Assessment on the status of *Osyris quadripartita* Decn. in Borena, East Shewa, West and East Guji Zones, Oromia region, Ethiopia

Amare Seifu¹, Tamene Yohannes², Fissaha Asmelash³, Ashenafi Ayenew⁴

¹,²Ethiopian Biodiversity Institute, Genetic Resources Access and Benefit Sharing Directorate, Ethiopia
³Forest and Rangeland Biodiversity Directorate, Ethiopia

Corresponding author
Ethiopian Biodiversity Institute, Genetic Resources Access and Benefit Sharing Directorate
Ethiopia
Email: ameseifu21@gmail.com

Article History
Received: 29 October 2019
Accepted: 18 November 2019
Published: November 2019

Citation

Publication License
This work is licensed under a Creative Commons Attribution 4.0 International License.

General Note
Article is recommended to print as color digital version in recycled paper.

ABSTRACT

*Osyris quadripartita*, is an economically important plant species that occurs in most Ethiopian regions, but its population status, threat, habitat preference and its associated plant species have not been studied in Oromia region, Ethiopia. Therefore, the objective of this study was to assess the population status, threat and habitat preference of *O.s quadripartita* and associated species in Borena, East Shewa, East and West Guji Zones of the Oromia region, Ethiopia. Accordingly, the study was conducted in selected nineteen districts within these zones. From the nineteen districts, thirty three forest areas were selected purposively based on the distribution...
of *O. quadripartita*. The data was collected through Participatory Rural Appraisal (PRA) whereby vegetation survey, direct observation and local informants' interviews were conducted. The results showed that over in half of the exploration sites (51.4%), *O. quadripartita* was not found. Only in few areas of the exploration sites (8.1%), *O. quadripartita* was relatively abundant whereas in 24.3% and 16.2% of the exploration sites *O. quadripartita* was found rarely and very rarely respectively. Moreover, most of the areas that *O. quadripartita* was found abundantly were protected areas (community forests, closure areas and state forests). Furthermore, the plant's poor natural regenerative ability from seed and root sucker and dioecious and root hemi parasitic nature may threaten the survival of the plant. As a result of these facts the cultivation of the plant should be encouraged.

**Keywords:** *Osyris quadripartita*, population status, threat, rare and socio economic importance.

1. INTRODUCTION

*Osyris quadripartita* Decn., East African Sandalwood (Santalaceae) is an evergreen, root hemi parasitic, dioecious shrub or tree up to 7 m tall and highly branched. It is most commonly found in Gallery forest *Juniperus, Podocarpus, Combretum* and *Dodonea* woodland, *Erica* scrub, *Acacia nilotica*, *Commiphora* scrub, on rocky slopes or along the margins of dry forest, degraded woodland and scrub; 900 to-2900 m.a.s.l in areas with mean annual rainfall of 600 to 1600 mm. Occurs in most Ethiopian regions, throughout Africa, Southern Asia to China [1,3, 4].

*Osyris quadripartita* is indigenous to east Africa, used for its scented wood and to extract essential oil. The tree is harvested from the wild for local use as a food, medicine and source of wood and materials. The wood is sold locally and also traded internationally for its essential oil which is used in making perfume. The wood is over-exploited in parts of its range despite legal protection. Its numbers have been greatly reduced by overexploitation of its roots, which are the source of an expensive essential oil [2, 3, 4].

*Osyris quadripartita* has recently entered the international market as a substitute of the traditional sandalwood oil originally sourced from Asia and Australia. The oil is useful in perfumery, pharmaceutical and religious practices. The limited supply, coupled with high demand and escalating prices of sandalwood oil from the traditional source countries have led to exploitation of the East African sandalwood as a preferred alternative. This is occasioned by diminishing populations and strict regulations on Australian sandalwood. In India and China, Sandalwood is under State protection and often referred to as sacred tree and harvesting from the wild is prohibited. This has shifted the trade to the East African sandalwood leading to over exploitation of the species in the range States. The exploitation of *O. quadripartita* from Africa could soon drive the species to extinction unless proper control measures are put in place to regulate international trade in the species [5,4].

