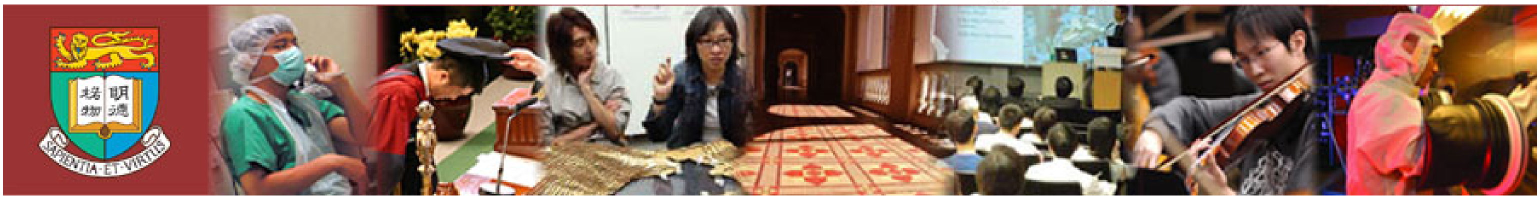

Title	**Physical and chemical properties of soils in an urban park in Hong Kong**
Author(s)	**Jim, CY**
Citation	**The 15th Congress of the International Union of Soil Sciences (IUSS 1994), Acapulco, Maxico, 10-16 July 1994. In Transactions: 15th World Congress of Soil Science, 1994, v. 5B, p. 229-230**
Issued Date	**1994**
URL	**http://hdl.handle.net/10722/116622**
Rights	

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOILS IN AN URBAN PARK IN HONG KONG

C.Y. Jim.
Department of Geography and Geology, University of Hong Kong, Pokfulam Road, Hong Kong.

INTRODUCTION: Soils in cities serve a wide range of amenity functions and are receiving more attention recently (1). In urban Hong Kong, soils support landscape plants and provide the substrate for greenery and recreational pursuits. The few urban parks accord welcome openings in the otherwise continuously and densely built-up city. The phenomenal visitor patronage imposes a heavy burden on the meagre soil resource, resulting in widespread degradation. An understanding of this component of the largely artificial ecosystem could furnish the basis for appropriate management strategy (2). This study aims at a comprehensive characterization of soils in Victoria Park, the earliest and most popular urban greenspace in Hong Kong.

MATERIALS AND METHODS: A stratified sampling approach divided the Park into three zones (good, average and degraded) according to the degree of trampling impacts using predetermined field criteria. For each stratum, two soil pits were dug to one metre deep, and profile morphology was studied. Infiltration (single-ring) and shear-strength (vane-shear) tests were performed in situ. Two sets of samples were taken from each horizon, namely the composite disturbed obtained from four sides of the pit, and two undistubed by a cylinder auger. A range of physical and chemical analyses were carried out in the laboratory.

RESULTS AND DISCUSSION: The profile morhpology showed the existence of four to five horizons with clear to gradual boundary distinctness and smooth form. The well-defined layering was differentiated according to colour, composition and associated properties. Horizonation was due more to the variations in the layered parent materials than to pedological processes. AT the bottom of most profiles, the grayish sand with single-grained structure and loose consistence, mixed with an abundant amount of seashells, suggested the shallow-marine environment of the place before reclamation by fill materials to create the Park. All materials lying above this original substratum were foreign and markedly different. Dark-coloured topsoil with organic matter accumulation could only be found in the good sites with intact turf; soils at the degraded parts had completely lost the turf as well as the O and A horizons.

With the loss of protective organic and organo-mineral cover, the exposed subsoil was heavily compacted by trampling and densely-packed by rainsplash action. The formation of a tightly-sealed and high-strength surface crust curtailed infiltration capacity down to a low level; the worst case registered a retarded rate of water entry at less than 2 cm/h whereas the better sites recorded up to 12 cm/h. Vane-shear results indicated that the compaction process had packed the particles close together and increased the shear strength significantly to more than 0.5 MPa in comparison with the average uncompacted subsoil value of 0.2 MPa. Corroborative evidence was provided by bulk density measurements, with the most badly compacted surface soils reaching 2.1 Mg/m^3, whereas the subsurface soil layers generally had an average value of 1.5 Mg/m^3. The total porosity of the most compacted samples dropped below 20%. Such deleterious physical properties associated with compaction and erosion are inimical to plant growth (3) which in an urban park is expected to be robust and well-maintained.

