

**Project Update: October 2019**

## **Vegetation Status of Desa'a Dry Afromontane Forest of Northern Ethiopia**

This second progress report on RSG is a continuation of our first RSG that was sent a month ago. This report emphasised on a detail vegetative survey of the study Desa'a forest that includes its floristic composition, diversity, frequency and evenness using differ indices. It also studied a detail stand structure of the dominant species of the forest for indicating their regeneration, saplings and mature stands for introduction of different community-based conservation interventions.

### **I. Floristic Composition**

Overall, 4327 individuals representing 26 species and 16 families were recorded in the study site (Table 1). Fabaceae was the most dominant family (four species) followed by Apocynaceae (three species) and *Anacardiaceae*, *Ebenaceae* and *Rubiaceae* represented with two species each. All the other families were represented by only one species.

### **II. Diversity and Evenness**

Considering the diversity indices of the Desa'a forest, the Shannon Index value is 2.16 while its Simpson diversity is 0.84 and its evenness is 0.33. The Shannon diversity index is within the normal range of 1.5 to 3.5. Results of the diversity index indicate that the forest is diverse as the Simpson index value is close to one, but the species are not evenly represented as the evenness value is much closer to zero.

**Table 1: Diversity indices of Desa'a Forest**

| <b>Diversity parameters</b> | <b>Minimum</b> | <b>Maximum</b> | <b>Forest Overall</b> |
|-----------------------------|----------------|----------------|-----------------------|
| Number of taxa (S)          | 2              | 12             | 26                    |
| Individuals                 | 13             | 420            | 4327                  |
| Dominance (D)               | 0.25           | 0.69           | 0.16                  |
| Simpson index (1-D)         | 0.31           | 0.75           | 0.84                  |
| Shannon index (H)           | 0.66           | 1.70           | 2.16                  |
| Evenness_e^H/S              | 0.28           | 0.99           | 0.33                  |
| Equitability_J              | 0.39           | 0.99           | 0.66                  |
| Fisher_alpha                | 0.66           | 2.48           | 3.68                  |

### **III. Density, Frequency and Dominance**

The mean density (# trees/ha) of all the woody species recorded in the forest were 167 trees/ha. The nine abundant woody species were *Cadia purpurea* Ait. (1161 trees/ha), *Carissa edulis* Vahl (795 trees/ha), *Juniperus procera* Hochst. ex Endl. (547 trees/ha), *Calpurnia aurea* Benth (417 trees/ha), *Rhus natalensis* Bernh. ex Krauss (359 trees/ha), *Tarchonanthus camphoranthus* 299 (trees/ha), *Maytenus arbutifolia* (Hochst. ex A. Rich.) (174 trees/ha), *Euclea racemosa* Murray subsp. *schimper* (A. DC.) F. White (89 trees/ha) and *Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif. (83 trees/ha). This indicates that the density of the woody species in general is very low.

The relative density of the forest was also in the order of *Cordia purpurea* Ait. (27.89%), *Carissa edulis* Vahl (19.11%), *Juniperus procera* Hochst. ex Endl. (13.15%), *Calpurnia aurea* Benth (10.03%), *Rhus natalensis* Bernh. ex Krauss (8.62%), *Tarchonanthus camphoranthus* (7.19%), *Maytenus arbutifolia* (Hochst. ex A. Rich.) (4.18%), *Euclea racemosa* Murray subsp. *schimperii* (A. DC.) F. White (2.15%) and *Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif. (1.99%). This indicates that the forest is being converted to the early successional shrub *Cordia purpurea* Ait while the original but late successional tree species like *Olea europaea* ssp. *Cuspidata* and *Juniperus procera* Hochst. ex Endl. are under threat.

The five most frequent species were *Rhus natalensis* Bernh. ex Krauss (92%), *Juniperus procera* Hochst. ex Endl. (77%), *Carissa edulis* Vahl (73%), *Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif. (65%) and *Maytenus arbutifolia* (Hochst. ex A. Rich.) (50%) while the least were *Meseguaguh*, *Dabiya*, *Clematis simensis* and *Clusia lanceolata* Jaub. & Spach each with 4% likely of occurrence.

