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Analysis of soil from point Calimere wildlife and bird sanctuary, Nagapattinam district, Tamil Nadu

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Abstract
The environmental factors influence plant growth and distribution directly. The plant distribution is primarily controlled by climatic factors and secondarily by edaphic factors. The climatic factors denotes the sum total of all atmospheric and meteorological conditions over a wide area like temperature, sunshine, air current, humidity, rainfall, etc. Edaphic factors influence a number of plant activities besides being a source of anchorage, water and minerals. The present study reported the relationship between edaphic factors with plant species to determine the main factors affecting the separation of vegetation types in Point Calimere Wildlife and Bird Sanctuary, Nagapattinam district, Tamil Nadu.

Keywords: physico-chemical properties, point Calimere Wildlife sanctuary, soil analysis, vegetation

Introduction
Soil sustains innumerable, microbes and a large number of plants and animals along with plenty of mineral reserves for purposeful exploitation. The factors like moisture, light, temperature, organic matter, P^H and soil characteristics play a major role in microbial activity changing the fauna and quantity of nutrients present in the soil. In order to understand and manage forest ecosystems, it is important to study the relationship between environmental factors and plants in these ecosystems. One of the main components of forest ecosystems is its' kinds of vegetation which are controlled by environmental variables such as climate, soil and topography [1, 2]. The distribution of vegetation types were most strongly controlled with some soil characteristic such as P^H, bulk density, texture, phosphorus, organic carbon, total nitrogen and electrical conductivity [3]. The vegetation is positively correlated with physical factors of soil. This has been reported by many investigators [4, 5, 6]. So, the present study aimed to analysis the physico-chemical characters of the soil from the selected locality of Point Calimere Wildlife and Bird Sanctuary, Nagapattinam district, Tamil Nadu. The present study also reported the relationship between edaphic factors with plant species to determine the main factors affecting the separation of vegetation types in the study area.

Area of Study
The area of study Point Calimere falls under the Nagapattinam district and it was under the erstwhile district of Tanjore of Tamil Nadu before bifurcation. Point Calimere (Kalli-medu in Tamil) is also called as Cape Calimere and Kodikkarai. It is the apex of the Cauvery river delta, and marks a nearly a right-angle turn in the coastline. In 1988, the sanctuary was enlarged to include the Great Vedaranyam Swamp and the Talaignayar Reserve Forest, and renamed the Point Calimere Wildlife and Bird Sanctuary, with a total area of 377 km². Point Calimere, at a sea level above MSL in the eastern side ending with the sea gradually raises in the west up to 25 mts in Ramarpadam located in the high sand dunes.

Methodology
Using a digger, soil samples up to a depth of 1 to 30 cm were collected from sites where the plants were found growing abundantly. The collected soil samples were air dried, ground and sieved through 2mm mesh and stored in polythene bags for various analyses**.** The important soil characteristics like soil pH, electrical conductivity, lime status, macronutrients and micronutrients, cation exchange capacity and exchangeable bases of the soil, organic carbon, organic matter, moisture and textural class of the soil were analysed based on the standard methods [7].

Map 1: Land cover map showing various sites in Point Calimere

Table 1: Selected sites for the Physico- chemical soil analysis

S. No.	Site	Location
1.	Site I	Muniappan Lake
2.	Site II	Vannapetchiamman kovil area
3.	Site III	Nandupallam area
4.	Site IV	Mattumunian kovil area
5.	Site V	Old railway tract area
6.	Site VI	Near old light house
7.	Site VII	Theerthapallam
8.	Site VIII	New light house
9.	Site IX	Opp. To Muniappan Lake
10.	Site X	Nalla thaneerkulam

Table 2: Physico-chemical properties of the soil

S. No.	*Site*	*pH*			*E.C. ds m-1*			*Lime Status*		
		2006	2007	2008	2006	2007	2008	2006	2007	2008
1.	Site I	6.5	6.9	7.7	8.2	0.14	0.46	N	N	N
2.	Site II	6.0	6.6	6.9	0.14	0.39	0.19	N	N	N
3.	Site III	6.6	7.5	8.4	2.8	5.4	0.85	N	N	N
4.	Site IV	7.7	8.1	8.6	2.1	1.22	1.28	N	N	P
5.	Site V	8.2	8.3	8.6	5.3	4.6	5.65	P	P	P
6.	Site VI	8.3	8.6	8.8	14.50	31.6	5.40	P	P	P
7.	Site VII	8.5	8.8	9.3	11.25	18.5	1.49	p	P	P
8.	Site VIII	6.1	9.2	7.3	0.39	13.0	1.25	p	p	P
9.	Site IX	7.5	6.8	8.5	0.15	0.65	0.13	N	P	P
10.	Site X	7.3	8.4	8.4	0.65	4.6	1.32	N	P	P

