Humaquepts
Pandura	27,952	69,041	Loamy, mixed, active, isohyperthermic, shallow Dystric Eutrudepts
Pellejas	9,975	24,639	Fine-loamy over sandy or sandy-skeletal, mixed, subactive, isohyperthermic Typic Dystrudepts
Picacho	836	2,066	Fine-loamy, mixed, subactive, isothermic Aquic Dystrudepts
Piñones	364	900	Fine, mixed, superactive, acid, isohyperthermic Fluvaquentic Endoaquepts
Plata	908	2,243	Clayey-skeletal, smectitic, isohyperthermic Dystric Eutrudepts
Prieto	75	185	Very-fine, mixed, semiactive, nonacid, isohyperthermic Vertic Epiaquepts
Rubias	547	1,352	Fine, mixed, active, isothermic Humic Eutrudepts
Sabana	6,698	16,543	Clayey, mixed, active, isohyperthermic Lithic Dystrudepts
Santa Clara	710	1,753	Fine, mixed, active, isohyperthermic Typic Eutrudepts
Serrano	575	1,420	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, nonacid, isohyperthermic Typic Endoaquepts
Sonadora	1,010	2,495	Fine, smectitic, isohyperthermic Vertic Eutrudepts
Teja	3,059	7,555	Loamy-skeletal, mixed, subactive, isohyperthermic Humic Lithic Dystrudepts
Utuado	394	974	Coarse-loamy, mixed, active, isothermic Aquic Humic Dystrudepts
Vieques	3,262	8,058	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, isohyperthermic Typic Dystrustepts
Vives	2,781	6,870	Fine-loamy, mixed, superactive, isohyperthermic Fluventic Haplustepts

Series	Hectares	Acres	Taxonomic Classification
Viví	1,783	4,405	Coarse-loamy over sandy or sandy-skeletal, mixed, active, isohyperthermic Fluventic Dystrudepts
Yunes	1,623	4,009	Loamy-skeletal, mixed, superactive, isohyperthermic, shallow Humic Dystrudepts
Total Area	**262,680**	**648,818**	
Mollisols			
Aguilita	11,070	27,342	Coarse-loamy, carbonatic, isohyperthermic Aridic Calciustolls
Annaberg	1,996	4,931	Loamy-skeletal, mixed, superactive, isohyperthermic Lithic Haplustolls
Bajura	8,746	21,603	Very-fine, mixed, superactive, isohyperthermic Vertic Endoaquolls
Camp Santiago	446	1,102	Fine-loamy, mixed, superactive, isohyperthermic Typic Argiustolls
Caracoles	419	1,035	Loamy, mixed, superactive, isohyperthermic Lithic Haplustolls
Cintrona	534	1,320	Fine, mixed, superactive, isohyperthermic Typic Calciaquolls
Coamo	2,817	6,958	Fine, mixed, superactive, isohyperthermic Typic Argiustolls
Colinas	13,812	34,115	Coarse-loamy, carbonatic, isohyperthermic Typic Haprendolls
Constancia	2,766	6,833	Fine, smectitic, isohyperthermic Aeric Calciaquolls
Cortada	1,637	4,044	Fine, smectitic, isohyperthermic Cumulic Haplustolls
Cuyón	734	1,814	Sandy-skeletal, mixed, isohyperthermic Torrifluventic Haplustolls
Descalabrado	19,006	46,944	Clayey, mixed, superactive, isohyperthermic, shallow Typic Haplustolls
Duey	877	2,166	Clayey-skeletal, mixed, superactive, isohyperthermic, shallow Typic Haplustolls
Durados	598	1,477	Sandy, mixed, isohyperthermic Fluventic Hapludolls
El Cacique	3,728	9,209	Clayey, magnesic, isohyperthermic, shallow Typic Argiudolls
El Descanso	209	515	Clayey-skeletal, magnesic, isothermic Lithic Argiudolls
Ensenada	158	390	Clayey-skeletal, mixed, superactive, isohyperthermic Calcidic Argiustolls
Estación	660	1,630	Fine-loamy over sandy or sandy-skeletal, mixed, active, isohyperthermic Fluventic Hapludolls
Guanábano	524	1,295	Fine, smectitic, isohyperthermic Calcidic Argiustolls
Hoconuco	187	462	Fine, magnesic, isothermic Typic Argiudolls

