

Status of *Osyris quadripartita* in borena and west guji zones, oromia region, Ethiopia

Abstract

Osyris quadripartita is an evergreen, dioecious shrub or tree up to 7m tall, root hemiparasite, is used for its scented wood and belongs to the family *Santalaceae*. It is most commonly known as East African Sandalwood, indigenous to east Africa. The tree is harvested from the wild for local use as a food, medicine and source of wood and materials. *Osyris quadripartita* is also used to extract essential oil. In Ethiopian, *Osyris quadripartita*, is an economically important plant species that occurs in most parts of the regions but its population status and associated plant species have not been studied in Borena and West Guji Zones, Oromia region, Ethiopia. Therefore, the objective of this study was to assess the population status of *Osyris quadripartita* and its associated plant species in the study areas. Accordingly, the study was conducted in four districts within the two zones. From five districts nine forest areas were selected purposively based on the distribution of *Osyris quadripartita*. The data was collected through vegetation survey, direct observation and local informants' interview. Systematic random sampling design was employed based on line transect approach for data collection from 29 quadrats, each with 20 m x 20 m area at 100m intervals. Majority of the respondents (75%), particularly the elders and other knowledgeable community members living for a long period in the study areas were reported that *Osyris quadripartita* was used for traditional medicine and perfume, that prepared by women, locally called "Qaya". The rest respondents (25%) were revealed that it used for local construction, firewood and income generation. Out of 29 quadrants of the study areas, in 19 (65.52%), *Osyris quadripartita* was abundantly found. while, in 5 (17.24%), rarely available and 5 (17.24%), not found. Regarding, associated plant species, the highest number of species 19(24.1%), was fabaceae family, followed by Anacardiaceae and Rutaceae each was contributed 4(5.1%). The result of this assessment study indicated that *Osyris quadripartita* was found somewhat abundantly in selected forest of Borena zone and rarely abundant in west Guji zone. Therefore, by raising awareness of local communities, it can be minimized the depletion of genetic resources and the cultivation of the plant should be also encouraged for future.

Keywords: *osyris quadripartita*, status, abundant, associated species

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Introduction

Osyris quadripartita is a synonymy of *Osyris lanceolata* Hochst & Steud and belongs to the family *Santalaceae*. It is most commonly known as East African Sandalwood,¹ indigenous to east Africa. It is an evergreen, dioecious shrub or tree up to 7m tall, an obligate root hemiparasite, meaning that it cannot complete its lifecycle without a host plant. *Osyris quadripartita* is monoecious, flowering from March to August or even later, September to February with fruits ripening between May and September. In some areas, the fruit is available throughout the year but most abundant from July to December.² The height of the plant varies depending on the soil type, climatic conditions and genetic variation. Accordingly, it has a wide geographic distribution in Africa from Algeria to Ethiopia, Tanzania and Kenya and South Africa.³ 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 1600mm. Occurs in most Ethiopian regions. Besides, sporadically in rocky sites and along the margins of dry forests, evergreen bush land, grassland, and thickets at an altitude range of 900-2250m above sea level.^{4,5}

Osyris quadripartita is 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 traded internationally for its essential oil, which is used in making perfume. For instance, Roots and bark are used for tea and as a tonic in soup, fruits are edible. Especially children or herdsmen eat ripe fruits raw, with the seed discarded, only as an emergency food. Besides, root decoction is used to treat diarrhea, a decoction of the bark, heartwood is used to treat sexually transmitted diseases and anemia, and extracts from the plant can cure certain diseases, including the killer Hepatitis B.²

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.⁵⁻⁷ However, Sandalwood has captured the attention due to its overexploitation to meet international demand for its perfumery and medicinal products. The mode and scale of harvesting has made the tree to be locally endangered, which threatens not only the survival of the species, but also the sustainability of the trade in the species products.^{8,9} The exploitation of *Osyris 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.^{6,7}

In Ethiopia, the population status of *O. quadripartita* is not well studied except the study by Amare Seifu et al.,¹⁰ in selected districts of South Omo and Gamu Gofa Zones, SNNPR, Ethiopia. The result of this study indicated that most of the areas that *Osyris quadripartita* abundantly found were protected areas. Furthermore, the plant's poor

natural regenerative power from seeds and root suckers, and its being dioecious may threaten the survival of the plant. On this regards the Ethiopian Biodiversity Institute (EBI) is responsible to conserve, sustainably utilized and fair and equitable sharing of benefit from the utilization of genetic resources. Therefore, the objectives of this study were to assess the population status and availability of *Osyris quadripartita* and associated species with it to keep up the sustainable utilization of the plant in selected nine forest areas. Such as (Qermso, Gaara Birbirsa, Dharito, Didera, Lakole, Surupa, Bada Magada, Dugda Dawa and Suro Badiya) of Borena and west Guji Zones of Oromia Region, Ethiopia.