As a safeguard, populations of the species occurring in eastern Africa have been protected under Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II. This means that, international trade in Sandalwood from these countries is subject to strict regulation in order to avoid utilization incompatible with the survival of the species in the wild. Protection of natural populations will be achieved by setting up a domestication programme where cultivation and harvesting of the species will ease pressure on natural populations while providing income to growers [4,5].

In Ethiopia the population status of *O. quadripartita* is not well studied and unknown. Therefore, the objectives of this exploration were to assess the population status, availability, threat and habitat preference of *O. quadripartita* and associated species in Borena, East Shewa, west and East Guji Zones of Oromia region, Ethiopia.

2. MATERIALS AND METHODS

**Methods of data collections**

The study was conducted in four zones namely: Borena, East Shewa, west and East Guji (figure 1). From the four zones the study was conducted only on nineteen districts. Accordingly, Abaya, Gelana, Melka soda, Telttele, Dillo, Miyo, Moyale, Dahas, Goro-dala, Wadera, Adola, Shakiso, Liben Chqala, Dugida, Bora, Lume, Fentale, Boset and Adama were selected to conduct this assessment study. From nineteen districts, thirty three forest areas (community forests, closure areas and state forests) were selected purposively based on the distribution of *O. quadripartita*. 
These three ways of data collection were used:

**Local informants interview**
Local informants included were:-districts agricultural bureau officials and experts and male and female farmers or pastoralists.

**Direct observation**
The researchers were also observed every forest patch if they were suspected the existence of *O. quadripartita* and check for presence/absence. If the species was present, the researchers were estimated its abundance.

**Vegetation survey**
The closure areas or forest patches identified by the help of informants or found during our random observation and where there seemed to be abundant *O. quadripartita* individuals, the researchers laid twenty nine 20x20 plots and within each plot, the number of *Osyris quadripartita* present was counted so that abundance per hectare was estimated. The sampling method was based on line transect approach and systematic random sampling techniques using one transect line. The assessment was conducted in community forest, communal land and area closures. Two consecutive plots were separated from each other by 100 m. In each plot, the number of *O. quadripartita* was recorded and the associated species also identified and recorded or assessed the abundance and availability of *O. quadripartita*.

**Methods of Data Analysis**
The collected data was analyzed by using SPSS (statistical package for social sciences). A descriptive statistical method was employed to analyze and summarize the data and to calculate percentages, frequency and mean.

3. RESULT AND DISCUSSION
In a little above half of the exploration sites (51.4%), *Osyris quadripartita* was not found. Only in few areas of the exploration sites (8.1%) *Osyris quadripartita* was relatively abundant. The relatively abundant exploration sites were:-Gelana, Shakiso and Lume districts. In some of the exploration site (Gelana) the size of the plant was small (at sapling stage) whereas in other exploration site (Shakiso district), the plant was found in most of the clumps of associated plants but the area that contained the clumps was very
small (around the farm land, communal land and near the fences) and somewhat medium in size. In the remaining exploration sites (40.5%) the status of *O. quadripartita* was rare and very rare. The result of similar study by [6] indicated that the regeneration status of *O. quadripartita* was somewhat fair in that particular study area, which is Menagesha Amba Mariam Forest in Central Highlands of Shewa, Ethiopia.

**Population status of Osyris quadripartita in selected forest of Borena Zone**

In Borena Zone from five districts (Teltele, Dillo, Miyo, Moyale and Dahas), seven forest and closure areas were purposively selected based on the information obtained from the key informants. In the majority these explored sites (71.4%), *O. quadripartita* doesn’t exist. In the remaining explored sites (28.6%) *O. quadripartita* was present very rarely (Table 1).