Note: Electrical conductivity

Table 3: Macronutrients and micronutrients of the soil

S. No.	Site	Macronutrient (kg/acre)									Micronutrients (PPM)											
		Nitrogen (N)			Phosphorus (P)			Potassium (K)			Iron (Fe)			Manganese (Mn)			Zinc (Zn)			Copper (Cu)		
		2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
1	Site I	17	34	54	1.5	5.5	5.5	157.5	65	25	10.92	8.24	6.32	3.26	5.36	7.82	1.16	0.85	0.20	0.98	0.82	0.74
2	Site II	76	73	71	2.5	8.2	13.0	27.5	87	95	59.2	37.0	7.32	2.48	6.48	8.62	0.42	0.31	0.12	0.52	0.51	0.50
3	Site III	28	47	83	4.0	5.0	6.0	15	18	28	12.66	8.03	4.56	8.56	7.48	6.33	0.86	0.64	0.12	0.96	0.72	0.34
4	Site IV	14	36	73	1.5	1.8	2.5	150	69	35	11.14	8.36	3.49	1.00	5.02	8.03	0.70	0.55	0.31	0.60	0.10	0.09
5	Site V	18	27	74	4.0	4.3	5.0	300	76	35	13.36	12.46	7.97	6.46	14.66	5.61	0.38	0.24	0.36	0.30	0.33	0.46
6	Site VI	71	129	80	20.5	7.5	10.0	190	500	230	12.56	52.2	3.91	11.29	20.6	4.59	0.38	3.14	0.24	0.92	0.86	0.32
7	Site VII	21	59	76	1.5	6.5	5.0	210	420	300	11.22	54.6	2.24	11.16	20.0	4.33	0.18	1.04	0.18	0.94	0.50	0.17
8	Site VIII	67	48	78	9.0	7.5	9.0	135	220	250	44.6	27.0	5.97	25.0	6.58	5.12	3.86	0.66	0.24	0.92	0.52	0.26
9	Site IX	102	80	77	5.5	6.3	3.5	175	74	60	20.4	10.28	8.03	1.52	2.36	3.49	0.46	0.32	0.31	0.26	0.25	0.09
10	Site X	60	78	70	6.5	4.0	4.0	50	142	65	24.4	13.78	4.78	4.44	12.18	2.82	0.72	2.80	0.33	0.38	3.5	0.82

Table 4: Cation exchange capacity and exchangeable bases of the soil

S. No.	Site	Exchangeable bases (m. mhos/c.ml)												C.E.C (m. mhos/c.ml)			B.S. P			E.S. P		
		Ca			Mg			Na			K											
		2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
1	Site I	3.6	3.8	3.5	2.4	2.4	2.6	1.1455	1.5687	1.1955	0.0732	0.0154	0.0154	9.1	9.3	9.0	83.50	83.75	82.17	15.48	16.65	16.16
2	Site II	4.0	3.6	4.1	2.1	2.9	2.2	0.1579	0.6548	0.7065	0.0457	0.0684	0.0641	8.5	8.4	8.0	86.44	86.33	87.13	11.53	11.85	10.13
3	Site III	2.6	2.0	2.3	2.3	2.7	2.0	2.6744	2.4587	2.9348	0.0182	0.0539	0.0641	9.4	9.7	9.0	81.29	81.45	84.43	34.87	37.45	32.61
4	Site IV	4.6	3.8	4.8	9.4	8.9	10.2	4.5714	4.2876	4.239	0.0468	0.0125	0.0641	22.0	23.5	21.0	93.59	90.57	90.99	21.54	20.75	20.18
5	Site V	3.8	4.6	4.5	5.1	4.7	5.0	2.6048	3.6510	2.63	0.1574	0.1648	0.1282	13.5	13.7	12.5	94.28	92.68	92.46	21.54	21.78	21.04
6	Site VI	5.4	5.2	5.9	5.7	5.1	5.6	4.5871	4.8914	4.3473	0.2519	0.3866	0.3205	16.8	17.9	17.0	92.54	92.78	92.16	25.83	26.34	25.57
7	Site VII	8.2	8.6	9.1	4.8	5.7	4.6	4.5621	4.3578	4.6725	0.0453	0.0497	0.0641-	17.6	18.1	18.5	96.54	93.78	94.44	25.62	24.70	25.25
8	Site VIII	3.4	3.4	3.2	7.5	7.4	6.8	5.3489	4.6157	4.891	0.3516	0.3486	0.3205	16.4	17.6	16.5	93.54	94.50	93.424	31.86	32.00	31.73
9	Site IX	4.8	4.5	4.7	3.5	2.8	2.2	0.4598	0.9300	0.8974	0.1864	0.1957	0.1923	8.2	8.9	8.6	94.78	94.27	94.07	16.75	11.53	11.09
10	Site X	5.0	4.8	4.2	2.4	1.9	1.0	0.5583	1.3542	0.9615	0.1543	0.1345	0.1282	7.6	6.5	7.6	92.54	93.78	93.29	12.83	13.47	12.65

