ASSESSMENT OF INVASIVE ALIEN SPECIES IN DEHRADUN

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ABSTRACT

Invasive alien species represent a major disruption for all biotic systems including terrestrial and aquatic, managed and wild. Invaders can have enormous economic and human health impacts as well as degrading many system properties that society values, including biodiversity. The frequency, density, abundance, relative frequency, relative density, dominance, relative dominance and Important – value index of the recorded invasive species has been recorded. A total of 17 invasive species were found in the study sites which were highly invasive. In both study sites, Lantana Camara was the most dominant invasive species. The study concludes that the impacts of invasive plant species may be more severe as they increase both in numbers and extent, and as they compete for diminishing resources such as water and soil minerals. This affects the multiple roles of ecosystems in providing provisioning, regulating, supporting and cultural services.

KEYWORDS: Invasive Alien Species, Lantana Camara, Relative Frequency, Important – Value Index

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INTRODUCTION

The introduction and spread of exotic invasive species into human-influenced and natural environments has gained increasing attention globally. Biological invasions may be considered as a form of biological pollution and significant component on human-caused global environmental change and one of the major causes of species extinction. IUCN (2000) defines IAS as an alien species, which becomes established in natural or semi – natural ecosystems or habitat, an agent of change, and threatens native biological diversity. IAS occurs in all major taxonomic groups. IAS can modify the structure and species composition of ecosystems by establishing effective populations with appreciable growth rates enough to displace elements of native biota or to change disturbance regimes, thereby potentially modifying ecosystem structure and functioning, or by outcompeting native inhabitant for resources by changing the path through which nutrients are cycled in the system. IAS is a threat to the environment, economy and human welfare. It also affects the biodiversity, replaces important native species and increases investment in agriculture and silviculture, disturbing the existing vegetation dynamics and biogeochemical cycling.
Major causes of spread and invasion of alien species observed by local communities were modes of plant reproduction, large number of seed production, plant allelopathy, etc. as biotic factors and wind dispersal mechanism, land use change, depopulation, road and transportation, etc. were abiotic factors. Small seeds, wind dispersal, plant with high competitive ability, etc. are other important factors that accelerate plant introduction and establishment.

MATERIALS AND METHODS

Field work was conducted from March to June 2014. Intensive field studies were conducted to record the number of Invasive species in within the study sites. Quadrate method was used to sample the vegetation, size of quadrat used during the study was 5m x 5m followed Misra (1968), this standard quadrat size was found sufficient to enumerate shrubs and herbaceous plants respectively. 10 number of quadrates were laid as in Site - I (Dhoolkot – forest Reserve) and in Site - II (Selequi) 10 quadrates were laid to enumerate the entire shrubs and herb layer respectively.

Individuals between 10.5 to 31.5cm CBH (circumference at breast height i.e., 1.37 cm above ground level) were recorded as shrubs and individuals less than 10.5cm CBH were considered as herbaceous plant (Knight, 1963).

Frequency

Frequency refers to the degree of dispersion of individual species in an area and is usually expressed in terms of percentage occurrence. It can be calculated as:
Assessment of Invasive Alien Species in Dehradun

Density

It represents the relative abundance of a species in a community. It gives an area of numerical strength of a species and degree of competition. It can be calculated as:

\[
\text{Density (D)} = \frac{\text{Total no. of individuals of a species in all the quadrates}}{\text{Total no. of quadrates studied}}
\]

Abundance

Abundance is an ecological concept referring to the relative representation of a species in a particular ecosystem. It is usually measured as the large number of individuals found per sample. It can be calculated as:

\[
\text{Abundance (A)} = \frac{\text{Total no. of individuals of a species in all the quadrants}}{\text{Total no. of quadrates in which species occurred}}
\]

Relative frequency (RF) = \( \frac{\text{Frequency of the species}}{\text{Frequency of all the species}} \times 100 \)

Relative density (RD) = \( \frac{\text{Density of the species}}{\text{Density of all the species}} \times 100 \)

Basal Area

This is regarded as an Index of dominance of a species. Higher the basal area, greater is the dominance and this is calculated by the term of relative dominance.

\[
\text{Rel. Dom (RDom)} = \frac{\text{Total basal area of the species in all quadrats}}{\text{Total basal area of all species in all the quadrats}} \times 100
\]

A total picture of the ecological status of a species with respect to a particular community structure can be obtained only after calculating the values of RF, RD, RDom. These values when added together given the importance value index (IVI) based on which an association is derived and can interpret the impact of Forest Invasive Species on the other species with respect to their IVI values. Thus the IVI as such gives the total picture of sociological structure of a species in a community.