**Table 1** *Osyris quadripartita* Exploration sites and their status in Borena Zone

<table>
<thead>
<tr>
<th>No.</th>
<th>Exploration sites</th>
<th>Districts</th>
<th>Zone</th>
<th>Altitude (m.a.s.l)</th>
<th>Average no. of <em>Osyris</em> per plot (400 m²)</th>
<th>Present/Absent</th>
<th>Status</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bes biresa</td>
<td>Teltele</td>
<td>Borena</td>
<td>1397</td>
<td>No need of laying qadrat b/s it is very rarely available</td>
<td>Present</td>
<td>Very rare</td>
<td>State forest</td>
</tr>
<tr>
<td>2.</td>
<td>Halo</td>
<td>Teltele</td>
<td>Borena</td>
<td>1318</td>
<td>No need of laying qadrat b/s it is very rarely available</td>
<td>Present</td>
<td>Very Rare</td>
<td>State forest</td>
</tr>
<tr>
<td>3.</td>
<td>Dillo areas (small forest around village)</td>
<td>Dillo</td>
<td>Borena</td>
<td>943</td>
<td>--------</td>
<td>Absent</td>
<td>Not found</td>
<td>--------</td>
</tr>
<tr>
<td>4.</td>
<td>Mite</td>
<td>Miyo</td>
<td>Borena</td>
<td>1292</td>
<td>--------</td>
<td>Absent</td>
<td>Not found</td>
<td>--------</td>
</tr>
<tr>
<td>5.</td>
<td>Moyale (small forest around village)</td>
<td>Moyale</td>
<td>Borena</td>
<td>1171</td>
<td>--------</td>
<td>Absent</td>
<td>Not found</td>
<td>--------</td>
</tr>
<tr>
<td>6.</td>
<td>Dahas Woreda (small forest around village)</td>
<td>Dahas</td>
<td>Borena</td>
<td>1348</td>
<td>--------</td>
<td>Absent</td>
<td>Not found</td>
<td>--------</td>
</tr>
<tr>
<td>7.</td>
<td>Wuchile</td>
<td>Dahas</td>
<td>Borena</td>
<td>1061</td>
<td>------</td>
<td>Absent</td>
<td>Not found</td>
<td>----</td>
</tr>
</tbody>
</table>

**Population status of Osyris quadripartita in selected forest of West and East Guji Zones**

In East and West Guji Zones from seven districts (Abaya, Gelana, Melka soda, Goro-dala, Wadera, Adola and Shakiso), sixteen forests and closures areas were purposively selected based on the information obtained from the key informants. In majority of exploration sites (57.9%), *O. quadripartita* was present. Of this 15.7% of the explored areas *O. quadripartita* was found relatively abundantly and 42.2% of the explored areas it was found rarely (21.1%) and very rarely (21.1%). A study by [7] in Tigray region, indicated that *O. quadripartita* was one of the dominant species in the study areas. On the remaining exploration sites (42.1%) *Osyris quadripartita* was not present (Table 2).

**Table 2** *Osyris quadripartita* Exploration sites and its status in West and East Guji Zones

<table>
<thead>
<tr>
<th>No.</th>
<th>Exploration sites</th>
<th>Districts</th>
<th>Zone/Region</th>
<th>Altitude (m.a.s.l)</th>
<th>Average no. of <em>Osyris</em> per plot (400 m²)</th>
<th>Present/Absent</th>
<th>Status</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Debeke-debobesa</td>
<td>Abaya</td>
<td>West Guji,Oromia</td>
<td>1302</td>
<td>2</td>
<td>Present</td>
<td>Rare</td>
<td>In area closure and community forest</td>
</tr>
<tr>
<td>2.</td>
<td>Tore Badiya Forest</td>
<td>Gelana</td>
<td>West Guji,Oromia</td>
<td>1832</td>
<td>8</td>
<td>Present</td>
<td>Relatively abundance, Protected area &amp; Very small in size (Sapling)</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Dawa becho</td>
<td>Melka soda</td>
<td>West Guji,Oromia</td>
<td>1321</td>
<td>------</td>
<td>Absent</td>
<td>Not found</td>
<td>area closure and community forest</td>
</tr>
<tr>
<td>4.</td>
<td>Soda germama</td>
<td>Melka soda</td>
<td>West Guji,Oromia</td>
<td>1372</td>
<td>------</td>
<td>Absent</td>
<td>Not found</td>
<td>area closure and community forest</td>
</tr>
</tbody>
</table>
### Population status of *Osyris quadripartita* in selected forest of East Shewa Zone