Series	Hectares	Acres	Taxonomic Classification
Humacao	465	1,148	Fine-loamy, mixed, superactive, isohyperthermic Typic Hapludolls
Jacaguas	2,346	5,795	Loamy-skeletal, mixed, superactive, isohyperthermic Fluventic Haplustolls
Jácana	3,921	9,685	Fine, mixed, superactive, isohyperthermic Vertic Haplustolls
La Taína	1,885	4,656	Clayey-skeletal, magnesic, isohyperthermic, shallow Typic Argiudolls
La Tea	333	823	Clayey, vermiculitic, isohyperthermic, shallow Typic Argiudolls
Maresúa	590	1,457	Clayey-skeletal, magnesic, isohyperthermic Typic Argiudolls
Naranjo	1,961	4,843	Fine, carbonatic, isohyperthermic Inceptic Haprendolls
Pozo Blanco	530	1,309	Fine-loamy, mixed, superactive, isohyperthermic Aridic Calciustolls
San Antón	3,373	8,331	Fine-loamy, mixed, superactive, isohyperthermic Cumulic Haplustolls
San Germán	7,005	17,301	Clayey-skeletal, mixed, superactive, isohyperthermic Lithic Haplustolls
San Sebastián	12,020	29,690	Clayey-skeletal, carbonatic, isohyperthermic Calcic Argiudolls
Santoni	331	817	Fine, mixed, superactive, isohyperthermic Vertic Endoaquolls
Soller	18,648	46,060	Clayey, mixed, active, isohyperthermic, shallow Typic Haprendolls
Toa	8,790	21,711	Fine, mixed, active, isohyperthermic Fluventic Hapludolls
Vayas	1,128	2,786	Fine, smectitic, isohyperthermic Vertic Endoaquolls
Yauco	1,376	3,400	Fine-silty, carbonatic, isohyperthermic Typic Calciustolls
Total Area	**135,626**	**334,997**	
Oxisols			
Adjuntas	885	2,186	Very-fine, kaolinitic, isohyperthermic Inceptic Hapludox
Agüeybaná	2,618	6,467	Very-fine, ferruginous, isothermic Typic Kandiperox
Aljibe	23	57	Clayey, ferruginous, isothermic, shallow Rhodic Haploperox
Almirante	7,940	19,611	Very-fine, kaolinitic, isohyperthermic Plinthic Hapludox
Bayamón	9,333	23,052	Very-fine, kaolinitic, isohyperthermic Typic Hapludox
Catalina	108	267	Very-fine, ferruginous, isohyperthermic Typic Hapludox
Cerro Gordo	100	247	Fine-loamy, mixed, isothermic Typic Haploperox

Series	Hectares	Acres	Taxonomic Classification
Consejo	964	2,381	Fine, kaolinitic, isohyperthermic Xanthic Hapludox
Cotito	254	627	Clayey, ferruginous, isohyperthermic Lithic Kandiudox
Coto	5,071	12,525	Very-fine, kaolinitic, isohyperthermic Typic Hapludox
Cristal	1,685	4,163	Very-fine, parasesquic, isohyperthermic Aquic Hapludox
Dagüey	7,411	18,304	Very-fine, kaolinitic, isohyperthermic Inceptic Hapludox
Delicias	280	692	Fine, ferruginous, isohyperthermic Rhodic Hapludox
Dwarf	215	530	Very-fine, kaolinitic, isothermic Humic Haplaquox
Guamá	9	22	Very-fine, ferruginous, isothermic Rhodic Haploperox
Indiera	7	18	Very-fine, ferruginous, isothermic Typic Haploperox
Limones	1,010	2,494	Fine, kaolinitic, isohyperthermic Typic Kandiudox
Los Guineos	20,526	50,698	Very-fine, kaolinitic, isothermic Humic Haploperox
Matanzas	1,720	4,249	Clayey, kaolinitic, isohyperthermic Lithic Eutrudox
Nipe	861	2,126	Very-fine, ferruginous, isohyperthermic Typic Acrudox
Rosario	778	1,922	Clayey, ferruginous, isohyperthermic, shallow Inceptic Hapludox
Sábana Seca	1,339	3,307	Very-fine, kaolinitic, isohyperthermic Plinthic Haplaquox
Yunque	1,810	4,471	Very-fine, kaolinitic, isothermic Plinthaquic Haploperox
Zarzal	4,058	10,023	Very-fine, kaolinitic, isohyperthermic Typic Hapludox
Total Area	**69,005**	**170,439**	
Spodosols			
Algarrobo	808	1,996	Coarse-loamy over clayey, siliceous over mixed, subactive, isohyperthermic Entic Alorthods
Arecibo	205	507	Sandy, siliceous, isohyperthermic Entic Grossarenic Alorthods
Corozo	720	1,778	Sandy over clayey, aniso, siliceous over kaolinitic, isohyperthermic Typic Alorthods
Total Area	**1,733**	**4,281**	
Ultisols			
Aceitunas	4,693	11,591	Very-fine, kaolinitic, isohyperthermic Typic Kandihumults

Series	Hectares	Acres	Taxonomic Classification
Aibonito	485	1,197	Very-fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Cabo Rojo	326	806	Fine, mixed, semiactive, isohyperthermic Vertic Paleudults
Cidral	619	1,530	Fine, mixed, semiactive, isohyperthermic Typic Paleudults
Consumo	36,919	91,191	Fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Corozal	304	750	Very-fine, parasesquic, isohyperthermic Typic Haplohumults
Daguao	1,004	2,480	Fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Espinosa	3,212	7,934	Fine, mixed, isohyperthermic Typic Kandiudults
Guanajibo	566	1,397	Very-fine, mixed, isohyperthermic Plinthic Kandiudults
Humatas	58,089	143,480	Very-fine, parasesquic, isohyperthermic Typic Haplohumults
Ingenio	1,586	3,918	Fine, kaolinitic, isohyperthermic Typic Hapludults
Islote	347	857	Fine, mixed, semiactive, isohyperthermic Typic Rhodudults
Jagüeyes	478	1,181	Fine-loamy, kaolinitic, isohyperthermic Typic Kanhapludults
Jobos	1,968	4,860	Fine, kaolinitic, isohyperthermic Plinthaquic Paleudults
Lares	2,367	5,846	Very-fine, mixed, semiactive, isohyperthermic Aquic Hapludults
Lirios	9,964	24,610	Fine, mixed, subactive, isohyperthermic Typic Hapludults
Maleza	266	656	Fine, parasesquic, isohyperthermic Typic Paleudults
Mariana	481	1,189	Fine, mixed, active, isohyperthermic Typic Haplohumults
Maricao	14,873	36,735	Very-fine, mixed, subactive, isothermic Typic Haplohumults
Moca	2,882	7,118	Very-fine, mixed, semiactive, isohyperthermic Vertic Paleudults
Moteado	588	1,453	Very-fine, kaolinitic, isothermic Aeric Kanhaplaquults
Naranjito	17,658	43,615	Fine, mixed, semiactive, isohyperthermic Typic Haplohumults
Palmarejo	368	910	Fine, mixed, semiactive, isohyperthermic Typic Haplustults
Patillas	1,268	3,132	Loamy, mixed, superactive, isohyperthermic, shallow Typic Hapludults
Río Arriba	4,679	11,558	Fine, mixed, subactive, isohyperthermic Vertic Paleudults
Río Piedras	2,052	5,068	Fine, kaolinitic, isohyperthermic Typic Hapludults