RESULTS

A total of 17 invasive species were found in the study sites. Out of 17 species, 9 species were recorded in site – I(Dhoolkot – forest Reserve) and 8 species in site - II(next to the Suvarna River - Selequi). In both study sites, Lantana Camara, Ageratum Conyzoides, Solanum Torvum, Ageratina adenophora, Parthenium hysterophorus, Ziziphus xylopyrus were found. Lantana Camara was found to be the most dominant species in both study sites. The fallow lands and less attended agricultural plots were invaded by invasive aliens particularly by Lantana Camara, in site – II (next to the Suvarna River - Selequi) at lowlands and at higher elevations along roads in site – I(Dhoolkot – forest Reserve).
Site - I (Dhoolkot – Forest Reserve)

Dhoolkot - forest reserve is located 14 Km towards west from District head quarters Dehradun. The study site was located at 30°21’6”N 77°53’31”E, a secondary forest dominated by Sal trees (Shorea robusta). The following invasive species were recorded in the study site – I (Table 1, Shows the frequency, density, abundance, relative frequency, relative density, dominance, relative dominance and Important – value index of the recorded invasive species.):

- Clerodendrum infortuantum
- Lantana Camara
- Ageratum Conyzoides
- Oxalis Corniculata
- Compositae Eupatorium adoratum
- Solanum Torvum
- Ageratina adenophora
- Parthenium hysterophorus
- Ziziphus xylopyrus

Maximum frequency (80%), density (7.8), abundance (9.7), Relative frequency (14.3), relative density (18.5) and IVI (61.62) was recorded in Clerodendrum infortuantum. Maximum dominance (152.50) and relative dominance (34.04) were recorded in Lantana Camara. Minimum frequency (40%), density (1.8), abundance (4.5), Relative frequency (7.1), relative density (4.3) and IVI (15.02) was recorded in Ziziphus xylopyrus. Lowest Dominance and relative dominance were recorded in Oxalis Corniculata with values 0.60 and 0.13 respectively.

Site - II (Next to the Suvarna River - Selaqui)

The study site is situated next to the Suvarna River, Selaqui and is surrounded by greenery on all sides. The following invasive species were recorded in the study site – II (Table 2, Shows the frequency, density, abundance, relative frequency, relative density, dominance, relative dominance and Important – value Index of the recorded invasive species.)

- Argemone mexicana
- Parthenium hysterophorus
- Ageratum conyzoides
- Solanum torvum
- Lantana camara
- Ziziphus xylopyrus
- Ageratina adenophora

Maximum frequency (70%), density (7.2), abundance (10.3), Relative frequency (17.9), relative density (25.9)
were recorded in *Parthenium hysterophorus*. Maximum dominance, relative dominance and IVI were recorded in *Lantana camara* with values 131.99, 40.16 and 74.26 respectively. Minimum frequency (40%), density (2.3), Relative frequency(10.3), relative density(8.3) were recorded in *Ziziphus xylopyrus*. Lowest Dominance (15.74) and relative dominance (4.79) were recorded in *Ageratina adenophora*. Lowest IVI was recorded in *Ziziphus xylopyrus* (23.63)

Table 1: Shows the Frequency, Density, Abundance, Relative Frequency, Relative Density, Dominance, Relative Dominance and Important – Value Index of the Recorded Invasive Species in Dhulkot – Forest Reserve

<table>
<thead>
<tr>
<th>Name of the Species</th>
<th>F (%)</th>
<th>d</th>
<th>A</th>
<th>RF</th>
<th>Rd</th>
<th>D</th>
<th>RDom</th>
<th>IVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clerodendrum infortuantum</td>
<td>80</td>
<td>7.8</td>
<td>9.7</td>
<td>14.3</td>
<td>18.5</td>
<td>129.10</td>
<td>28.82</td>
<td>61.62</td>
</tr>
<tr>
<td>Lantana Camara</td>
<td>60</td>
<td>5.7</td>
<td>9.5</td>
<td>10.7</td>
<td>13.5</td>
<td>152.50</td>
<td>34.04</td>
<td>58.24</td>
</tr>
<tr>
<td>Ageratum conyzoides</td>
<td>70</td>
<td>6.1</td>
<td>8.7</td>
<td>12.5</td>
<td>14.5</td>
<td>18.01</td>
<td>4.02</td>
<td>31.02</td>
</tr>
<tr>
<td>Oxalis corniculata</td>
<td>70</td>
<td>6.0</td>
<td>8.5</td>
<td>12.5</td>
<td>14.2</td>
<td>0.60</td>
<td>0.13</td>
<td>26.83</td>
</tr>
<tr>
<td>Eupatorium adenophorum</td>
<td>70</td>
<td>5.0</td>
<td>7.1</td>
<td>12.5</td>
<td>11.9</td>
<td>10.95</td>
<td>2.44</td>
<td>26.84</td>
</tr>
<tr>
<td>Solanum torvum</td>
<td>60</td>
<td>2.9</td>
<td>4.8</td>
<td>10.7</td>
<td>6.9</td>
<td>54.06</td>
<td>12.07</td>
<td>29.67</td>
</tr>
<tr>
<td>Ageratina adenophora</td>
<td>60</td>
<td>4.0</td>
<td>6.7</td>
<td>9.5</td>
<td>7.5</td>
<td>17.33</td>
<td>3.87</td>
<td>24.07</td>
</tr>
<tr>
<td>Parthenium hysterophorus</td>
<td>50</td>
<td>2.8</td>
<td>5.6</td>
<td>8.9</td>
<td>6.7</td>
<td>49.17</td>
<td>10.98</td>
<td>26.58</td>
</tr>
<tr>
<td><em>Ziziphus xylopyrus</em></td>
<td>40</td>
<td>1.8</td>
<td>4.5</td>
<td>7.1</td>
<td>4.3</td>
<td>16.24</td>
<td>3.62</td>
<td>15.02</td>
</tr>
</tbody>
</table>

F-Frequency, d- Density, A- Abundance, RF- Relative Frequency, Rd - Relative density, D- Dominance, RDom- Relative Dominance, IVI- Important value index.