The five most dominant species contributing to more than of 78% of the relative dominance were *Juniperus procera* Hochst. ex Endl. (25.21%), *Cordia purpurea* Ait. (20.27%), *Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif. (14.12%), *Tarchonanthus camphoranthus* (10.61%) and *Carissa edulis* Vahl (8.58%).

#### IV. Importance Value Index

Importance Value Index (IVI) was used to determine the overall importance of each species in the community structure (Table 2). The top five most important species in the current status of Desa'a forest are *Juniperus procera* Hochst. ex Endl. (115%), *Rhus natalensis* Bernh. ex Krauss (109%), *Carissa edulis* Vahl (101%), *Cordia purpurea* Ait. (87%) and *Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif. (81%).

#### V. Stand Structure

Based on the results of the IVI, the population structure of the five (*Juniperus procera* Hochst. ex Endl., *Rhus natalensis* Bernh. ex Krauss, *Carissa edulis* Vahl, *Cordia purpurea* Ait. and *Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif.) very important woody species were evaluated. Accordingly, none of them showed an inverted J curve of population structure indicating the species are at risk if restoration measures are not underway. *Juniperus procera* has a missing diameter class in the larger diameter class and a pick in the middle. The seedling and sapling of the species are very low in stock (5 tree/ha) indicating the recruitment is very low due to overgrazing, erratic rainfall and drought incidence. The reason for the missing in the larger diameter class could be due illegal cutting for house construction, farm implements and household utensils as discussed during our focus group discussions.

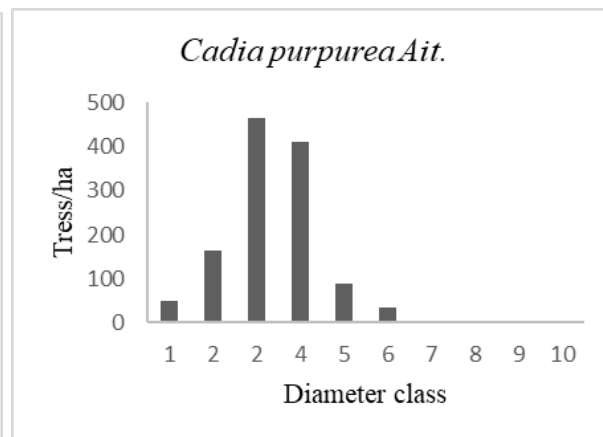
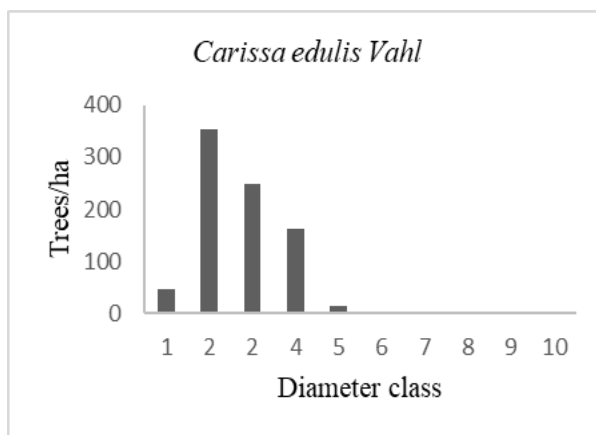
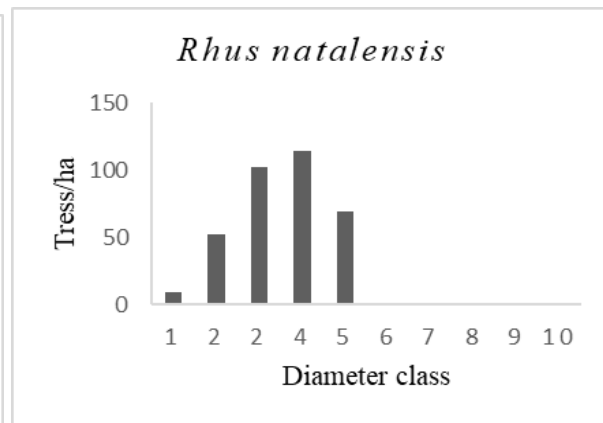
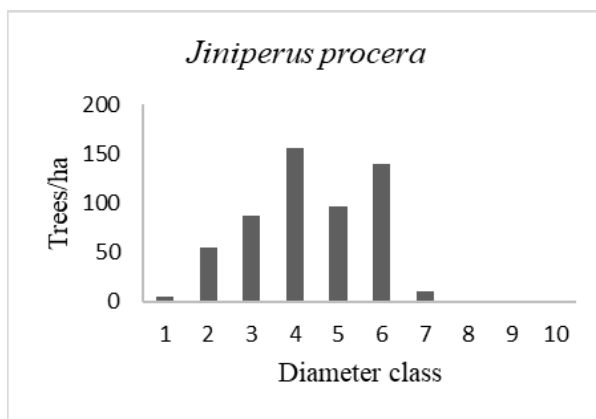
**Table 2: Tree density ha<sup>-1</sup>, Relative Frequency (RF), Relative Abundance (RA), Relative Dominance (RD) and Importance Value Index (IVI) of woody species**