Series	Hectares	Acres	Taxonomic Classification
Torres	281	694	Fine, kaolinitic, isohyperthermic Plinthic Palehumults
Vega Alta	5,784	14,287	Fine, parasesquic, isohyperthermic Typic Hapludults
Voladora	3,330	8,225	Very-fine, mixed, active, isohyperthermic Plinthic Haplohumults
Total Area	**177,437**	**438,268**	
Vertisols			
Aguirre	2,298	5,677	Very-fine, smectitic, isohyperthermic Sodic Epiaquerts
Camagüey	143	354	Fine, smectitic, isohyperthermic Aquic Hapluderts
Cartagena	2,032	5,020	Fine, mixed, superactive, isohyperthermic Sodic Haplusterts
Fajardo	304	751	Fine, mixed, active, isohyperthermic Chromic Epiaquerts
Fe	721	1,780	Fine, smectitic, isohyperthermic Sodic Haplusterts
Fraternidad	8,959	22,129	Fine, smectitic, isohyperthermic Typic Haplusterts
Guánica	1,336	3,301	Fine, smectitic, isohyperthermic Typic Calciaquerts
Gurabo			Clayey over loamy, mixed, active, isohyperthermic Aeric Epiaquerts
Juncos	930	2,297	Fine, smectitic, isohyperthermic Chromic Hapluderts
Llanos	3,875	9,570	Fine, smectitic, isohyperthermic Entic Haplusterts
Mabí	6,400	15,807	Very-fine, mixed, active, isohyperthermic Aquic Hapluderts
Melones	614	1,516	Fine, smectitic, isohyperthermic Chromic Calcitorrerts
Montalva	709	1,750	Fine, mixed, superactive, isohyperthermic Typic Haplotorrerts
Montegrande	2,503	6,182	Very-fine, mixed, superactive, isohyperthermic Chromic Hapluderts
Paso Seco	2,298	5,675	Fine, mixed, superactive, isohyperthermic Entic Udic Haplusterts
Perchas	2,134	5,270	Fine, smectitic, isohyperthermic Chromic Dystraquerts
Ponceña	1,268	3,132	Fine, mixed, superactive, isohyperthermic Typic Calciusterts
Santa Isabel	350	864	Fine, smectitic, isohyperthermic Typic Haplusterts
Teresa	1,822	4,501	Very-fine, smectitic, isohyperthermic Sodic Haplusterts
Total Area	**38,696**	**95,576**	

Soil Taxonomy: A dynamic system

The constant evaluation of soils has resulted in changes in order distribution as can be observed in the soil order map of 1982 and the current soil order map (Figures 1 and 2). The revision of soil orders indicates larger areas of Oxisols that include soils previously classified as Ultisols. In addition, the Aridisols order is included in the current map. A total of 13,337 ha (32,942 acres) of Aridisols were identified, located mostly in the municipalities of Cabo Rojo, Lajas and Guánica, in southwestern Puerto Rico. Other areas of Aridisols may be identified as a more detailed evaluation of the soils in the southern area is conducted. The occurrence of aridic moisture regime, not previously documented in Puerto Rico, resulted in the inclusion of the Aridisols order and in the recognition of several new soil series (Lugo-Camacho, 2005). This author along with USDA-NRCS Soil Science Division staff identified areas with a perudic moisture regime in Sierra de Cayey and Sierra de Luquillo mountain ranges, and in some areas of the Central Mountain range. The new moisture regime data required the designation of new soil series in areas of aridic and perudic moisture regimes. For example, some areas previously designated as the Aguilita series (Coarse-loamy, carbonatic, isohyperthermic Aridic Calciustolls) are currently designated as Altamira series (Coarse-loamy, carbonatic, isohyperthermic Typic Haplocalcids). In the perudic moisture regime, areas previously designated as Nipe series (Very-fine, ferruginous, isohyperthermic Typic Acrudox) are currently designated as Cerro Gordo series (Very fine, ferruginous, isothermic Typic Haploperox).