In East Shewa Zone from seven districts (Liben Chqala, Dugida, Bora, Lume, Fentale, Boset and Adama), ten forests and closures areas were purposively selected based on the information obtained from the key informants. In a little above half of the exploration sites (54.5%), *O. quadripartita* were absent. On the other hand, in 45.5% of the exploration site *O. quadripartita* were present. Of this 9.1% of the explored areas, *O. quadripartita* was found relatively abundantly and 27.3% of the explored areas it was found rarely and in 9.1% of the exploration sites *O. quadripartita* were found very rarely (Table 3).

**Table 3 *Osyris quadripartita* Exploration sites and it status in East Shewa Zone**

<table>
<thead>
<tr>
<th>No.</th>
<th>Explorations site</th>
<th>Districts</th>
<th>Zones</th>
<th>Altitude (m.a.s.l)</th>
<th>Average no. of <em>Osyris</em> per plot(400m²)</th>
<th>Present / Absent</th>
<th>Status</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zuqala forest</td>
<td>Liben Chqala</td>
<td>East Shewa</td>
<td>1844</td>
<td>Not found in the quadrat b/s it is very rare</td>
<td>Present</td>
<td>Very rare</td>
<td>Protected area</td>
</tr>
<tr>
<td>2</td>
<td>Goro forest</td>
<td>Dugida</td>
<td>East Shewa</td>
<td>1816</td>
<td>----</td>
<td>Absent</td>
<td>Not found</td>
<td>Protected area</td>
</tr>
<tr>
<td>3</td>
<td>--</td>
<td>Bora</td>
<td>East Shewa</td>
<td>1648</td>
<td>----</td>
<td>Absent</td>
<td>Not found</td>
<td>----</td>
</tr>
</tbody>
</table>
4. Gererisa forest/Tede dildema Kebele | Lume | East Shewa | 1848 | ------ | Present | Rare | Community forest, relatively larger in size but the total areas of the forest is very small.

5. Sike Ayu forest | Lume | East Shewa | 1937 | 10 | Present | Relatively abundance | Association forest, relatively larger in size but the total areas of the forest is very small (only 14 ha).

6. Fentale 1 | Fentale | East Shewa | 1207 | ------ | Absent | Not found | Community forest.

7. Tututi | Fentale | East Shewa | 1402 | ------ | Absent | Not found | Area closure.

8. Buta dalecha | Boset | East Shewa | 1654 | ------ | Present | Rare | Area closure.

9. Kechema Kenchero | Adama | East Shewa | 1739 | ------ | Present | Rare | Community forest.

10. Dibibisa Kebele, Wacho lafa forest | Adama | East Shewa | 1609 | ------ | Absent | Not found | Area closure.

11. Egizaherab forest | Adama | East Shewa | 1603 | ------ | Absent | Not found | Community forest.

**Figure 2** The three morphotypes of *Osyris quadripartita* observed during field work.

**Local knowledge**

In all the districts where *O. quadripartita* was found to grow, the species was recognized by a single local name “Watto”. Tooth brush and women beautification were the two most important uses identified by informants. From the informants discussion it was also
known that the species can regenerate from root. If proved to be true, the fact that it can regenerate from left over root, it may have conservation implication.

Taxonomic issues
Three types of morphotypes of the species were observed during the field work (Figure 2). Other species also may somewhat confusing for the species. These include; Cadaba farinosa and Boscia mosambicensis mainly in the Acacia-Comiphora type of ecosystems and Osyridocarpus schimperanus in the dry afromontane grass land kind of ecosystems. In addition to Osyris quadripartita, Osyris compressa was encountered in some parts of the study area.

