INTRODUCTION

Sacred groves are patches of native vegetation traditionally protected by local communities, and are unique, and significant, examples of in situ biodiversity conservation (Sunita & Rao 1999; Upadhaya et al., 2003). The nature of religiousness associated with sacred groves suggests that the practice of sacred groves dates back to the nomadic hunter-gatherer age of human history (Gadgil & Vartak 2004). Around 14,000 sacred groves have been reported from all over India, which act as reservoirs of rare fauna, and more often rare flora, amid rural and even urban settings. Experts believe that the total number of sacred groves could be as high as 100,000. India is believed to have nearly 14,000 sacred groves, which act as the valuable gene pool. They give much ecological and genetically significance and play an important role in wildlife conservation also.

STUDY AREA

Borra caves sacred grove is located in Anantagiri Mandal and Sunkarimetta Reserved Forest, is one of the rich biodiversity areas in the Eastern Ghats of India. It falls in the State of Andhra Pradesh. William King, the British geologist discovered the cave in 1807. It is a naturally formed cave believed to be 150 million years old. It lies between 18°16’50.50” North latitude and 83° 2′21.43” East longitude and at an altitude ranging from 800 to 926 m. The vegetation type is mixed dry deciduous with semi evergreen species. The name of local god is sivalingam is located inside the caves and local festival is holding during sivarathri.

MATERIAL METHODS

Phytosociological studies were carried out during year 2017-2018 at Anathagiri Mandal, Borra Sacred Grove, Visakhapatnam District, Andhra Pradesh.
The following phytosociological parameters were undertaken for the study. Density, Relative Density, Frequency, Relative Frequency, Abundance, Relative Dominance, IVI (Importance Value Index). IVI is the sum total of Relative Density, Relative Dominance and Relative Frequency for a species were estimated. Collected specimens were made into herbarium as per the methods suggested by Jain & Rao (1977). The collected specimens were identified only after a critical examination with the help of different floras like Flora of the Presidency of the Madras (Gamble & Fischer 1915–1936), Flora of Visakhapatnam District (Rao & Kumari 2002–2008), and Flora of Vizianagaram District (Venkaiah 2004). The voucher specimens were deposited at the Botany Department Herbarium (BDH), Andhra University, Visakhapatnam.

RESULT AND DISCUSSION

The type of vegetation is mixed dry deciduous forest. It has 31 species, 28 genera and 20 families with 59 stems per 0.5 ha -1. The total basal area of this site is 4.080346912 m² ha⁻¹, with a maximum contribution by girth classes 61-90cm and >150cm). Basal area and tree density are correlated against each other (Fig 1), the stand density is more for small stemmed individuals (31-60cm) and (61-90cm).

