Diagnostic of Draa Naga arboretum on the forest of Djebel El Ouahch (north-eastern Algeria)

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Abstract
This study concerns particularly Draa Naga arboretum, created inside the forest station of Djebel El Ouahch (Constantine, east-Algeria) in the fifties. It occupies an area of 31 hectares and is actually managed by the Forest Conservation, it is a valuable tool for education and ecotourism. Until now, no system of measurement or supervision of its viability was created so that the ecological status is unknown at all. Analyses results show a mid viability of the arboretum which is indicated by a medium stability of forests stand’s quality, a high rate of mortality and a very low future potentiality (0% of regeneration). In addition to that, artificial forest suffers from invasion of autochthones species, the principal pressure affecting the arboretum which is placed among forest. Consideration of two dendrologous types of forest’s stand reveals that broadleaved trees ones presents better attribute than conifers. The necessity of a management plan is evident to ameliorate the place and so is a regular survey. For that, a forest management plan is proposed for the arboretum.

Key words: Draa Naga Arboretum, current status, viability, GIS.

1. Introduction
An arboretum is a garden containing a collection of documented woody plants maintained for aesthetic, educational, and scientific purposes. To have any lasting importance, an arboretum must define clearly stated purposes for itself (Hachette, 1994; Andrianandrasana and al., 2005; Roger and al., 2005). Without stated purposes and goals, conflicts may develop between the aesthetic, educational, and research functions and the gardens may become cluttered with haphazard collections (Pieper and Forster, 1993; Rajaonarisoa, 2002). This inevitably destroys the appearance of the landscape that the collections originally were to enhance (Duplat and Perrotte, 1981; Dreux, 1986; Roger and al., 2007).
This study concerns particularly the arboretum of Draa Naga, created inside the forest of Djebel El Ouahch (Constantine, east-Algeria) in the fifties. Actually managed by the Forest Conservation of Constantine, it is a valuable tool for education and ecotourism. Until know, no system of measurement or supervision of its viability was created so that the ecological status is unknown at all. The objectives mainly are to collect data about the current ecological status of the site, to identify monitoring indicators to measure sustainability and, at the last, to include a system of permanent ecological monitoring in a overseeing in a proposal of a management plan for the arboretum. Monitoring is a helpful instrument when analyzing and controlling forest resources. With it, intervention can be more defined and more adapted to the reality (Schatz, 2001 ; Bazin and Barnaud, 2002 ; Sajan, 2006). This research produces a database but it doesn’t consider the entire problem. Thematic maps elaborated with Geographic Information System (GIS) give more information and make the overseeing easier (Hadef and al., 2014).

2. Materiel and methods
2.1. Presentation of the study area
The study area of Draa Naga arboretum (Djebel El Ouahch’s forest) belongs administratively to the province of Constantine (Map 1). It is located between longitude (X1: 6°42’5”, X2: 6°42’30”) and latitude (Y1: 36°20’45”, Y2: 36°22’15”). The estimate terrain elevation above sea level is 950 meters. The relief is characterized by a low slope (3-12%). The drainage system consists of a few ravines and collected by temporary flow regime. Its bioclimatic is semi-arid to sub-humid. The climate of the region Draa Naga is characterized by a hot and dry summer, and a cold and wet winter with an annual rainfall of 700 mm. Soil type of forest station is silico-clay.
2.2. Methodology

Research all existing documentation such as:
- Topographic Maps of the study area at 1/25 000 scale and turn them into digital format by scanning with a scanner.
- Existing thematic maps and old maps of the arboretum.
- Acquisition of a recent satellite image (2014) of the arboretum from Google Earth.

After integrating satellite imagery in the GIS, we conducted a digitalization of 77 parcels of the arboretum. Data entry field in the GIS is made by ARCGIS 10 software by creating an attribute table. This phase is assigned for each plot several fields of information such as plot number, type of existing species, the necessary work, etc... Finally, thematic maps of the arboretum are developed according to the criteria (species, Type) for the three periods (1954-1983-2014).

3. Results and discussion

The installation of Draa Naga arboretum was created by the French during the fifties. In 1954, plots (77) were prepared for planting after tillage. The first plantings were made between 1954 and 1960 with plants and seeds from various sources. In 1960, the first phase of installation could be considered completed on 60 plots. There were at that time about 14 genera, which are as follows: Oaks (5), Pine (7), Eucalyptus (16), Cypress (2), Fir tree (10), Alder (2), ash (2), Japanese Sophora, Melia, Acacia, Cedar, Hackberry, white birch (map 2).