Materials and methods

Description of the study area

Borena zone is located between 3°36' – 6°38' North latitude and 3°43' - 39°30' East longitude. Borena zone shares common boundaries with Guji zone in the east, Somali regional state in southeast, SNNPR in the north and west and one international boundary with Kenya. The capital city of the zone is Yabello, which is located at distance of 570 Km south of Addis Ababa.¹¹ Besides, West Guji Zone is one of the zones of the Oromia Region; it is located on the paved Addis Ababa-Moyale highway at the distance of 481Km. It has a latitude and longitude of 5°34'59.99" N 38°19'60.00" E and an altitude of 1716 meters above sea level (Figure 1).

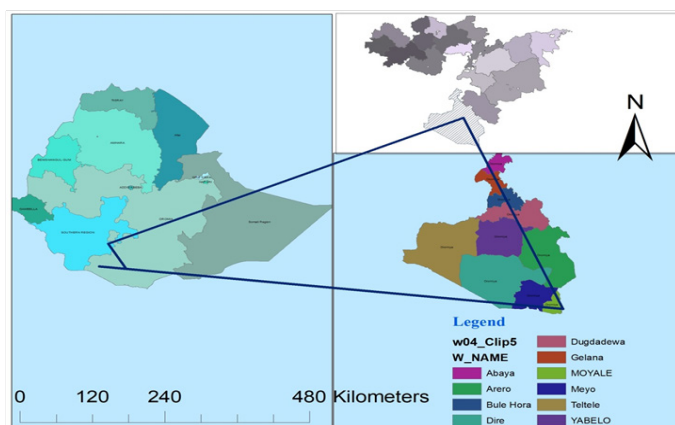


Figure 1 Administrative map of the study areas.

Methods of data collections

The study was conducted in Borena and West Guji Zones in four districts, two districts from each Zone. From the two Zones, the study was conducted only in four districts. Hence, Yabello, Dire, Bule Hora and Suro Barguda was selected to conduct this assessment study. From four districts eight forest areas (Gaara birbirsa, Dharito, Lakole, Didera, Qermso, Dhobdo, Suro Badiya and Bada Megada) were selected purposively based on the distribution of *O. quadripartita*.

These three ways of data collection were used:

Direct observation and semi-structured questionnaires designed

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. Besides, elders and other knowledgeable community

members in particular living for a long period in the areas and have knowledge about the plant were selected and interviewed.

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 *Osyris 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 100m. 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) version 23. A descriptive statistical method was employed to analyze and summarize the data and to calculate percentages, frequency and mean.

Result and discussions

Abundance of *osyris quadripartita* in selected forest of borena zone

Elders and other knowledgeable community members in particular living for a long period of time in the areas and have well developed knowledge about their environment and called plant species in vernacular name were reported that *Osyris quadripartita* called “Wato” in vernacular name in the areas. Beside this, 75% of them were described *Osyris quadripartite* used for traditional medicine and perfume (that prepared by women, locally called “Qaya”). In addition to this, most of respondents were stated that the plant used for local construction, firewood and for sell (income generation) in the zone. Out of a total 22 plots were laid, in 68.2%, *Osyris quadripartita* was abundantly found, whereas, in 13.6%, the plant was rarely available and in 18.2% of the plots, *Osyris quadripartita* was not found. In other hand, from 22 plots almost in all of the 15 (68.18%) plots trees were dominated. In addition, during this surveying the newly *Osyris* species or not recorded before in Ethiopia was observed around Dirre wored near to Mega town and we were recorded and identified this species as *Osyris compressa* (Figure 2) (Table 1).

Osyris quadripartita is a potential industrial plant with very high content. In order to study abundance and areas of distribution field evaluation were carried out. Besides this, an altitude of collecting sites were varied and range between 1,250 and 2,050m.a.s.l. rather than protected areas there were no *O. quadripartita* counted in most unprotected open forests. This could be an indication of change in land use system and environmental degradation and, hence, loss of genetic resources of the species.

Abundance of *osyris quadripartita* in selected forest of west guji zone

In west Guji Zone, two forest areas (Bada Magada and Suro Barguda) were purposively selected based on the information

obtained from the key informants. In these two forests 7 plots were laid, out of 7 plots in 4(57.1%) of the sites *Osyris quadripartita* was abundantly found, in 2 plots (28.6%) the plant was relatively abundance and in only one plot the plant was not found. On the other hand, in 3 plots only *Osyris compressa* was found and most of them

were trees. Similarly, in 3 plots only *Osyris quadripartita* was found and both trees and saplings were found in these plots (Table 2). As we mentioned above the existence of *Osyris compressa* in Borena and West Guji zones was a newly identified plant species, which was not registered before in the Flora of Ethiopia and Eretria Volumes.

