



Distribution regularity and habitats of Salt Tree [*Halimodendron halodendron* (Pall.) Voss] in Georgia (South Caucasus)

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ABSTRACT

The studies have been made on the area, habitats and condition for the rare species of the flora of Georgia - *Halimodendron halodendron*. Its main area is the Iori plateau, including the North side territory of David Gareja monastery complex and Jangiriskhevi gorge (Karaduzi). *H. halodendron* is spread on the banks of ravines, terraces, plain places and slopes, elevation - approximately 530–650 msl. Growing in moist and semi-moist, as well as in dry and semidry ecotypes. Its main habitats are mesophilous and xeromesophilous shrubberies, where it is represented as a dominant-edificator. *H. halodendron* also invades hemixerophilous shrubberies of shibliak type. It is rarely in hemixerophilous communities of steppe. The studies on density, distribution, height and life condition of *H. halodendron* has been done according to the habitats. The accompanied species, main physical-geographical and phytosociological characteristics, use and level of disturbance for each habitat are given below. The conditions and vitality of *H. halodendron* is discussed in connection with various biotic and abiotic factors (vegetation, topography, soil, moisture and grazing).

Introduction

The general distribution area of *Halimodendron halodendron* (Pall.) Voss includes the Southern parts of Eastern Europe and Western Siberia, Middle Asia, Iran, parts of Central Asia (North-West Mongolia and China) and Caucasus [1–6]. Its areas in Central Asia, especially in China, are extremely disjunctional. Taking into consideration the area of distribution and extent of zones of abundant populations, we regarded it to Irano-Turanian chorotype.

In the main area (Middle Asia – Turan) the Salt Tree grows in moist and semi-moist ecotypes, relatively rare in dry and semidry ecotypes. It grows on various types of soil, including sand and is well adapted to the salted ones as well. It is spread on river terraces, as well as on plain places between river terraces and slopes. It is usually seen in moist depressed topography. It is mostly phreatophyte or trichohydrophyte. It is widely spread in tugai ecosystems and represents one of the characteristic components for forests and shrubberies of tugai. It is the component for both mesophylous and xeromesophylous ecosystem vegetation. It cuts through the desert habitats as well. It creates the separate plant communities on the terraces, more or less distant from a river. It is rarely seen in steppe plant communities [7–14].

In Caucasus *H. Halodendron* is spread in Georgia, Armenia,

Azerbaijan and Russian Federation (North Caucasus), however with a highly disjunctional area. According to Grosheim [15] and Chamberlen [4] its area in Turkey is within the framework of Caucasus eco-region. South Caucasus represents the end point of the South-Western distribution area of the Common Sal Tree and the locations within this territory are isolated from the main area. Despite the fact, that *H. Halodendron* is spread in every country of Caucasus, it is one among the rare plant species. It is included in Red List of Georgia as an endangered species (EN) [16]. It was included in The Red Book of Georgian SSR [17].

There are only a few information about *H. Halodendron* in Georgia [5,18]. Specification of its areas is required. No studies has been done on its habitats, plant populations, quantities and contemporary condition.

The aim of our study was to determine the areas and habitats of *H. Halodendron* in Georgia; to classify the habitats according to the main physical-geographical and phytosociological characteristics; to determine *H. Halodendron* cenotic role in selected habitats; to study the conditions and vitality of *H. Halodendron* individuals in connection with various biotic and abiotic factors (topography, exposure, slope, soil and its moisture, vegetation, grazing, level of habitat disturbance) and compare them to the relevant data of the main area (Iran-Turan); to

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determine the future threats for the existence and distribution for *H. halodendron* through that whole area of Georgia.

Objectives and methods

The object of our research is one of the rare species of the flora of Caucasus - *Halimodendron halodendron* (Pall.) Voss and its habitats. The research was carried out in the second half of May, year of 2017, the massive blooming period for *H. halodendron*. The research area included the Iori plateau (Eastern Georgia).

The configurations of *H. halodendron* separate areas have been marked by GPS. The main habitats for *H. halodendron* plant individuals and their distributions were selected and described. Considering the topography condition and configuration, the areas were more or less different, though they varied somewhere within 25 m². In each described area the following things were marked: (1) general physical-geographical characteristics (location, coordinates, topography, exposure, slope, elevation, soil type), (2) general phytosociological characteristics (coverage of each layer of community, distribution, height), (3) general characteristics for *H. halodendron* plant individuals (density, distribution, height – average, maximal and minimal, phenological stage, life condition – good, satisfactory, bad), (4) accompanied plant species, (5) level of habitat disturbance (low, average, high) and (6) habitat use.

Results and analysis

I. Area and distribution regularities

The South and South-West parts of Iori plateau represents the areas of *H. halodendron* in Georgia. It is isolated and composed of two parts: Jangiriskhevi (Karaduzi) and North side of Davit Gareja monastery complex. The overall area in Jangiriskhevi gorge is approximately 33000 m², and 3000 m² in the North side of Davit Gareja monastery complex. According to the literature data [5], *H. halodendron* is also spread on the crossing of Iori plateau and Kvemo Kartli lowland (Gardabani lowland), nearby Natlismtsemeli monastery.

