# The microbiology of sand-dune eco-systems in the Namib desert.

by

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## S U M M A R Y .

1. A study was undertaken on the microbial populations occurring in the sands of different eco-systems in the dune area of the Namib desert in South West Africa.

2. The literature on the microbiology of desert soils was reviewed, with special reference to the important ecological factors affecting the microflora under these hostile conditions.

3. Samples were taken from a dune near the Desert Research Station at Gobabeb in July, 1968 and December, 1968. Three systems were sampled each time i.e. bare wind-blown sand (designated $DH_sW$); a loose sand covered with detritus (designated DLM) and a stable packed sand, containing clay and pebbles, in the valley at the foot of the dune (designated VG).

4. A physical and chemical analysis of the samples showed a significantly higher organic matter content in the sand covered with detritus than in the other systems. The pH of the valley samples (VG) was higher than that of the others. The moisture content of all the samples was very low.

5. The microbiological analysis undertaken, included direct and plate counts of bacteria and plate counts of fungal propagules. The physiological groups of bacteria in the eco-systems were also enumerated.

6. There was a difference between direct counts and plate counts of bacteria in samples from the different eco-systems and the ratio of direct to plate count was the highest in the wind-blown sand and the lowest in the stable sand systems. This possibly indicated a larger viable population in the latter systems.

7. The wind-blown sand ($DH_sW$) contained significantly lower numbers of nearly all the physiological groups of bacteria-enumerated i.e. spore-formers, ammonifiers, psychrotrophic bacteria, anaerobes and Gram-negative bacteria than any of the other systems examined. It also harboured extremely low numbers of fungal propagules. It harboured higher numbers of thermoduric bacteria than the two other systems, however.

8. The gravelly sand (VG) had the highest number of bacteria, although not always significantly different from the sand containing detritus (DLM). In spite of lower numbers of bacteria in general, the latter eco-system did not differ significantly from the gravelly sand in the numbers of physiological groups of bacteria present. Azotobacter spp. were found to occur in the sand containing detritus (DLM) and the gravelly sand (VG).

9. Strict thermophilic bacteria capable of growing at 60°C were absent from all the eco-systems, but thermoduric bacteria growing at 50°C, occurred in low numbers in all the eco-systems.

10. No nitrifying bacteria were detected in the wind-blown

sand and the gravelly sand (VG), but a slight nitrifying activity occurred in the sand containing detritus (DLM).

11. Bacterial and fungal isolates obtained from the different eco-systems and from fall-out plates (FO), exposed to the atmosphere at the sampling site, were examined and identified to generic level.

12. The following genera of bacteria occurred amongst isolates from the different eco-systems. Pseudomonas (FO and $DH_sW$) Aerobacter (DLM), Bacillus (all systems) Streptomyces (all systems) Micromonospora (FO and $DH_sW$) Micrococcus (all systems except DLM) Streptococcus (DLM) Arthrobacter (all systems) Mycobacterium (DLM).

13. A high proportion of the isolates was Streptomyces spp. and Bacillus spp. The former predominated in the wind-blown sand ($DH_sW$) and the stable gravelly sand (VG). The majority of the isolates from DLM was Bacillus subtilus; very few other Bacillus spp. were observed.

14. Arthrobacter spp. formed part of the population in all systems and a description of an interesting group, germinating by producing buds, was given.

15. Bacterial isolates from all the eco-systems were found to be metabolically very active especially the Bacillus spp. Streptomyces spp. were the only isolates capable of decomposing cellulose. Most isolates were able to hydrolise starch, gelatin and casein and the highest percentage of isolates capable of dissimilating sugars, occurred in the DLM eco-system.

16. The following fungal genera occurred among isolates obtained from the different eco-systems: Alternaria, Aureobasidium (Pullularia), Curvularia, Helminthosporium, Phoma, Chaetomium and Fusarium. Dark sterile mycelia were also observed. The sand containing detritus harboured mostly Aureobasidium spp. and pigmented yeast-like fungi. Most of the fungal isolates were capable of degrading cellulose.

17. The respiratory activity of samples from the different eco-systems were ascertained for unamended (endogenous) and samples amended with substrates.

18. The wind-blown sand showed no notable respiratory activity probably due to the extremely low numbers of micro-organisms.

19. The microbial population in the sand containing detritus (DLM) showed a better ability to utilise ethanol and glucose. It also oxidised casamino-acids well. This indicated a zymogenic microbial population in this eco-system. However, a longer lag period was required in the case of casamino-acid utilization by the microflora in this eco-system, than that in the VG system.

20. The stable gravelly sand (VG) had a higher endogenous respiration than the other systems. The microbial population in this eco-system was slightly better adapted for utilizing casamino-acids.