| Scientific Name   | Density (Trees/ha) | Frequency | BA       | RA    | RF | RD    | IVI |
|---|--------------------|-----------|----------|-------|----|-------|-----|
| <i>Juniperus procera</i> Hochst. ex Endl.                               | 547                | 20        | 45388.94 | 13.15 | 77 | 25.21 | 115 |
| <i>Rhus natalensis</i> Bernh. ex Krauss                                 | 359                | 24        | 14775.88 | 8.62  | 92 | 8.21  | 109 |
| <i>Carissa edulis</i> Vahl  | 795                | 19        | 15448.13 | 19.11 | 73 | 8.58  | 101 |
| <i>Cadia purpurea</i> Ait.  | 1161               | 10        | 36505.19 | 27.89 | 38 | 20.27 | 87  |
| <i>Olea europaea</i> L. subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.  | 83                 | 17        | 25431.96 | 1.99  | 65 | 14.12 | 81  |
| <i>Maytenus arbutifolia</i> (Hochst. ex A. Rich.)                       | 174                | 13        | 4692.97  | 4.18  | 50 | 2.61  | 57  |
| <i>Tarchonanthus camphoranthus</i>                                      | 299                | 10        | 19102.31 | 7.19  | 38 | 10.61 | 56  |
| <i>Calpurnia aurea</i> Benth.   | 417                | 10        | 6489.22  | 10.03 | 38 | 3.60  | 52  |
| <i>Euclea racemosa</i> Murray subsp. <i>schimperi</i> (A. DC.) F. White | 89                 | 11        | 2045.24  | 2.15  | 42 | 1.14  | 46  |
| <i>Combretum aculeatum</i>  | 42                 | 10        | 523.17   | 1.02  | 38 | 0.29  | 40  |
| <i>Acokanthera schimperi</i> (A.DC.) Benth. & Hook.f. ex Schweinf.      | 54                 | 7         | 3172.57  | 1.29  | 27 | 1.76  | 30  |
| <i>Acacia abyssinica</i> Hochst. ex Benth.                              | 10                 | 7         | 586.35   | 0.23  | 27 | 0.33  | 27  |
| <i>Rhus retinorrhoea</i> Steud. ex Oliv.                                | 6                  | 4         | 709.22   | 0.14  | 15 | 0.39  | 16  |
| <i>Dodonaea angustifolia</i>  | 50                 | 3         | 1247.65  | 1.20  | 12 | 0.69  | 13  |
| <i>Canthium pseudosetiflorum</i> Ridson.                                | 13                 | 3         | 257.97   | 0.32  | 12 | 0.14  | 12  |
| <i>Psydrax schimperiana</i> (A.Rich.)Bridson                            | 9                  | 3         | 434.56   | 0.21  | 12 | 0.24  | 12  |
| Mai Awlie*  | 8                  | 3         | 1026.32  | 0.18  | 12 | 0.57  | 12  |
| <i>Osyris quadripartita</i> Salzm. ex Decne.                            | 8                  | 3         | 246.84   | 0.18  | 12 | 0.14  | 12  |
| <i>Diospyros abyssinica</i>   | 9                  | 2         | 382.35   | 0.21  | 8  | 0.21  | 8   |
| <i>Buddleja polystachya</i> Fresen.                                     | 4                  | 2         | 546.62   | 0.09  | 8  | 0.30  | 8   |
| <i>Acacia etbaica</i> Schweinf.   | 2                  | 2         | 397.37   | 0.05  | 8  | 0.22  | 8   |
| <i>Teclea nobilis</i> Del.  | 2                  | 2         | 280.46   | 0.05  | 8  | 0.16  | 8   |
| Meseguaguh*   | 13                 | 1         | 98.39    | 0.32  | 4  | 0.05  | 4   |
| Dabiya*   | 6                  | 1         | 232.70   | 0.14  | 4  | 0.13  | 4   |
| <i>Clematis simensis</i>  | 1                  | 1         | 20.35    | 0.02  | 4  | 0.01  | 4   |
| <i>Clutia lanceolata</i> Jaub. & Spach                                  | 1                  | 1         | 7.95     | 0.02  | 4  | 0.00  | 4   |