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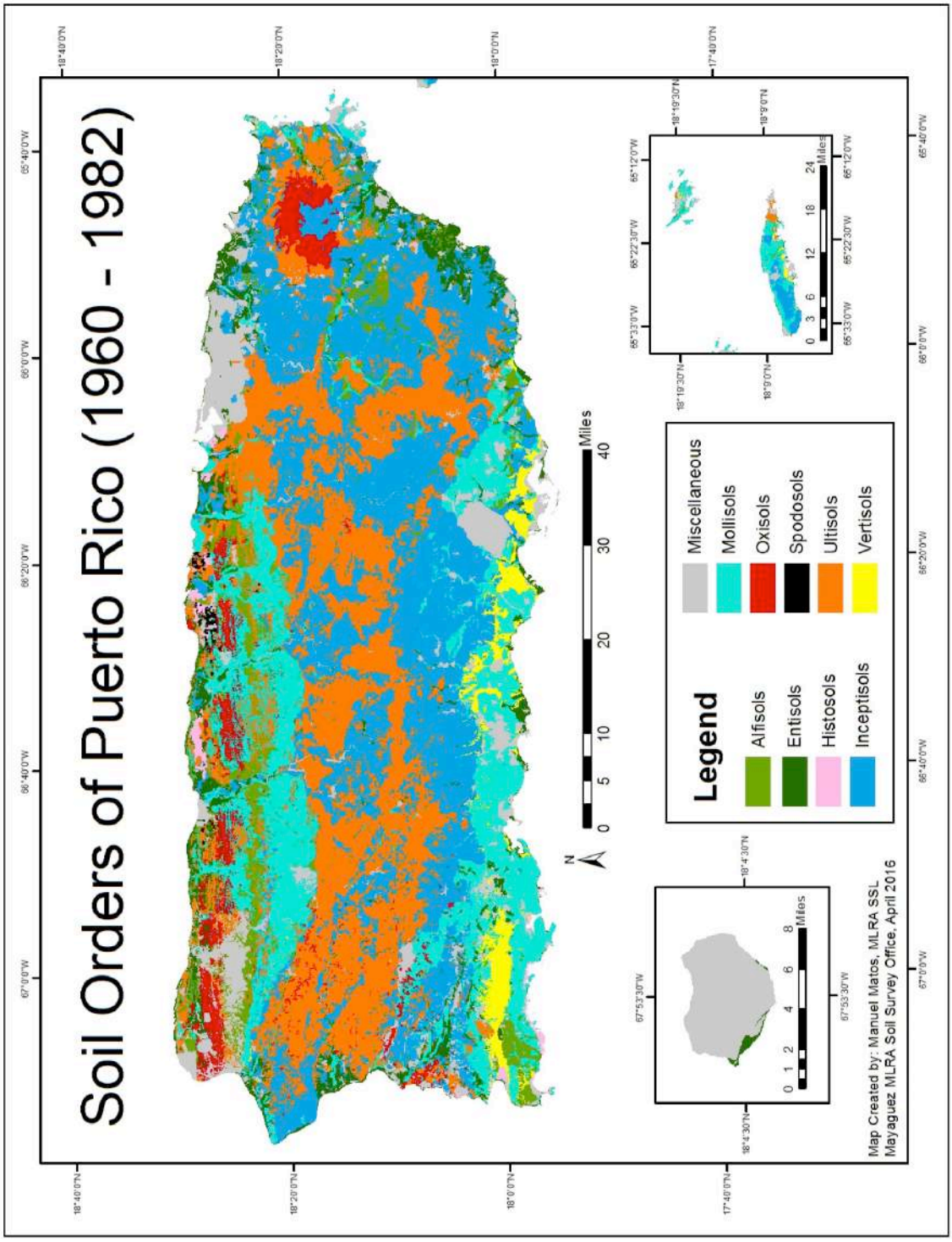


Figure 1. Soil Orders of Puerto Rico (1960-1982)

