# Long-term analysis of the role of *Traganum moquinii* plants in the foredune formation of an arid dunefield (Maspalomas, Gran Canaria, Canary Islands)

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## INTRODUCTION

Foredunes of arid dunefields have been hardly studied. They present significant differences with respect to the foredune of other climatic zones. ***Traganum moquinii*** is the predominant plant species in the foredune of arid dunefields around the Canary Islands (including South Morocco, Mauritania and other close archipelagos, like Cape Verde). This bush species plays an important geomorphological role: its interaction with the aeolian sedimentary processes generates nebkhas, shadow dunes and arid parabolic shape dunes. In Maspalomas is located a example of this arid foredune. However, the touristic devolpment in last decades have produced as result an altered system (Figure1 and 2)

**Figure1. Nebkha with *Traganum moquinii* and some human impacts**

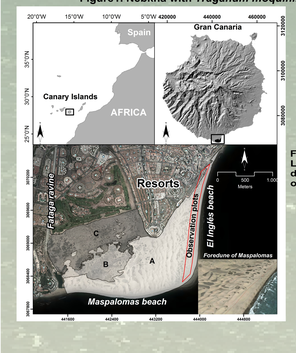



**Figure2. Location of Maspalomas, urban-touristic development around of the dunes system of Maspalomas and the observation plots.**

**A: Active area**

**B: Semi-stabilized area**

**C: Stabilized area**

## METHODOLOGY

The objective of this work is to show the morphometric evolution of the foredune of an arid dunefield of the Canary Islands, Maspalomas (Gran Canaria), as well as explain the function of ***Traganum moquinii*** on it. The next historical aerial photography, ortophotos and WMS service were used:

| Date | Scale | Spatial resolution (m) | RMS (m) | Error Delineation (m) |
|---|---|---|---|---|
| 03/1961 | IdeCanarias´s WMS service | 0.12 | * | 1.2 |
| 03/1977 | 1:6,500 | 0.9 | 1.54 | 1.3 |
| 03/1987 | 1:5,000 | 0.15 | 1.05 | 1 |
| 03/2003 | * | 0.15 | * | 0,15 |
| 04/2012 | IdeCanarias´s WMS service | 0.25 | * | 0.25 |

Ten observation plots were designed along El Inglés beach and all the ***Traganum moquinii*** plants were identified on them. The next variables were measured using GIS:

**Morphometric variable**

- Number of Nebkhas, according to the total number of *Traganum moquinii.*

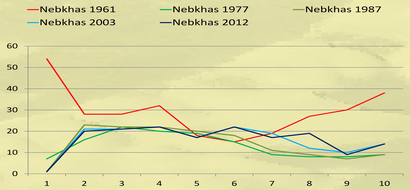
**Morphologic variables of *Traganum moquinii***

- Density of *Traganum moquinii* individuals in each plot
- Mean distance between *Traganum moquinii* individuals in each plot
- Number of *Traganum moquinii* individuals in line one
- Mean diameter of *Traganum moquinii* individuals in line one
- Mean distance between *Traganum moquinii* individuals in line one
- Density *Traganun moquinii* individuals in line one

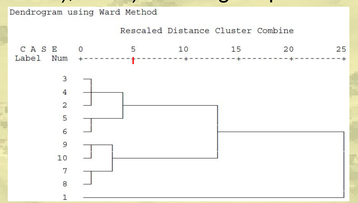

**Figure 3 Observation plots, location and evolution of the number of *Traganum moquinii individuals***

## RESULTS

In the next graphic the evolution of the number of nebkhas in each observation plot, from N to S, is shown. The red line show the number of nebkhas in 1961, the green lines (1977-1987) and the blue lines (2003-2012).




The measured variables were statistically analysed by a cluster analysis, using Ward method. In the next dendrogram the grouping of the observation plots according to the evolution of the variables is shown. Three groups can be separate: 1) represented by the plot 1 (N), 2) with the plots 2 to 6 (central area), and 3) including the plots 7 to 10 (S).




**Correlations between variables**

The variables of the first group's *Traganum moquinni* individuals were not correlationed because this observation plot has not a significative number of *Traganum moquinii* plants. This is due to the human activities: the build of a commercial centre in part of this plot caused the loss of the plants. (Figure 3)

**Group 2 (plots 2-6). Center of the Maspalomas´s Foredune**

| | Nº nebkhas | Density | Dist_between_Tm | Tm_line1 | Diameter_Tm_line1 | Distance_between_Tm_line1 | Density_line1 |
|---|---|---|---|---|---|---|---|
| Nº nebkhas | 1 | ,478(*) | -,484(*) | 0,072 | -0,066 | -0,247 | 0,393 |
| Density | | 1 | -,977(**) | 0,086 | -,515(**) | 0,077 | 0,002 |
| Distance_between_Tm | | | 1 | -0,031 | ,489(*) | -0,004 | -0,046 |
| Tm_line1 | | | | 1 | -,815(**) | -,618(**) | ,571(**) |
| Diameter_Tm_line1 | | | | | 1 | 0,116 | -0,046 |
| Distance_between_Tm_li | | | | | | 1 | -,942(**) |
| Density_line1 | | | | | | | 1 |

**Group 3 (plots 7-10) South of the Maspalomas´s Foredune**

| | Nº nebkhas | Density | Dist_between_Tm | Tm_line1 | Diameter_Tm_line1 | Distance_between_Tm_line1 | Density_line1 |
|---|---|---|---|---|---|---|---|
| Nº nebkhas | 1 | ,780(**) | -,636(**) | ,773(**) | -,446(*) | -0,341 | 0,427 |
| Density | | 1 | -,842(**) | ,891(**) | -,526(*) | -,650(**) | ,710(**) |
| Distance_between_Tm | | | 1 | -,692(**) | ,567(**) | ,768(**) | -,755(**) |
| Tm_line1 | | | | 1 | -,574(**) | -,575(**) | ,626(**) |
| Diameter_Tm_line1 | | | | | 1 | ,448(*) | -0,300 |
| Distance_between_Tm_line1 | | | | | | 1 | -,911(**) |
| Density_line1 | | | | | | | 1 |

*. Significative correlation level 0,05 (bilateral). **. Significative correlation level 0,01 (bilateral).

**Tm: *Traganum moquinii***

## DISCUSSION

The morphometric evolution of the Maspaloma´s foredune has not been homogeneous from N to S. The motives of this differential evolution are different anthropogenic and natural processes. The changes in the number of nebkhas (and *Traganum moquinii* plants) enables to characterize three types of foredune environments, which lie from N to S. In the Group 1 (N) human activities have removed all *Traganum moquinii* individuals. The Group 2 (central area) it is characterized by the stability in the number of nebkhas and *Traganum moquinii* individuals. It can be related with stability of the coastline in this area, studied by other authors. The Group 3 (S) is characterized by the recovery of the number of nebkhas and the *Traganum moquinii* individuals, which disappeared due to factors not studied in detail yet, but attributable to natural processes (variation in the sediments input) as well as to human activities (direct action on the plants by tourists).

Morphological variables measured in the first line of the foredune present significant relationship with the number of nebkhas (morphometric variable) and with the evolution of these variables. These relationships change according to the types of foredune environment group.

## CONCLUSION

Three types of foredune environments have been identified in Maspalomas, considering the variation of the *Traganum moquinii* plants and some morphometric changes. Measured variables in the first line of the foredune present significant relations with the number of nebkhas. The changes detected and the relationships observed between variables are related to natural and antrophogenic processes. This information can be useful for arid coastal dune systems management, as well as for restoration tasks in arid foredunes.

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