The proportional circle of Draa Naga arboretum provides information on the distribution of 9 families of species in 1954 (Figure 1); there’s a dominance of the Myrtaceae (20) and Pinaceae (20) and come at last position the Meliaceae and Ulmaceae families with one plot. 17 plots were unexploited.

Figure 1. Presentation of families of Draa Naga arboretum (1954).

The arboretum is classified by type of forest species: Hardwood or softwood (Map 3). The plot plan of the Draa Naga arboretum shows that it’s dominated by hardwoods.
In 1967, a diagnosis of the arboretum indicates that 8 plots planted in 1954 were completely degraded (14, 16, 17, 20, 23, 24, 28 and 49). The characteristics of the new species planted in these plots are shown in Table 1. The most dominant families are Myrtaceaes and Pinaceaes. There is a decrease in the number of undeveloped plots compared to 1954.

Table 1. The characteristics of the new species planted in 1967.

<table>
<thead>
<tr>
<th>N°</th>
<th>Species (1954)</th>
<th>Degradating factors</th>
<th>Species (1967)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Abies normandiana</td>
<td>Not resistant to drought</td>
<td>Pinus canariensis</td>
</tr>
<tr>
<td>16</td>
<td>Pinus caribae</td>
<td>Cannot stand the cold; not resistant to drought</td>
<td>Eucalyptus brockcwayi</td>
</tr>
<tr>
<td>17</td>
<td>Juglans nigra</td>
<td>Very susceptible to spring frosts and wind</td>
<td>Pinus patula</td>
</tr>
<tr>
<td>20</td>
<td>Thuja plicata</td>
<td>Not resistant to drought or frost</td>
<td>Eucalyptus pauciflora</td>
</tr>
<tr>
<td>23</td>
<td>Pinus palustris</td>
<td>Quite sensitive to cold winter</td>
<td>Pin brutia de Grèce</td>
</tr>
<tr>
<td>24</td>
<td>Picea sitchensis</td>
<td>It is very concerned drought; It is very sensitive to wind and spring frosts</td>
<td>Cupressus Atlantica</td>
</tr>
<tr>
<td>28</td>
<td>Abies pinsapo</td>
<td>Not resistant to low temperatures and do not withstand frost winter</td>
<td>Pinus radiata</td>
</tr>
<tr>
<td>49</td>
<td>Alnus incana</td>
<td>Gasoline semi-shade tolerant</td>
<td>Pinus jefferyi</td>
</tr>
</tbody>
</table>

In 1983, the arboretum has undergone a complete renovation (silviculture, planting, repopulation ...). Map 4 shows the state of the arboretum in 1983. The Pinaceaes are the most dominant followed by the Myrtaceaes and degraded plots. In 1982, it was noted that there's equivalence between conifers and hardwoods (Map 5).
We identified six types during field visit which are: Pine, Oak, Cedar, Cypress, Eucalyptus and Acacia. Thus, the arboretum is strongly affected by repeated previous years and partially abandoned fires. A preliminary diagnosis of the current state of the arboretum gave the map 6.

The proportional circle of families of Draa Naga arboretum shows there is a disappearance of four families compared with 1983 when there were 12 families and a degradation of 39% of the plots (Figure 2). This degradation is mainly caused by repeated fires, drought, frost, and total abundance (dark decade). The hardwoods appear tinted compared to softwood (Map 7).

After 60 years of its inception, the arboretum is totally degraded. Downside risks are various such as, human activities, cold, drought, heat, frost and fire. Hardwoods have dominance over softwood (Map 7). The frequency of severe winters and minimum temperatures are important for foreign plants in the region. These winters have a drastic selection of the collections by eliminating all species that are not adapted to these extreme cold. Contrary, summer can be marked by the periods of very high temperatures. The fires have affected the arboretum in 1958 and caused a notable damage. Drought causes severe damage to spring planting as a result of the imbalance between transpiration and absorption. Snowfalls are relatively common in the arboretum, which cause serious damage.

Figure 2. Presentation of families of Draa Naga arboretum (2014).
Conclusion

Even if the studied sample was established to represent as much as possible all the species of the arboretum, some questions couldn’t be answered because several mosaic of artificial forests’ stand with different woods species compose the arboretum and each species has got their own particularity. Permanent observation’s plots could just be placed as reference (current status) but it is obvious that an integral overseeing and a pack action are necessary to preserve the viability of the arboretum.

References