Figure 1: Top Ten Basal Area in Site

Figure 2: Top Ten IVI Species in Site

Table 1: Important Value Index (IVI) of Borra Sacred Grove

<table>
<thead>
<tr>
<th>S. NO</th>
<th>Name of the plants</th>
<th>Family</th>
<th>T1</th>
<th>T2</th>
<th>T NI</th>
<th>D</th>
<th>F</th>
<th>BA</th>
<th>RD</th>
<th>RF</th>
<th>RBA</th>
<th>IVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anogeissus latifolia</td>
<td>Combretaceae</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>100</td>
<td>0.073798</td>
<td>6.77966</td>
<td>4.3478</td>
<td>205</td>
<td>12.936</td>
<td>12097</td>
</tr>
<tr>
<td>2</td>
<td>Artocarpus heterophyllus</td>
<td>Moraceae</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>50</td>
<td>0.050922</td>
<td>1.69491</td>
<td>2.1739</td>
<td>536</td>
<td>6.77966</td>
<td>4.3478</td>
</tr>
<tr>
<td>3</td>
<td>Bauhinia racemosa</td>
<td>Caesalpiniaceae</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>0.049657</td>
<td>1.69491</td>
<td>2.1739</td>
<td>861</td>
<td>1.80863</td>
<td>12097</td>
</tr>
<tr>
<td>4</td>
<td>Buchanania lanzan</td>
<td>Anacardiaceae</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1.5</td>
<td>0.074681</td>
<td>100</td>
<td>4.3478</td>
<td>2609</td>
<td>1.24800</td>
<td>34413</td>
</tr>
<tr>
<td>5</td>
<td>Callicarpa tomentosa</td>
<td>Verbenaceae</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>0.024069</td>
<td>296</td>
<td>4.3478</td>
<td>2609</td>
<td>1.27387</td>
<td>44289</td>
</tr>
<tr>
<td>6</td>
<td>Canthium dicoccum</td>
<td>Rubiaceae</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>2.5</td>
<td>0.012579</td>
<td>963</td>
<td>1304</td>
<td>377</td>
<td>10.545</td>
<td>10521</td>
</tr>
<tr>
<td>7</td>
<td>Cleistanthus collinus</td>
<td>Euphorbiaceae</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>0.009197</td>
<td>963</td>
<td>2.1739</td>
<td>1304</td>
<td>10.545</td>
<td>10521</td>
</tr>
<tr>
<td>8</td>
<td>Diospyros Montana</td>
<td>Ebenaceae</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>2.5</td>
<td>0.112579</td>
<td>84.7457</td>
<td>4.3478</td>
<td>2609</td>
<td>75906</td>
<td>15.581</td>
</tr>
<tr>
<td>9</td>
<td>Ficus semicordata</td>
<td>Moraceae</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>0.064449</td>
<td>1.69491</td>
<td>1304</td>
<td>15790</td>
<td>1.57950</td>
<td>36031</td>
</tr>
<tr>
<td>10</td>
<td>Ficus benjamina</td>
<td>Moraceae</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>50</td>
<td>0.191160</td>
<td>1.69491</td>
<td>1304</td>
<td>15790</td>
<td>1.57950</td>
<td>36031</td>
</tr>
<tr>
<td>11</td>
<td>Firmiana colorata</td>
<td>Sterculiaceae</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>50</td>
<td>0.114576</td>
<td>1.69491</td>
<td>1304</td>
<td>15790</td>
<td>1.57950</td>
<td>36031</td>
</tr>
<tr>
<td>12</td>
<td>Flacourtia jangomas</td>
<td>Flacourtiaceae</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>0.344525</td>
<td>1.69491</td>
<td>1304</td>
<td>15790</td>
<td>1.57950</td>
<td>36031</td>
</tr>
</tbody>
</table>
13 Gardenia latifolia Rubiaceae 1 0 1 0.5 50 0.050922 979 1.69491 525 2.1739 1304 1.24800 612 5.1168 34413
14 Garuga pinnata Burseraceae 0 1 1 0.5 50 0.160534 691 1.69491 525 2.1739 1304 3.93433 927 7.8031 6757
15 Grewia tilifolia Tiliaceae 1 0 1 0.5 50 0.064449 395 1.69491 525 2.1739 1304 1.57950 773 5.4483 36031
16 Kydia calycina Malvaceae 1 1 2 1 100 0.121873 011 3.38983 051 4.3478 2609 2.98682 964 10.724 48624
17 Mallotus philippensis Euphorbiaceae 1 1 2 1 100 0.049021 324 3.38983 051 4.3478 2609 1.20140 089 8.9390 57483
18 Mangifera indica Anacardiaceae 1 1 2 1 100 0.560351 687 3.38983 051 4.3478 2609 13.7329 423 21.470 59889
19 Murraya paniculata Rutaceae 2 0 2 1 50 0.025310 312 3.38983 051 2.1739 1304 0.62029 804 6.1840 41594
20 Naringia crenulata Rutaceae 0 1 1 0.5 50 0.023201 782 1.69491 525 2.1739 1304 0.56862 278 4.4374 51077
21 Phyllanthus emblica Euphorbiaceae 1 1 1 1 100 0.089910 885 3.38983 051 4.3478 2609 2.20351 08 9.9411 67398
22 Protium serratum Burseraceae 1 1 2 1 100 0.108983 132 3.38983 051 4.3478 2609 2.67092 809 10.408 58469
23 Pterocarpus marsupium Fabaceae 0 1 1 0.5 50 0.071809 357 1.69491 525 2.1739 1304 1.75988 362 5.6287 11919
24 Schleichera oleosa Sapindaceae 1 2 3 1.5 100 0.612070 337 5.08474 576 4.3478 2609 15.0004 485 24.433 02035
25 Stereospermum personatum Bignoniaceae 1 0 1 0.5 50 0.016112 349 1.69491 525 2.1739 1304 0.39487 694 4.2637 05237
26 Syzygium cumini Myrtaceae 1 1 2 1 100 0.269334 819 3.38983 051 4.3478 2609 6.60078 236 14.338 43895
27 Terminalia alta Combretaceae 1 1 2 1 100 0.122740 293 3.38983 051 4.3478 2609 3.00808 474 10.745 74134
28 Terminalia arjuna Combretaceae 0 1 1 0.5 50 0.045957 989 1.69491 525 2.1739 1304 1.12632 553 4.9951 53828
29 Terminalia chebula Combretaceae 1 0 1 0.5 50 0.024069 064 1.69491 525 2.1739 1304 0.58987 788 4.4587 06181
30 Wrightia tinctoria Apocynaceae 1 1 2 1 100 0.031516 55 3.38983 051 4.3478 2609 0.77239 879 8.5100 55381
31 Xyla xylocarpa Mimosaceae 3 3 6 3 100 0.388971 992 10.1694 915 4.3478 2609 9.53281 67 24.050 13432