Habitat preference of Osyris quadripartita
In the present field work, it was possible to determine that Osyris quadripartita does not grow in plantation forest (Cupressus and Eucalyptus plantations). It was also observed that the species preferred degraded dry evergreen and Acacia-Comiphora forests, with clay textured soils. The study by Herrera (1988) indicated that Osyris quadripartita stony soil with clay texture.

Threat to Osyris quadripartita populations
Over exploitation for its root have resulted in rapid decline in the O. quadripartita abundance in East Guji (Box 1). In Bora wereda of the Rift Valley, informants have mentioned charcoal making to be the one factor responsible for its reduction in abundance.

Box 1: Osyris quadripartita is now scarcely available even in the kebele named after it. Watto kebele is found in the Gorodollo wereda of the East Guji zone, Oromiya. Osyris quadripartita was once a dominant plant in the area. Hence, the kebele was named “Watto” to mean Osyris quadripartita in afan Oromo. Osyris quadripartita in Watto kebele, like in other kebeles of the Guji zone, is traditionally used by women for beautification. The root is smoked to make the woman clean and smell good. The beautification use of Osyris quadripartita is highly valued by the Guji women. Likewise, there is a saying; “Wati busimela, wottohimbusin” meaning; A Guji woman would rather prefer to lose a calf than to lose a single Osyris quadripartita. However, despite its availability in the past, Osyris quadripartita is now known to be very rarely available in the Watto kebele. This may be attributed to continuous over exploitation of the species for its root. Due to its current scares availability, nowadays, women cover Osyris quadriparteta individuals with other twigs and leaves to hide it from being uprooted by other user. Therefore, Osyris quadripartita was found to be a conservation priority species for watto Kebele and other areas. This may be true for other similar kebeles of Guji and other zones as well.

Associated Species with Osyris quadripartita
In different exploration sites, O. quadripartita was found associated with varieties of plant species. It was mostly occurring with Dodonaea angustifolia, Acokanthera schimperi and Rhus spp.( Table 4).

Table 4 Species occurring with Osyris quadripartita

<table>
<thead>
<tr>
<th>No.</th>
<th>Scientific name</th>
<th>Family</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acacia mellifera</td>
<td>Fabaceae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acacia Senegal</td>
<td>Fabaceae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acokanthera schimperi</td>
<td>Apocynaceae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Albizia spp.</td>
<td>Fabaceae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aloe spp.</td>
<td>Aloaceae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asparagus officinalis</td>
<td>Asparagaceae</td>
<td></td>
</tr>
</tbody>
</table>
4. CONCLUSION AND RECOMMENDATION

The results of this study indicated that in 51.4% of the explored sites Osyris quadripartita was not found. On the other hand in 40.5% of the exploration sites Osyris quadripartita was found rarely and very rarely. Therefore, in 91.9% of the exploration sites, Osyris quadripartita was found to be a conservation priority species. Contrary to this, only in few areas of the exploration sites (8.1%), O. quadripartita was relatively abundant.

Moreover, according to direct observation and informants’ reports, the numbers of the plant have been greatly reduced due to overexploitation of its roots and stems for aesthetic purpose (natural perfume) and charcoal production. Furthermore, the plant’s poor natural regenerative potential from seeds and root suckers, and its being dioecious threatens the survival of the plant, which leads to the extinction of the species. Consequently, the cultivation of the plant should be encouraged.
Acknowledgment

The people of Borna, East Shewa, East and West Guji Zones, Oromia Regional State, Ethiopia who gave us information are gratefully acknowledged. We are grateful to Ethiopian Biodiversity Institute (EBI) for financial support during fieldwork. We are also grateful to Agricultural workers in Abaya, Gelana, Melka soda, Teltele, Dillo, Miyo, Moyale, Dahas, Goro-dala, Wadera, Adola, Shakiso, Liben Chqala, Dugida, Bora, Lume, Fentale, Boset and Adama districts for their kind assistance as translators of Afan Oromo language during the fieldwork.

Abbreviations


REFERENCE

5. CITES (2013) Sixteenth meeting of the Conference of the Parties, Consideration of Proposals for Amendment of Appendices I and II, Bangkok (Thailand), 3-14.