Table 1 *Osyris quadripartita* exploration sites in borena zone

No	Exploration sites	Districts	Altitude	Latitude	Longitude	Average no. of <i>Osyris</i> per plot	Present/ Absent	Status	Remark
1	GaraBibirsa (Obdo) 1	Yabello	2075	04°53'20.1"N	038°02'14.3"E	No	Absent	Not found	Natural forest
2	GaraBibirsa (Obdo) 2	Yabello	2073	04°53'21.2"N	038°02'15.0"E	1	Present	Rare	<i>O. compressa</i>
3	Gara Bibirsa (Obdo) 3	Yabello	2086	04°53'22.2"N	038°02'12.7"E	3	Present	Rare	<i>O. compressa</i> & <i>O. Quadripartita</i>
4	Dhereto 1	Yabello	1705	04°47'23.7"N	038°09'19.4"E	25	Present	Abundant	
5	Dhereto 2	Yabello	1703	04°47'24.2"N	038°09'18.3"E	30	Present	Abundant	
6	Dhereto 3	Yabello	1739	04°47'27.1"N	038°09'17.3"E	32	Present	Abundant	
7	Dhereto 4	Yabello	1750	04°47'27.7"N	038°09'16.7"E	16	Present	Abundant	
8	Dhereto 5	Yabello	1756	04°47'29.0"N	038°09'16.1"E	15	Present	Abundant	
9	Dhereto 6	Yabello	1758	04°47'29.1"N	038°09'20.0"E	20	Present	Abundant	
10	Didera 1	Yabello	1530	04°47'42.3"N	038°25'36.1"E	-	Absent	Not found	
11	Didera	Yabello	1457	04°47'50.1"N	038°23'23.3"E	1	Present	Rare	
12	Dire (Lakole) 1	Dirre	1852	04°06'45.7"N	038°17'23.5"E	23	Present	Abundant	
13	Dire (Lakole) 2	Dirre	1852	04°06'44.7"N	038°17'14.0"E	18	Present	Abundant	Trees with DBH 6-8cm
14	Dire (Lakole) 3	Dirre	1856	04°06'43.0"N	038°17'14.7"E	20	Present	Abundant	<i>O. compressa</i> all are trees
15	Dire (Lakole) 4	Dirre	1806	04°07'14.2"N	038°17'10.4"E	17	Present	Abundant	
16	Dire (Lakole) 5	Dirre	1799	04°07'15.8"N	038°17'11.0"E	21	Present	Abundant	
17	Dire (Lakole) 6	Dirre	1801	04°07'16.2"N	038°17'12.1"E	28	Present	Abundant	
18	Dire (Lakole) 7	Dirre	1795	04°07'16.8"N	038°17'11.7"E	20	Present	Abundant	
19	Dire (Lakole) 8	Dirre	1777	04°07'18.8"N	038°17'08.7"E	15	Present	Abundant	
20	Dire (Lakole) 9	Dirre	1776	04°07'18.3"N	038°17'06.2"E	25	Present	Abundant	
21	Qermso (Dhobdo)	Yabello	1897	04°54'00.0"N	038°03'31.0"E	No	Absent	Not found	
22	GaraBibirsa (Dhobdo) 1	Yabello	2075	04°53'20.1"N	038°02'14.3"E	No	Absent	Not found	

Table 2 *O. quadripartita* exploration sites in west guji zone, bule hora (b) and suro barguda (s) district

No.	Exploration sites	Districts	Altitude	Latitude	Longitude	Average no. of <i>Osyris</i> /per plot	Present/ Absent	Status	Remark
1.	BadaMagada	B/Hora	1970	05°29'14.4"N	038°15'38.0"E	No	Absent	Not found	Informant report indicated it found at the back of forest like kola
2.	Suro Badiya1	S/Barguda	1895	05°34'00.9"N	038°100'31.2"E	7	Present	Relatively abundance	<i>O. quadripartita</i>
3.	Suro Badiya2	S/Barguda	1885	05°34'00.5"N	038°00'33.1"E	15	Present	Abundant	Tree and Saplings <i>O. quadripartita</i>
4.	Suro Badiya3	S/Barguda	1884	05°34'02.5"N	038°00'32.7"E	8	Present	Relatively Abundant	Sapling (All Female)
5.	Suro Badiya4	S/Barguda	1912	05°33'40.7"N	038°02'35.9"E	20	Present	Abundant	
6.	Suro Badiya5	S/Barguda	1923	05°33'40.5"N	038°02'34.3"E	10	Present	Abundant	All Tree and <i>Osyris compressa</i>
7.	Suro Badiya5	S/Barguda	1919	05°33'42.8"N	038°02'34.1"E	12	Present	Abundant	



Figure 2 Morphological appearance of *Osyris* species, A, *Osyriscompressa*, B, *Osyrisquadripartita*.