Note: C.E.C: Cation Exchange Capacity; B.S.P: Base Saturation Percentage; E.S.P: Exchangeable Sodium Percentage

Results and Discussion

Soils vary in their physical and chemical properties. Soil samples (ten) were collected from different localities of the area of study (Table: 1). The results of the soil analysis in the area of study are presented in the Tables: 2, 3, 4 and 5.

The pH of the soil is slightly alkaline in nature in sites IV, V, VI, VII and X, but in site II it is slightly acidic (6.0). In site I neutral P^H was reported in 2006 (6.6) and 2007 (6.9), but in 2008 alkali P^H (7.7) was recorded. This may be due to the heavy rainfall in the year 2006 and 2007, all the exchangeable ions have been leached out and the exchangeable sites are occupied by the H^+ ions. Electrical conductivity denotes the degree of salinity on the amount of total dissolved salts in the soil. Electrical conductivity of the soil was found to be statistically superior in the soil collected from the site VI. High values of EC indicate enrichment of soil with soluble cations and anions such as Na, K, Mg, Cl^{-1}, SO_4^{2-}. In the present observation the EC above 5 is reported to have many salt tolerant species such as *Salicornia brachiata, Suaeda maritima, Suaeda nodiflora, Cressa cretica, Lumnitzera racemosa, Aegiceras corniculatum, Acanthus ilicifolius, Tamarix troupii, Avicennia officinalis* and *Excoecaria agallocha.*

The soil in the sites V, VI, VII and VIII is strongly calcareous (lime status) (Table: 2). The soil contains high amount of calcium carbonate and calcium oxide. Humus and nutrient content are poor but water holding capacity is moderate. The plants grow in this calcareous soil exhibit a number of xerophytic characters. The xerophytic species such as *Commiphora berryii, Euphorbia antiquorum, Euphorbia tortilis, Sarcostemma acidum, Catunaregam spinosa, Benkara malabarica, Dalbergia horrida, Zizyphus mauritiana* and *Zizyphus xylopyrus* are found common.

The available nutrients in the soil are the indicators for the capability of the soil to supply the nutrients for plants growth and productivity. Macronutrients and micronutrients content of the soil are reported in Table: 3. The soil nitrogen availability is less than 113 Kg/ac. rated as low, 113 – 181 rated as medium and above 181 rated as high. The soil samples in the area of study reported to have less nitrogen content except site VI which contains moderate nitrogen level. The soil phosphorus availability is less than 4.5 Kg/ac. rated as low, 4.5– 9.0 Kg/ac. rated as medium and above 9.0 Kg/ac. rated as high. In the sites I, III, IV, V, VII, IX and X the level of phosphorus is less and in the remaining sites, moderate level of phosphorus is reported. The soil potassium availability is less than 48 Kg/ac. rated as low, 48 - 113 Kg/ac. rated as medium and above 113 Kg/ac. rated as high. The amount of potassium is moderate in site II and site III, but in the remaining sites (site VI, site VII, site VIII) more amount of potassium is reported. The Fe (iron) concentration below 3.7 mcq./lit. is deficient for luxurious growth of plants. In the present observations the iron concentration is generally more than the critical level. The Mn concentration below 2.0 mcq./lit. is deficient for the normal growth of species. In the present findings the Mn concentrations is above critical level in all the selected sites. The Zn and Cu concentration 1.2 mcq./lit. is the critical in level. In the present observations the soil is deficient of Zn and Cu concentration when compared with the critical level.

