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## Coastal Dune Restoration in *El Inglés* Beach (Gran Canaria, Spain): a Trial Study

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### KEYWORDS

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Sand collector  
Arid beach-dune system  
Nebkha

Although the restoration of degraded coastal dune systems has been carried out in many parts of the world, there have been scarcely studies on arid dune systems. Moreover, no specific methodology has been developed for the purposes of restoration in arid foredunes, where the vegetation tends to be shrub species which forms mound dunes (nebkhas). The objectives of foredune restoration include, among others, the supply of sediments to the corresponding beaches, the recovery of morpho-ecological states and sedimentary dynamics, and the restoration of natural vegetation and endemic species. On these basis, ecological restoration techniques allow the dune formation from the recovery of geomorphological and ecological processes. For this, native dune-building species that accumulate sand while consolidating the dune that is being formed can be planted, or sand can first be accumulated with passive collectors with revegetation taking place later.

Bearing in mind the objective of improve and adapt methodologies for the ecological restoration of foredunes in arid systems, this research presents a first exploration in the results of the scientific monitoring of a trial study of foredune restoration on *El Inglés* beach (Gran Canaria, Spain).

*El Inglés* beach is located in the southern vertex of the island of Gran Canaria. It is aligned in a north-south direction, from the cliff of the *El Inglés* upper terrace to *La Bajeta* tip, and is the area that mainly supply of



sediment to the *Maspalomas* dunefield. The foredune is constituted by specimens of the *Traganum moquinii* shrub, that act as a dune-builder species which are responsible of the first natural retention of the sediments that advance inland. The growth of this species is stimulated by sand burial, favoring the formation of mound dunes that regulate the aeolian sedimentary transport into the dune system and promote the formation of barchan dunes and barchanoid ridges. This beach, located in the eastern boundary of the dunefield, is an area of considerable recreational activity and one of the main touristic development areas on Gran Canaria island, so its foredune had been consequently impacted by this intensive human activity. These impacts have led the deterioration and fragmentation of the foredune of *El Inglés* beach, which presents discontinuities due to the decrease in the number of *T. moquinii* specimens and the disappearance of the associated dunes.

To deal with this problem, a trial study to relocate 60,000 m<sup>3</sup> of sand from the tip of *La Bajeta* to *El Inglés* beach was initiated in July 2018. This sand relocation was carried out in three phases. The objectives of the project included, as well as the sand relocation, the installation of sand collectors and the reintroduction of *T. moquinii* specimens, some of them associated with sand collectors and others not, which act as builders of new dunes in the foredune. A part of the scientific monitoring of the project was focused on the efficiency of the sand collectors and the evolution of the *T. moquinii* specimens that were planted.

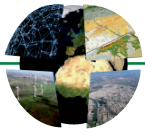
Sand collectors and *T. moquinii* specimens were placed in two zones adjacent to the sand deposit area. To determine the beneficial use or otherwise of sand collectors, different combinations were tested: sand collectors with associated plant specimens (51), and only plants of *T. moquinii* (18). Moreover, two typologies of sand collector were installed to compare their efficiency. On one hand, a tested design comprising two semicircles of wicker rods 2 m apart with two associated *T. moquinii* specimens planted about 2 m from the second row (29). On the other hand, an experimental model comprising a closed circle of wicker rods with a diameter of 2 m with two associated *T. moquinii* specimens planted inside (22). A total of 138 specimens of *T. moquinii* was planted.

The capacity of the sand collectors and the *T. moquinii* specimens for the formation of dunes, as well as the evolution in the state of vitality of the plants, were monitored in the field for 13 months. Measures and observations were carried out with respect to the sand volumes around the plants and sand collectors, and the survival and morphological development of the plants.

The results showed that most of the collector-plant units accumulated sediments, increasing the height of the sand mound associated with its accumulation zone, whereas in the case of *T. moquinii* specimens planted without a sand collector the trend was not so clear and there were differences in behavior depending on the planting zone. In summary, the sediment capture in the elements located in the Zone 2 was higher than in the Zone 1, and the elements located close to the beach accumulated a greater amount of sand than those located in the inner area. Both typologies of sand collector were effective for the generation of mound dunes. The results also evidenced a progressive decrease in the survival rate of the plants, more pronounced in the specimens associated with sand collectors. Nevertheless, the biovolume of *T. moquinii* specimens increased gradually after their planting. However, two periods were identified in which there was a more pronounced decrease in survival rate, probably related to the sand relocation periods.

The rapidly falling survival rate of the planted seedlings during the first months after planting suggests that the introduced plants could have been too small to be introduced into the system. On one hand, they need long roots to ensure rapid and effective rooting for plant stability and the acquirement of the water necessary for its survival. On the other hand, the aerial part of the plant must have sufficient length and size to cope with temporary burial and to ensure its progressive growth and development. The fact that survival was greater in plants not associated to sand collectors suggests the idea of a sudden burial of *T. moquinii* specimens that could promote the drowning of the plants located in the sand collectors, that were unable to cope with sand accumulation. This sand accumulation was also greater after the lack of sediment mobility in the summer season, when effective NE winds do not normally occur. This situation caused a massive entry of sediment into the collector areas after the summer, when effective winds arose again and caused a new sudden burial of collectors and plants.

Valuable conclusions and recommendations can be drawn from this experimental project, not only to restore the coastal dune of *El Inglés* beach but also to be applied to other arid dune systems. These conclusions



recommend the use of circular sand collectors to generate larger and stable mound dunes, as well as the plant of specimens that must be adapted to the conditions of the environment in which they are to be planted. Moreover, it is essential not to accumulate sand from contributions in the relocation area, doing new contributions only when the volume of sand introduced in the previous sand relocation has been completely incorporated inside the system, in order to avoid the sudden burial of collectors and plants. Finally, this research underlines the handicap that the actions of certain users represent for the success of the restoration, and highlights the need to implement a scientific monitoring program in restoration projects that helps the development of a more effective coastal dune restoration protocol applicable in arid dune systems.