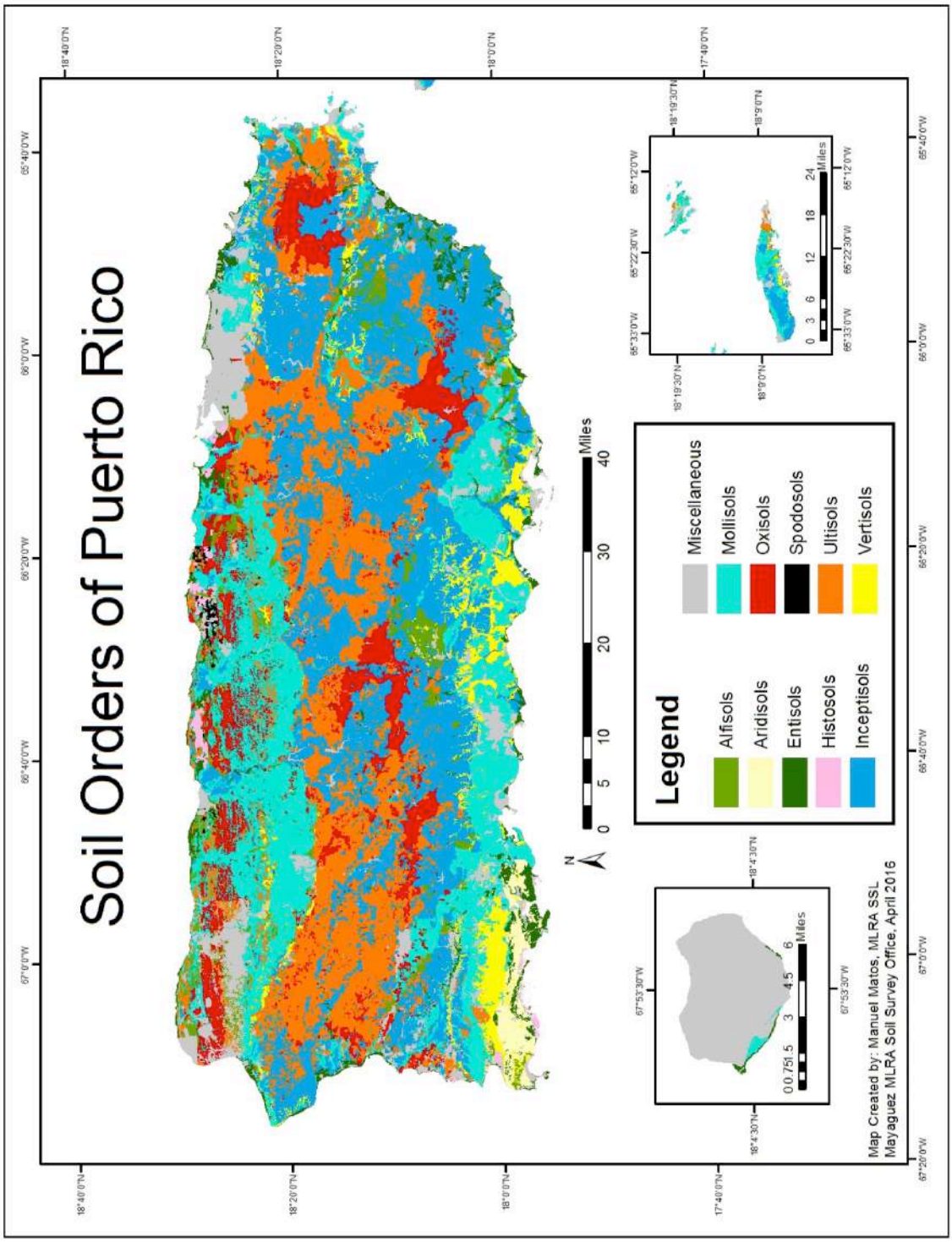


Figure 2. Soil Orders of Puerto Rico (2016)

APPENDIX: Representative soil profiles and landscapes

A selection of soil profiles and corresponding landscapes is included in this publication to provide the user with a clear representation of the diversity and richness of the soils of Puerto Rico. The best natural resource that any country can have is the soil. A country with healthy soils will have healthy crops, healthy plant and animal species, good quality of water, healthy and productive marine resources and a healthy population. The diversity of soils in Puerto Rico will fascinate the soil scientist, the student, the farmer, the environmentalist, the soil conservationist; guardians who will protect and preserve this wonderful natural resource. The redness of an Oxisol will tell a pedological story with dynamic geological and chemical processes, defying time, weather and climate, and claiming the right to control biota and all living creatures. The darkness of a Mollisol will express its fertility and the fame of being the most fertile and productive soils. Both orders, as well as the other ten in *Soil Taxonomy*, encompass the beauty and usefulness of an excellent taxonomic system. Enjoy the beauty of color and light in soil profiles!

ALFISOLS

Tanamá Series Profile (Clayey, mixed, active, isohyperthermic Lithic Hapludalfs)

Tanamá Series Landscape

The Tanamá series consists of shallow, well-drained, moderately permeable soils formed in materials weathered from limestone. They are gently sloping to very steep soils on foot slopes and side slopes of limestone hills. The Tanamá soils are mostly used for pasture and woodland. Slopes range from 2 to 60 percent. The mean annual precipitation is about 70 inches, and the mean annual temperature is about 76 degrees F. Tanamá soils are associated with San Sebastián and San Germán soils. A typical pedon of Tanamá soil is located 2 miles southwest of the town of Aguada, 1.2 miles on a dirt road west of kilometer marker 24.9 on Highway 115.

ARIDISOLS

Altamira Series Profile (Coarse-loamy, carbonatic, isohyperthermic Typic Haplocalcids)

Altamira Series Landscape

The Altamira series consists of deep, well-drained soils with moderate permeability. These soils formed in material that weathered from soft limestone bedrock and occupy ridge tops, summits, and side slopes in uplands of the limestone hills of the Semiarid Mountains and Valleys Major Land Resource Area (MLRA) of southern Puerto Rico. The average annual precipitation ranges from 28 to 36 inches and the average annual temperature ranges from 78 to 82 degrees F. Altamira soils are associated with Casabe, Costa, Guayacán, La Covana, Melones, Parguera, Pitahaya, and Seboruco soils. Altamira soils are used mostly for hayland and pasture land. Other areas are under natural vegetation of mesquite and other xerophytic grasses and shrubs. Slopes range from 2 to 60 percent. A typical pedon of Altamira gravelly clay, 2 to 20 percent slope, is located about 3.7 miles northeast of the community of El Combate, Cabo Rojo, southeast of the intersection of Puerto Rico Highways 301 and 303; about 200 feet east of the highway, in a hayfield.