Table 2: Shows the Frequency, Density, Abundance, Relative Frequency, Relative Density, Dominance, Relative Dominance and Important – Value Index of the Recorded Invasive Species in Suvarna River- Selaqui

<table>
<thead>
<tr>
<th>Name of the Species</th>
<th>F (%)</th>
<th>d</th>
<th>A</th>
<th>RF</th>
<th>Rd</th>
<th>D</th>
<th>RDom</th>
<th>IVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argemone mexicana</td>
<td>60</td>
<td>2.9</td>
<td>4.8</td>
<td>15.4</td>
<td>10.4</td>
<td>57.87</td>
<td>17.60</td>
<td>43.40</td>
</tr>
<tr>
<td>Parthenium hysterophorus</td>
<td>70</td>
<td>7.2</td>
<td>10.3</td>
<td>17.9</td>
<td>25.9</td>
<td>33.99</td>
<td>10.34</td>
<td>54.14</td>
</tr>
<tr>
<td>Ageratum conyzoides</td>
<td>50</td>
<td>3.7</td>
<td>7.4</td>
<td>12.8</td>
<td>13.3</td>
<td>17.30</td>
<td>5.26</td>
<td>31.36</td>
</tr>
<tr>
<td>Solanum torvum</td>
<td>60</td>
<td>2.6</td>
<td>4.3</td>
<td>15.4</td>
<td>9.4</td>
<td>55.26</td>
<td>16.81</td>
<td>41.61</td>
</tr>
<tr>
<td>Lantana Camara</td>
<td>60</td>
<td>5.2</td>
<td>8.7</td>
<td>15.4</td>
<td>18.7</td>
<td>131.99</td>
<td>40.16</td>
<td>74.26</td>
</tr>
<tr>
<td>Ziziphus Xylopyrus</td>
<td>40</td>
<td>2.3</td>
<td>5.7</td>
<td>10.3</td>
<td>8.3</td>
<td>16.54</td>
<td>5.03</td>
<td>23.63</td>
</tr>
<tr>
<td>Ageratina adenophora</td>
<td>50</td>
<td>3.9</td>
<td>7.8</td>
<td>12.8</td>
<td>14.0</td>
<td>15.74</td>
<td>4.79</td>
<td>31.59</td>
</tr>
</tbody>
</table>

F-Frequency, d- Density, A- Abundance, RF- Relative Frequency, Rd- Relative density, D- Dominance, RDom- Relative Dominance, IVI- Important value index.
Figure 3: R, RDom and IVI of the Invasive Species in Site – I

Figure 4: RF, Rd, RDom and IVI of the Invasive Species in Site - II
DISCUSSIONS

A total of 17 invasive species were found in the study sites which were highly invasive. In both study sites, Lantana Camara was the most dominant invasive species. In site - II (next to the Suvarna River - Selaqui), the fallow lands and less attended agricultural plots were most invaded by Lantana Camara and in site – I (Dhoolkot – forest Reserve) at higher elevations along roads were most invaded by it. The extent to which these introduced species may proliferate and spread is affected by the state of the receiving ecosystem. These invasive species may find a vacant niche and spread, or it may compete for one already occupied by a native species. Some IAS proliferates because they find no natural enemies in their new habitat. Although some species have invaded habitats on their own, human activity such as exploration, colonization, trade and tourism may have dramatically increased the diversity and scale of invasions by invasive species. It was revealed that climate change and invasive species present two of the greatest threats to biodiversity and the provision of valuable ecosystem services. Climate change contributes to erratic rainfall, drying up of local springs and streams, adjustment of species distribution, phenology and morphology, shift in agriculture calendar, emergence of invasive species and outbreak of diseases and pests, etc. Climate change impacts, such as warming temperatures and changes in CO2 concentrations, may increase opportunities for introduction of invasive species because of their adaptability to disturbance and to a wider range of bio-geographic conditions and environmental controls.

CONCLUSIONS

It is determined that biological invasions can have strong effects on structure and function of ecosystems that responds to a changing climate and climate change is also responsible for determining the potential of invasive species to succeed or fail. The impacts of invasive plant species may be more severe as they increase both in numbers and extent, and as they compete for diminishing resources such as water and soil minerals. This affects the multiple roles of ecosystems in providing provisioning, regulating, supporting and cultural services. Whatever the cost may be, the unintended spread of invasive species remains unabated, inspite of the earnest efforts are being made to manage them. In both study sites, some or all of these factors will be at play in varying degrees, leading to the rampant spread and prevalence of invasive species. The relationship is a very complex one, and these results indicate some directions for further research into the mechanics of alien species invasion. Therefore, extensive and intensive research should be promoted.

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REFERENCES