Chemical elements in the soil are dissolved in soil solution. Parts of organic matters are adsorbed on the soil particles. Cation exchange capacity and exchangeable bases of the soil is reported in Table 4. Positively charged minerals called cations are stored on the surface of the particles, whereas anions are dissolved in soil water. Plant roots absorb cations by replacing them with hydrogen ions. The total number of negatively charged exchange sites on clay and humus particles that attract positive charged cations is called cation exchange capacity (CEC) [8.9]. In the present findings the exchangeable bases like Na, K, Ca and Mg are high. The negative charges enable the soil to prevent the leaching of cations. Exchange sites are occupied by calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), sodium (Na^+) and hydrogen (H^+). These ions increase the osmotic potential of the soil. So the halophytic plants having high osmotic potential are dominant in all the chosen sites.

Cation Exchange Capacity (CEC) is related to the sum of cations held by the permanent negative charges on the clay particles and the cations held by the organic matter. The CEC concentration is below 5 rated as very low, 5 – 15 low, 15 – 25 medium, 25 – 40 high and 40 very high. In the present observation the CEC concentration is medium in sites: IV, VI, VII and VIII.

Base saturation percentage (B.S.P.) is the proportion of CEC accounted for by the exchangeable bases (Ca, Mg, Na and K). It is used as an indication of soil fertility. In the present observations the B.S.P concentration is high in all the selected sites. Exchangeable sodium percentage (E.S.P.) is the proportion of exchangeable sodium to the CEC of the soil. It indicates the sodic hazard of the soil [10]. In the present findings sites II, IX and X exhibit non-sodic soil, and all the remaining selected sites are sodic soils.

Soil texture is determined by the relative proportion of mineral particles classified as gravel, sand, silt and clay. Texture decides pore space. Coarse textured soils possess

large pore spaces that favour rapid water filtration and rapid drainage. Fine textured soils have high proportion of clay and are poorly aerated [11]. In the present observation, sandy soil was found to favour the growth of xerophytic plants. Sandy loam soil favours the growth of plants having underground storage organs. This may be due to the good aeration and high-water holding capacity of the soil types. Clay loam soil favours the plants requiring more of soil moisture. The sandy loam soil is collected from the Railway tract area, near light house, Theerthapallam, and opp. to Munniappan Lake area have dominant species such as *Memecylon umbellatum, Canthium diccocum, Ochna obtusata, Dryptes sepiaria, Toddalia asiatica, Psvetta indica, Chomelia asiatica, Salacia chinensis, Grewia rhamnifolia, Capparis oppositifolia,* and *Capparis diversifolia.*

Soil organic matter represents an accumulation of partially decayed and partially synthesized plant and animal residues. It is a major soil source of important mineral elements phosphorus, sulphur and nitrogen. It increases the water holding capacity of the soil. It is the main source of energy for soil microorganisms, pl ants and animals. The soil organic matter vary from 2 – 6% by weight is favourable for plant growth. In the present observations the site X has good organic matter deposits (Table: 4). The area is rich with vegetation like *Mimusops elengi, Toddalia asiatica, Tarrena asiatica, Canavalia virosa, Dryptes sepiaria, Lablab purpureus, Capparis diversifolia, Carissa spinarum, Premna serratifolia, Strychnos minor, Cadapa fruticosa and Ficus bengalensis.*

The soil moisture is the percent water content in a field sample at any given time. In the present observations soil moisture is more in the site IX (Table: 2). The soil moisture also depends on the rain fall and wind.

Conclusion

Sandy beaches can be narrow strips backed by coastal forest, or wide with large undulating dunes that have a variety of creepers, grasses, and woody species. Coastal and near-shore marine ecosystems have several unique characters that determine how they behave in the face of disturbance and influence their amenability to restoration efforts. Despite the considerable challenges, the restoration of coastal and near-shore marine environments is widely practiced, and with mixed success. Restoration efforts have been attempted under a range of conditions.

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