ENTISOLS

Reilly Series Profile (Sandy-skeletal, mixed, isohyperthermic Mollic Udifluvents)

Reilly Series Landscape

The Reilly series consists of gravelly, very deep, excessively drained soils with rapid permeability. These soils formed in stratified alluvial deposits of mixed origin and occupy floodplains along riverbanks and stream channels of the Humid Coastal Plains MLRA of Puerto Rico. The deposits are coarse-textured and stratified with gravel and sand. Most areas of Reilly soils are in pastureland and are used for grazing. The slope ranges from 0 to 2 percent. The climate is humid tropical. The average annual precipitation ranges from 43 to 72 inches, and the average annual temperature ranges from 74 to 79 degrees F. Reilly soils are associated with Bajura, Coloso, Dique, Lares, and Toa soils. A typical pedon of Reilly sandy loam, 0 to 2 percent slope, frequently flooded, is located about 1.95 miles southwest of downtown Sabana Grande; about 0.5 miles southeast of the community of Minillas, about 0.5 mile northeast from Puerto Rico Highway 329 on a gravel road, San Germán.

HISTOSOLS

Tiburones Series Profile (Euic, isohyperthermic Typic Haplosaprists)

Tiburones Series Landscape

The Tiburones series consists of deep, poorly drained organic soils formed from sediments of highly decomposed plant tissues. Tiburones soils occur on nearly level bottomland and in depressional areas. Slopes range from 0 to 2 percent. They have formed from the sediments of organic decomposition under natural wet conditions. The climate is humid tropical. Average annual rainfall is 60 inches, and the average annual temperature is 78 degrees F. Typically, Tiburones soils have black, granular muck surface layers, are extremely acid and very strongly acid between 9 and 31 inches, and are slightly acid to neutral below 31 inches. These soils were used in the past for pasture and sugarcane. Tiburones soils are associated with Garrochales, Jareales, Palmar and Vigía soils. The largest area of Tiburones soil is located in the municipality of Arecibo, northern Puerto Rico, in the wetland known as Caño Tiburones, declared a natural reserve in 1998.

INCEPTISOLS

Caguabo Series Profile (Loamy, mixed, active, isohyperthermic, shallow Typic Eutrudepts)

Caguabo Series Landscape

The Caguabo series consists of shallow, well-drained soils, that are slightly acid and moderately permeable. These soils formed in residuum and colluvium weathered from basalt bedrock, and occupy hillslopes and mountain slopes in strongly dissected volcanic uplands at elevations below 1,800 feet or 550 meters. The substratum is a thin layer of weathered and partially weathered fragments of volcanic rock underlain with consolidated volcanic rock. Most areas of Caguabo soils are used for pasture and a few small areas are planted to woodland. The slope ranges from 12 to 60 percent. The climate is humid tropical. The average annual precipitation ranges from 75 to 85 inches, and the average annual temperature ranges from 75 to 77 degrees F. Caguabo soils are associated with Consumo, Humatas, La Tea, Malaya, Múcara, and Quebrada soils. A typical pedon of Caguabo clay loam, 20 to 60 percent slope, is located about 1.3 miles southeast of the intersection of Puerto Rico Highways 128 and 373, on a paved road, Yauco.

MOLLISOLS

San Antón Series Profile (Fine-loamy, mixed, superactive, isohyperthermic Cumulic Haplustolls)

San Antón Series Landscape

The San Antón series consists of very deep, well-drained, moderately permeable soils on flood plains in the semiarid area. These soils formed in stratified alluvial deposits that weathered from volcanic rock and limestone. The slope ranges from 0 to 2 percent. The climate is tropical semiarid, the average annual precipitation ranges from 35 to 40 inches, and the average annual temperature ranges from 78 to 80 degrees F. San Antón soils are used for pasture, vegetable, fruits and plantain production. This series is among the best for agricultural production. San Antón soils are associated with Cortada, Aguirre, Fraternidad and Cintrona soils. A typical pedon of San Antón clay loam is located at Fortuna, Agricultural Experiment Substation of the University of Puerto Rico, Juana Díaz.