Associated species and families with *osyris quadripartita*

In different Exploration sites, *Osyris quadripartita* was found associated with varieties of plant species. Out of 78 plant species recorded from 29 sites, which belongs to 33 families and 61 genera. Fabaceae, family which was found to be represented by the highest number of species 19(24.1%); followed by Anacardiaceae and Rutaceae each was contributed 4(5.1%), whereas, (Burseraceae, Cappariaceae, Combretaceae, Euphorbiaceae, Oleaceae, Rubiaceae, Vitaceae and Asteraceae) each individual were represented by 3 species (3.79%) and the rest were indicated in (Table 3). Similarly, we were observed that *Osyris quadripartita* was mostly associated with *Acacia* species, *Euclea racemosa*, *Dodonaea angustifolia*, *Combretum molle*, *Rhus spp*, *Canthium lactescens*, *Cadaba farinose*, *Dichrostachys cinerea*, *Tephrosia emerooides* and *Euclea divinorum* in these study areas. Since, most of those plant species associated with *O. quadripartita* were widespread in a variety of habitats, from arid marginal areas in Dry and Moist Kola, dry woodland, bushland, semi-desert, scrub, riverine forest and marginal arid areas or on forest edges. They tolerates forest or grass fires well. Likewise, *O. quadripartita* prefers a well-drained, humus-rich clay or loamy soil in the wild and hemi-parasitic plant due to this it might be mostly occur friendly with similar of these plant species.¹⁰ It also occurred with legume plant species that have play vital role in increasing soil fertility as they have

the capacity to fix atmospheric nitrogen through their root nodules. Whereas, the pollination biology dioecious woody species has often shown sexual dimorphism and differences in resources allocation between female and male. Accordingly, most species in the members of Anacardiaceae family are dioecious or polygamous and bear many-flowered inflorescences. Therefore, flowers possess nectary organs, they need cross-pollinated and are evidently *Entomophilous*. In addition, *Osyris quadripartita* and species of anacardiaceae family similar reproduction style and share in a deciduous habit and widely distribute semiarid conditions in lowland and highland woodlands of Moist and Wet Weyna Dega and Dega agro -climatic zones of Ethiopia.

Table 3 Composition of associated plants with *Osyris quadripartite*

No	Family	number of species	number of genera	(%) contribution to the total number of species
1	Sapindaceae	1	1	1.265822785
2	Acanthaceae	1	1	1.265822785
3	Aloaceae	1	1	1.265822785
4	Amaryllidaceae	1	1	1.265822785
5	Anacardiaceae	4	3	5.063291139
6	Apiaceae	1	1	1.265822785
7	Apocynaceae	2	2	2.53164557
8	Asparagaceae	1	1	1.265822785
9	Asteraceae	3	2	3.797468354
10	Balanitaceae	1	1	1.265822785
11	Burseraceae	3	1	3.797468354
12	Cappariaceae	3	3	3.797468354
13	Combretaceae	3	2	3.797468354
14	Cupressaceae	1	1	1.265822785

Table Continued

No	Family	number of species	number of genera	(%) contribution to the total number of species
15	Ebenaceae	2	1	2.53164557
16	Euphorbiaceae	3	3	3.797468354
17	Fabaceae	19	9	24.05063291
18	Fabaceae	1	1	1.265822785
19	Iridaceae	1	1	1.265822785
20	Meliaceae	1	1	1.265822785
21	Oleaceae	3	3	3.797468354
22	Polygalaceae	1	1	1.265822785
23	Proteaceae	1	1	1.265822785
24	Rhamnaceae	2	2	2.53164557
25	Rubiaceae	3	3	3.797468354
26	Rutaceae	4	3	5.063291139
27	Sapindaceae	2	2	2.53164557
28	Simaroubaceae	2	2	2.53164557
29	Solanaceae	1	1	1.265822785
30	Sterculiaceae	1	1	1.265822785
31	Thymelaeaceae	1	1	1.265822785
32	Tiliaceae	2	1	2.53164557
33	Vitaceae	3	3	3.797468354
Total		79	61	100

Conclusion and recommendations

We conclude that change in land use system and environmental degradation and, hence, loss of genetic resources of the species. However, the result of our assessment was indicated that *Osyris quadripartita* was found mostly abundant in Borena zone and relatively abundant in west Guji zone. Nevertheless, the abundance of the plant was found under protected areas except Dharito, which was found in natural forest (under human interference) or not protected in Borena zone. Similarly, in west Guji zone it was found under protected natural forests. Furthermore, we recommend raising up awareness of local communities on the value of genetic resources and ecological consequences of its loss and device mechanisms by which human impacts can be minimized through training; desiccation and

consultation with the local communities for continuously manage and preserve natural resources and the cultivation of the plant should be encouraged for future.

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Conflicts of interest

The author declares there is no conflicts of interest.

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