Similarly, *Rhus natalensis* bernh. Ex krauss, *Carissa edulis* Vahl and *Cadia purpurea* Ait. showed a missing diameter classes in their larger diameter and a low value in their small diameter classes indicating the species have low recruiting of seedling and saplings. The main reason for this could be recurrent drought and free grazing. The missing in the larger class could be due to the plants are either a small trees or shrubs that cannot grow larger than certain diameter limits.

The fifth most important plant, *Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif. also showed unhealthy population structure. It showed the occurrence of individuals in the smaller diameter class, occurrence of very few individuals and a pick in the medium diameter classes.

These unhealthy and unstable stand populations of the pioneer species of the relic Desa'a forest are indicating an urgent introduction of community-based interventions (these prioritized interventions can be seen in the first RSG progress report).



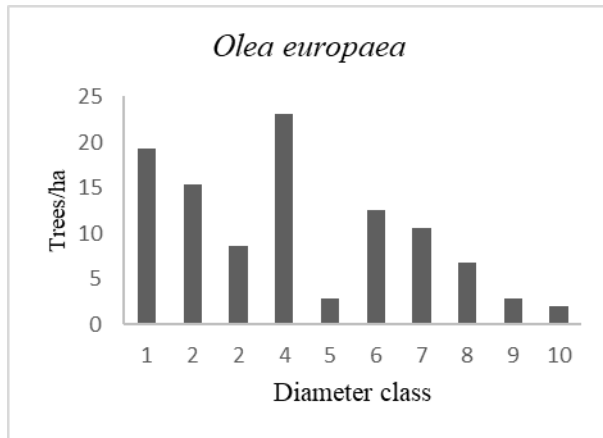


Figure 1: Population structure of selected dominant woody species.

Diameter class's number refers: (1) <2 cm, (2)  $\geq 2 < 4$ , (3)  $\geq 4 < 6$ , (4)  $\geq 6 < 8$ , (5)  $\geq 8 < 10$ , (6)  $\geq 10 < 20$ , (7)  $\geq 20 < 30$ , (8)  $\geq 30 < 40$ , (9)  $\geq 40 < 50$ , (10) >50 cm.



Figure 2: Drivers of deforestation top left) pile of wood ready for house construction; Right & bottom right) fuel wood) gully formation inside the forest and bottom left) free grazing.