OXISOLS

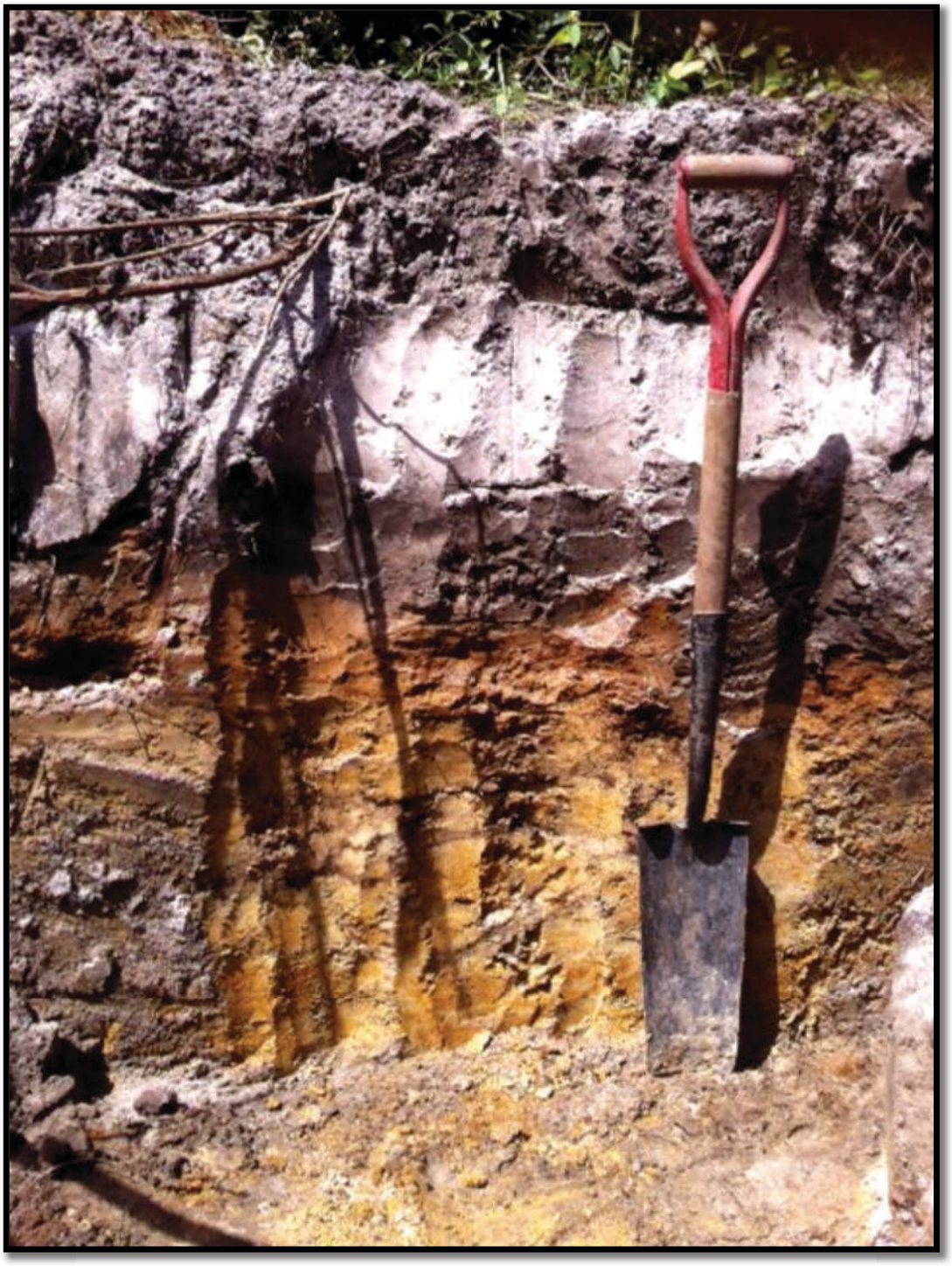
Bayamón Series Profile (Very-fine, kaolinitic, isohyperthermic Typic Hapludox)

Bayamón Series Landscape

The Bayamón series consists of deep, well-drained soils on upland and coastal plains, and in valleys interspersed among the limestone hills (haystacks or pipino hills). These soils formed in fine-textured sediments of mixed origin. The slope ranges from 2 to 12 percent. The climate is humid tropical with an average annual precipitation of 65 inches, and the mean annual temperature is 78 degrees F. The stability of the landforms enhances the weathering processes, the leaching of bases and weatherable minerals and the accumulation of more stable minerals and sesquioxides. The thickness of the solum is more than 60 inches, strongly acid or very strongly acid. The texture ranges from sandy loam to clay with horizons slightly plastic or plastic. Bayamón soils are used mainly for pasture, pineapples and starchy crops. In the past these soils were planted in sugarcane, and recently some coffee plantations were established. Bayamón soils are associated with Vega Alta, Almirante, Espinosa and Tanamá soils. A typical pedon of Bayamón clay, 2 to 5 percent slope, is located 50 meters north of kilometer marker 2.75 on Puerto Rico Highway 670, in the municipality of Barceloneta.

SPODOSOLS

Algarrobo Series Profile (Coarse-loamy over clayey, siliceous over mixed, subactive, isohyperthermic Entic Alorthods)