The territory is characterized by complex topography. One can clearly see how slopes with different exposure and inclination, plain places and ravines are interchanging. It is located in semi arid climate zone. The average annual temperature is 13 °C. The average annual precipitation is 350–400 mm. Evaporation – 1000–1200, precipitation-evaporation ratio - 0,4–0,6 [19–22]. Different modifications of mostly grey-cinnamonic soil are developed [23–26]. Often soil is skeletal. Salted clay badland slopes and hills are the parts of grey-cinnamonic soil area. Along of the moist ravines there is a narrow line of alluvial soils and stones.

For both territories, the distribution of *H. halodendron* is disjunctional (Map 2, 3). With different areas its populations are spread fragmentately. It is also seen as a single plant individual.

II. Habitats and their classification

On Iori plateau *H. halodendron* is spread in the following habitats: (1) mesophylous shrubberies, (2) xeromesophylous shrubberies, (3) hemixeromesophilous shrubberies of shibliak type and (4) hemixerophilous grass communities. The mentioned habitats are presented with the different modifications.

Mesophilous shrubberies are developed on the narrow slopes near ravines, plain places at ravine-sides and the first ravine terrace, as well as on weak inclined flattened areas between ravine and slope. Habitat characteristics include stony grey-cinnamonic and alluvial soils. The exposure of ravine-side terraces is North, North-West or South. Inclination - 10°–12° to 25°–30°. Salt Tree and Salt Cedar plant communities (*Halimodendronetum halodendron*, *Tamariceto-Halimodendronetum*, *Tamaricetum ramosissimae*) are spread.

We conferred the habitats transcending between shibliak type shrubberies and mesophilous shrubberies to **Xeromesophilous shrubberies**. They are developed on weak inclined (1°–5°) flattened areas between ravines and slopes, where the moisture near ravines, ground water and filtration moisture are quite remote. The exposure is South or North-West. Soil is grey-cinnamonic, skeletal. The habitat vegetation is formed by Salt tree plant communities (*Halimodendronetum halodendron*). Density of shrubs in some locations is small and a plant community, transcending between grassland and shrubby communities, is formed. Plant community of Christ's thorn and Salt Tree (*Paliurus spina-christi* + *Halimodendron halodendron*), described on ravine-side slope, is rare.

On one hand, **shibliak type hemixerophilous shrubberies** are spread on slopes and on the other hand, on weak inclined flattened areas (plane places). The exposure is North and North-West. Terrace inclination level is from 22°–25° to 30°–35°, whereas on flattened areas, it is from 1°–2° to 6°–7°. Grey-cinnamonic, mostly gravelly soil. Iberian Spirea, Jerusalem Thorn and polidominant plant communities are spread (*Spiraetum hypericifoliae*, *Paliuretum spina-christi*, *Mixtofruticetum*).

On Iori plateau, in **steppe** communities *H. halimodendron* is rare. Habitat is developed on a dry slope. Soil is grey-cinnamonic, skeletal. The vegetation is made by yellow bluestem communities (*Bothriochloetum ischaemum*) and is under a high anthropogenic pressure.

From the habitats mentioned above, the most characteristic for Salt Tree is mesophilous and xeromesophilous shrubberies.

III. Characteristic of habitats

A. Mezophilous shrubberies

Halimodendronetum halodendron

Physiographical characteristics. Location: Iori plateau, Gareja, North (North-West) side territory of the monastery complex; Eastern Georgia, Iori plateau, Karaduzi, Jangiriskhevi; Altitude (m): 580–600; Topography: ravine interfacing narrow slope, with uneven surface; ravine-side narrow plane place; first ravine terrace, plane place, uneven surface; Exposure: N; N-W (No exposure could be given in some locations) Inclination: from 1°–2° to 12°–15° (No inclination could be given in some locations). Soil: grey-cinnamonic, stony, alluvial;

Phytosociological characteristics. I layer (shrubs): *Density* - from 17–20%–40%, *average height (cm)* - 120–130 (Sometimes 90–100 or 150–160); II layer (herbs: semi-shrubs & dwarf semi-shrubs): *projective coverage* - 60–70%, *average height (cm)* - 5–20; III layer (moss cover): not developed;

Companion species. Shrubs: *Prunus incana*, *Cotoneaster* sp., *Crataegus* sp., *Paliurus spina-christi*, *Rubus* sp., *Tamarix ramosissima*; Perennial herbs: *Bothriochloa ischaemum*, *Cynanchum acutum*, *Dactylis glomerata*, *Eryngium campestre*, *Onobrychis cyri*, *Plantago lanceolata*; Annual herbs: *Bromus japonicus*, *Capsella bursa-pastoris*, *Erodium cicutarium*, *Geranium lucidum*, *Hordeum leporinum*, *Lolium rigidum*, *Medicago minima*, *Nonea lutea*, *Papaver arenarium*, *Polygonum aviculare*, *Crepis sancta*;

Land use. Pasture;

Level of disturbance. High or average-high (It is Grazed and full of weed vegetation).

Data of *Halimodendron halodendron*. *Density* - from 17–20%–40%; *Average height (cm)* - 120–130 (sometimes 90–100 or 150–160); *Maximum height (cm)* - 200; *Minimum height (cm)* - 20; *Vitality* – satisfactory or good.

Tamarix ramosissima + *Halimodendron halodendron* (*Tamariceto-Halimodendronetum*)

Physiographical characteristics. Location: Iori plateau, Gareja, North (North-West) side territory of the monastery complex; Eastern Georgia, Iori plateau, Karaduzi, Jangiriskhevi; Altitude (m): 590–600; Topography: ravine-side narrow plane place, weakly inclining

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