The predominantly coarse texture, all in the sand, loamy sand and sandy loam classes (USDA scheme), reflected the nature of the fill materials which were mainly decomposed granite excavated from hill-terracing sites at the city's edge. The light texture to a certain extent alleviated the undesirable effects of compaction, and also accorded a certain degree of resistance to extreme particle packing. The interstitial pores between the sand grains could afford some free avenues for air and water conductance as well as the storage of available moisture. The high stone (>2 mm diameter) content of the subsoil, exceeding 30% in most cases, was also an inherited and undesirable feature. Soil layers near the surface tended to have a much lower stone content, suggesting a conscious effort to furnish a less stressful substrate for turf cultivation. Continual top dressing using relatively fine earth also helped to build up or maintain the textural contrast.

Structure was poorly developed, with subsoil mainly angulai .ocky, topsoil often distinctly platy, and heavily compacted surface layers showing massive arrangement. Aggregate stability (wet sieving) was weak, with most samples showing substantial disintegration of the 1-2 mm diameter peds after standard laboratory treatments. Consistence tests indicated that most soils had strong strength (also shown by vane-shear experiments), and tended to behave in the brittle-deformation mode. Almost all samples were non-sticky and non-plastic, suggesting the lack of humic substances and colloidal clays, and feeble intergranular bonds.

In chemical terms, the soils could be described as dystrophic, and the nutrient composition was not untypical of the normal soils in the humid-tropical leaching regime. With the bulk of the parent materials originating from the local granitic weathering crust, the supply of plant-available fertility was expected to be low. The pH level of most soils fell in the range 7.3 to 8.5, and this was bequeathed from the alkalinity of the partly-weathered granitic materials; most local mature hill soils over granitic parent materials developed a reaction of around 5.5. The CEC values, averaged at about 10 me/100g, and those of the exchangeable bases, were quite low when gauged against the norm of tropical soils. The same was also true of organic nitrogen (micro-Kjeldahl) and available phosphorus (Olsen's method).

With sluggish infiltration and aeration, a shortage of rooting volume and a general lack of nutrients, the Park soils were generally poor media for plant growth. Additionally, they were unsightly as well as uncomfortable for park users. The normally rather aggressive turf-grass species, *Axonopus compressus* (Carpetgrass), failed to recolonize the bare patches. It was only with substantial cultural inputs, including sprigging, surface scarification, top dressing, fertilization, irrigation, and most importantly prohibition of visitor intrusion, that the turf was able to recover. Although most trees were able to linger, they suffered from root exposure and the general ill-effects of excessive compaction, and showed discernible loss of vigour.

The acreage of degraded lands in the park, unfortunately, had increased gradually in recent years due to an exceptionally high level of visitorship. The routine management response was principally the closure of more areas by fencing in a desperate attempt to preserve some remnant green pockets. This approach, however, had resulted in the concentration of user impacts in the diminishing pool of available turf, and further accentuating the rate and magnitude of destruction. Another strategy involved time restriction, with lawn opened only during weekends and public holidays. Innovative techniques of soil design by moulding the composition so as to resist compaction and provide reasonable sustenance to plant growth should be explored.

Literature Cited.

(1) Bullock, P. and Gregory, P.J. 1991 (eds.) Soils in the Urban Environment. Blackwell, Oxford, 184pp.

(2) Warner, J.W. Jr. and Hanna, W.E. 1982. Preliminary Report Soil Survey of Central Park, New York, New York. United States Department of Agriculture, Soil Conservation Service, and Cornell University Agricultural Experiment Station, 107pp.

(3) Jim, C.Y. 1993. Soil compaction as a constraint to tree growth in tropical and subtropical urban habitats. Environmental Conservation 20 (in press).