Vegetation dynamics within afforested coastal areas: regeneration by native species or invasion by alien species?

**Introduction**

During the last century, massive reforestation projects along the dunes of the southern Sicily have been carried out. Such interventions, far from being in line with the current trends of climate-to-nature transformation, are, however, particularly interesting to assess the vegetation dynamics in afforested areas. Furthermore, these kinds of interventions may determine two opposite effects, that is renaturalization by native woody species or invasion by alien species. Acacia spp. are among the most widespread and prominent invaders within Mediterranean-climate areas, where they have already shown the capability to deeply change the characters and the functioning of native ecosystems (e.g. HELMERS & COLLINS, 1997). For instance, Acacia longifolia (Andrews) Willd. may successfully invade the understory of pine forests, causing the alteration of the water balance and carbon storage of the whole forest ecosystem (RASCHER et al., 2011). In Sicily, especially in the last decades, Acacia saligna started to abundantly regenerate in many natural and semi-natural areas, with a stark preference for dune and coastal afforested areas (COLOMBO et al., 2002). This study area reserve “Foce del Fiume Platani” represents an excellent case study in this respect (BADALAMENTI et al., 2013).

**Aims of the study**

The present study aimed at understanding the woody vegetation evolution 16 years after preliminary investigations in the understory of a Mediterranean stone pine (Pinus pinea L.) regeneration. Our investigation was particularly focused on regeneration pattern and invasion process of Acacia saligna (Lahib) J.H.Wendl. and A. longifolia (Andrews) Willd.

**Study Site and Acacia invasion process**

The “Foce Platani” nature reserve is located in the Province of Agrigento, along the south-western coast of Sicily, Italy. The study area falls within the Thermomediterranean upper dry bioclimatic belt. The Reserve hosts diverse vegetation types, including Mediterranean maquis, riparian vegetation and, especially, sand dune vegetation along the coast. Within the Reserve the invasion process by A. saligna has steadily increased in the last 20-30 years. Nowadays, abundant regeneration by Acacia may be observed only within a stone pine plantation in the background.

**Materials and Methods**

The dynamic of woody vegetation within Pinus pinea afforested area was evaluated by comparing the results of surveys carried out in 2001 over two 450 m² circular plots with new surveys carried out on January 2017 over three 481 m² square plots. An additional area was considered in 2017 in order to take into account the particularly abundant natural regeneration. Renovation by woody species was assessed within four 5x3 m² subplots in each plot. The following parameters were surveyed:

1) canopy trait (Diameter at Breast Height [DBH = D₅₁₆₃, Tree Height]),
2) regeneration abundance (N seedlings or saplings m⁻²),
3) regeneration development (Diameter at root collar, height of the largest saplings).

**Results**

Acacia density has more than quintupled in just sixteen years, reaching up to 10,800 individuals per hectare. However, native species such as Pinus halepensis L. and Olea europaea var. sylvestris Mill. also displayed a notable density change. Pinus density increased up to 9 times, reaching a maximum density of 9,300 individuals per hectare, whereas Olea density increased as much as 800 times, with a maximum density of 120,000 individuals per hectare. The preliminary investigations showed that only about 15% of light was available in the understory of the pine plantation.

**Invasive pattern**

Some Acacia individuals reached the upper layer of the forest canopy thus representing nowadays the dominant tree species in some areas.

**Management of the key**

In such extremely dynamic situations, light availability has a prominent role in driving regeneration pattern. Forest management plays a key role. Localized interventions only where native species occur may favor the renaturalization process. By contrast, thinning seems to foster Acacia invasion and its rapid spread where this species is present.

**Conclusion**

The Invasion process - Massive natural regeneration by A. saligna in the understory of the stone pine P. pinea has been observed in the Foce Platani reserve in the last 20-30 years.

**Regeneration by native species**

Massive regeneration by Olea europaea var. sylvestris and Pinus halepensis was observed especially where thinning was not performed and canopy cover was higher.

**Table 1** - Denominator data of Pinus pinea cover (Mean ± standard deviation; 2001 vs. 2017). For basal area the total amount was considered.

<table>
<thead>
<tr>
<th>Plots</th>
<th>Tree density (N ha⁻¹)</th>
<th>DBH (cm)</th>
<th>Height (m)</th>
<th>Basal Area (m² ha⁻¹)</th>
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<tbody>
<tr>
<td>2001</td>
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**Table 2** - Denominator data of the regeneration layer (Mean ± standard deviation; 2001 vs. 2017).

<table>
<thead>
<tr>
<th>Years</th>
<th>Species</th>
<th>Density (N ha⁻¹)</th>
<th>Δ</th>
<th>Diameter at root collar (cm)</th>
<th>Height (m)</th>
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| thinning effects - The clearing of Pine cover seems to accelerate the development and spread of Acacia saplings.

**Conclusion**

The understory of Pinus pinea seems to offer suitable climatic conditions to facilitate A. saligna regeneration and seedlings establishment, protecting them from marine aerosols and frequent winds. No regeneration time has been observed in the dunes next to the sea. On the other hand, light availability appears to be a key factor to trigger natural regeneration by Acacia in mass and rapid growth. A similar ecological strategy has been found in A. longifolia (RASCHER et al., 2013) and A. dealbata (BANI et al., 2016). The effects of invasion by Acacia saligna on the soil structure and regeneration capacities of South African fynbos shrublands. J. Appl. Ecol., 34: 317-322.


**References**