<table>
<thead>
<tr>
<th>Total</th>
<th>3</th>
<th>2</th>
<th>9</th>
<th>59</th>
<th>29.5</th>
<th>230</th>
<th>4.080346</th>
<th>912</th>
<th>100</th>
<th>100</th>
<th>100</th>
<th>300</th>
</tr>
</thead>
</table>

TNI = Total Number of individuals  
IVI = Important Value Index  
D= Density  
F= Frequency

The IVI of ten most species represent 53% and top ten species of IVI value is shown in Fig-2. Predominant tree is Schleichera oleosa and Xyla xylocarpa and dominant trees are Mangifera indica, Diospyros montana, Syzygium cumini, Anogeissus latifolia and Callicarpa tomentosa. The Shannon index is 3.262, Simpson index is 0.9543, Evenness index is 0.8423 and Menhinick index is 4.036. Among the 20 observed families, Combretaceae with 4 species Euphorbiaceae and Moraceae with 3species each, Anacardiaceae, Burseraceae, Rubiaceae and Rutaceae with 2 species each. In the present forest study sites species richness is correlated with taxonomical studies, most of the trees show random distribution and was lowered when compared that of tropical forests of Indian Eastern Ghats and Western Ghats i.e., the number of species in Nallamalais (69, Sudhakar Reddy et al., 2008), Kolli hills (25-56, Chitti Babu and Parthasarathy, 2000), Kalarayan hills (42-47, Kadavul and Parthasarathy, 1996), the sacred groves of Kerala (14-23, Chandrasekhar and Sankar, 1998), Thirumani Kuzi Sacred grove (38, Parthasarathy and Karthikeyan, 1997), 30 species ha−1 in Nelliampathy (Chandrasekhar and Ramakrishnan, 1994), to 57 species ha−1 in Mylodai area of Courtallum reserve forest (Parthasarathy and Karthikeyan, 1997) and similar to a range of 59-79 species ha−1 in thirty 1 ha plots of tropical evergreen forest, Varagalair, Anamalais (Ayyappan and Parthasarathy, 1999).

CONCLUSION

Proper education should be provided to the people addressing about the need for conserving sacred groves. In the settlement areas, fencing the grove would help in reducing grazing and other human intervention especially, encroaching the grove area. Regeneration of groves by planting native plant species or species similar to that in the nearby groves, may help the survival and growth of many species. Constant grazing, extraction of fuel wood, collection of medicinal plants and non timber forest products causes the degradation of various rare and threatened plants in the sacred grove. This kind of
degraded sacred grove should be immediately restored or regenerated using appropriate technologies and by creating awareness about the significance of sacred groves in the maintenance of biodiversity. Therefore, it is important to take appropriate measures and protect such ecologically important groves.

ACKNOWLEDGEMENTS

The authors are grateful to the Human resource development for giving RJNF, GOI, New Delhi for providing financial support. The authors are thankful to the local people for their cooperation during the study period.

REFERENCE