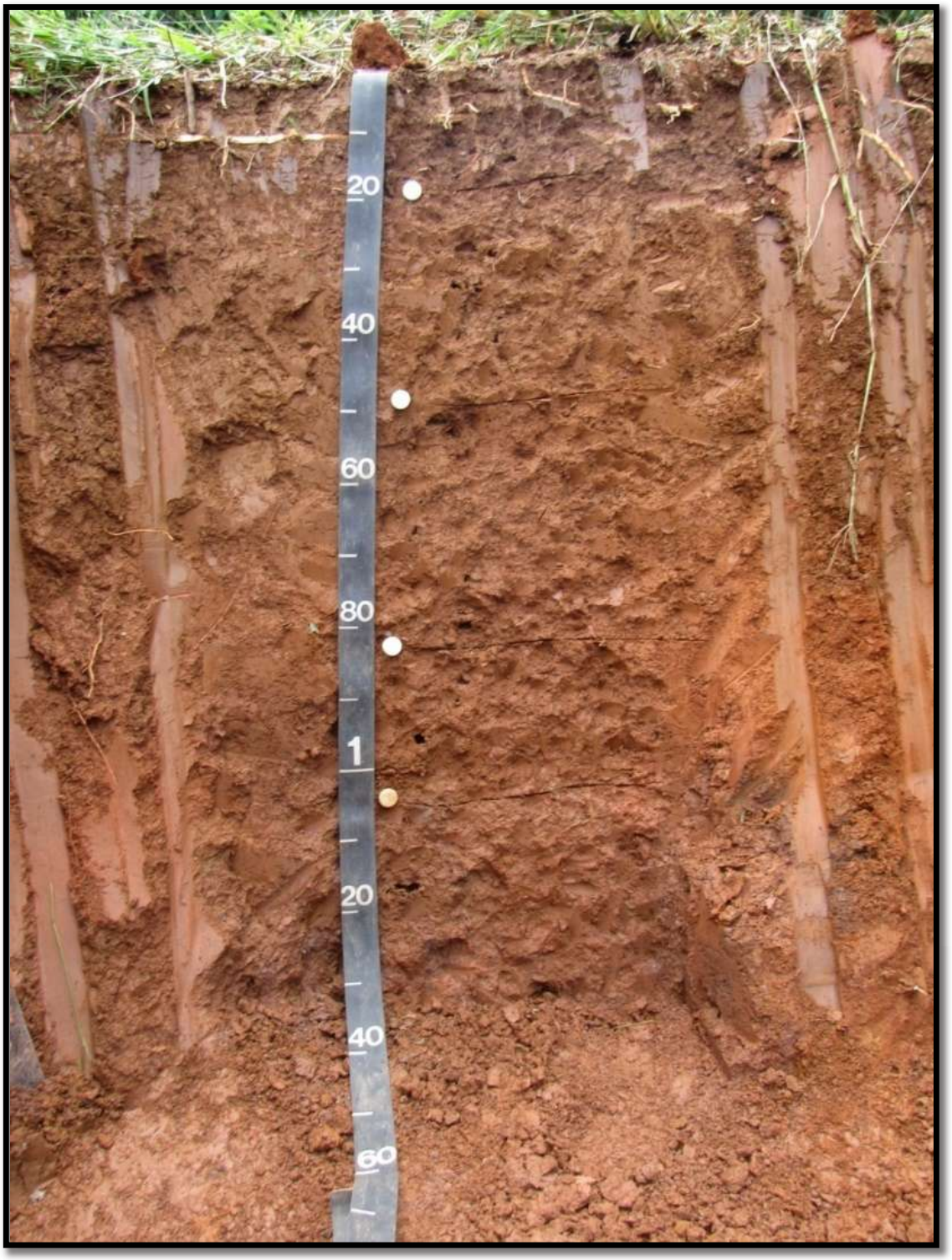


Algarrobo Series Landscape

The Algarrobo series consists of deep and excessively drained soils located on coastal plains. These soils formed in coarse textured sediments high in quartz and underlain by clayey coastal plain deposits. The slope ranges from 2 to 12 percent. The climate is humid tropical. The average annual precipitation ranges from 55 to 65 inches, and the average annual temperature ranges from 77 to 79 degrees F. Algarrobo soils are in areas of pangola grass, native pasture, coconut production, brushes and secondary forest. Some areas have been used for silica sand extraction. Algarrobo soils are associated with Corozo, Jobos, Guerrero, Arecibo, and Carrizales soils. The profile shown in the photo is Algarrobo fine sand, 2 to 12 percent slope, located at Finca Carmen Regadera, Puerto Rico Land Authority, Puerto Rico Highway 390, Vega Baja.

ULTISOLS

Humatas Series Profile (Very-fine, parasesquic, isohyperthermic Typic Haplohumults)



Humatas Series Landscape

The Humatas series consists of very deep, well-drained soils with moderately slow permeability. These soils formed in clayey and loamy residuum, weathered from basic igneous bedrock, and occupy ridges, hillslopes and mountain slopes. The climate is humid tropical. The average annual precipitation ranges from 70 to 86 inches, and the average annual temperature ranges from 74 to 76 degrees F. Most areas of Humatas soils are used for pasture, food crops, and coffee production. The slope ranges from 12 to 60 percent. The soil profile is strongly acid to very strongly acid throughout. Humatas soils are associated with Caguabo, Consumo, Morado, Múcara and Quebrada soils. A typical pedon of Humatas clay, 40-60 percent slope, is located at Adjuntas Agricultural Experiment Station, Puerto Rico Highway 525, Km. 2.5, Barrio Limaní, Adjuntas. The field is planted in coffee.

VERTISOLS

Fraternidad Series Profile (Fine, smectitic, isohyperthermic Typic Haplusterts)

Fraternidad Series Landscape

The Fraternidad series consists of very deep, moderately well-drained soils with very slow permeability. These soils formed in clayey alluvial sediments weathered from igneous, metamorphic and sedimentary rocks, and occupy fan skirts of basins and floodplains of the Semiarid Coastal Plains MLRA of southern Puerto Rico. Slopes range from 0 to 5 percent. The climate is semi-arid tropical. The average annual precipitation ranges from 40 to 50 inches, and the average annual temperature ranges from 73 to 77 degrees F. Fraternidad soils are used mainly for pasture, fruits and vegetable production. Fraternidad soils are associated with Aguilita, Aguirre, Cartagena, Fe, Guánica, Jácana, Olivares, Palmarejo, Pozo Blanco and Santa Isabel soils. A typical pedon of Fraternidad clay, 0 to 2 percent slope, is located about 1.1 miles southwest of Lajas, at the intersection of Puerto Rico Highways 315 and 101; about 0.7 mile southeast of the community of Palmarejo, at Lajas Agricultural Experiment Station of the University of Puerto Rico.