

Exploring the historical distribution of *Dracaena cinnabari* using ethnobotanical knowledge on Socotra Island, Yemen

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Research

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Abstract

Background

In this study, we present and analyze toponyms referring to Socotra Island's endemic dragon's blood tree (*Dracaena cinnabari*) in four areas of the Socotra Archipelago UNESCO World Heritage site (Republic of Yemen). The motivation is understanding of the past distribution of *D. cinnabari* trees which is an important part of conservation efforts by using ethnobotanical data. We assumed that dragon's blood trees had a wider distribution on Socotra Island in the past.

Methods

This research was based on field surveys and interviews with the indigenous people. The place names (toponyms) were recorded in both, Arabic and indigenous Socotri language. We grouped all toponyms into five different categories according to the main descriptor: Terrain, Human, Plant, Water and NA (unknown). In addition, this study identified current and historical Arabic names of dragon's blood trees of the genus *Dracaena*, through literature review.

Results

A total of 301 toponyms were recorded from the four study areas in Socotra Island. Among names related to plants, we could attribute toponyms to nine different plant species, of which six names referred to the *D. cinnabari* tree, representing 14.63% of total phytotoponyms in the category. Three historical naming periods prior to 2000 could be identified. The most commonly used Arabic name for dragon's blood trees (*D. cinnabari*, *D. serrulata*, *D. ombet*) appears to be "ahrieb" "أهريب", its resin "dum al-akhawin" "دوم الأخوين", while derived (mixed-cooked) products are called "edah" "إده"; while regionally different names can be found.

Conclusion

The place names that refer to *D. cinnabari* are herein suggested to represent remnant areas of once large populations. The toponyms may therefore support known hypotheses based on climate models that *D. cinnabari* had a wider distribution on Socotra Island in the past. This study also confirmed the historical importance of dragon's blood

Background

Ethnobotany and Toponymy

Since the beginning of civilization, people have used plants for food, medicine, as well as materials for construction and the manufacture of crafts and many other products [1]. In addition, plants have extensive symbolic uses, such as in art, mythology and literature [2]. Interactions between people and plants have accumulated large bodies of traditional ecological knowledge built by a group of people

through generations living in close contact with nature. It includes a system of management of resources, classification and observations [3]. The term *ethnobotany* was designated by Harshberger (1896)[4], originally linked to the description of plants materials use by Aboriginal Australians. Ethnobotany later became a more ecological term, focusing on relationships, interrelationships, and interaction with a cultural perspective [5]. Harshberger (1896)[4] considered that ethnobotany could also help in studying past distribution of plants.

People need to give names to areas to label, identify and locate them in space [6]. When the indigenous inhabitants give such names, they often use them for distinctive spatial orientation, landscape features, natural phenomena, fauna, flora, natural substances and names of tribes or important individuals [7]. Toponyms are conservative and although the language and wording may evolve, the roots of place names are not likely to be altered by changes in human activities in the landscape through time [8-10]. Toponyms can be easy to record and may provide useful information about the history of a land and its resources [11]. According to Berkes (1993)[12] systematic meaning through toponyms, oral history and spiritual relationships form part of a dimension of traditional ecological knowledge. Place names may also reflect intensity of land use, the extent of traditional ecological knowledge and population density of the associated society [13], historical-cultural environmental development [14], settlement history [15] and archaeology [16]. They can be used for studying current environmental issues such as tracking recent climate changes and perceptions of those changes [17-19], water issues[20] and the climatic environment [21]. The systematic study of indigenous place names can be an approach to the mapping of ethnoecological knowledge and understanding of the evolution of the landscape [22]. Toponyms concerning plants (phytotoponyms) and animals (zootoponyms), named according to what people used to see in their everyday life, can be the indicators of the present, or former presence of certain species [23-26].

Phytotoponyms may provide information on spatial locations, temporal information and landscape [27] they have been used to study landscape ecology and botany [10], vegetation cover and long-term vegetation degradation [28]. According to Cunningham et al. (2001)[11] local knowledge may sometimes be the only evidence that remains where some plant species use to occur. Phytotoponyms, not just the common plant names, describe also the usage of the species as food, medicine, fabric or for other activities [29,30], and their interaction with the surrounding environment [31,32]. Therefore, these specific types of place names can be used for the reconstruction of past events, specific vegetation or certain species [10,33-38].

Socotra Island, the largest island of the Socotra Archipelago (Yemen), which is located at the crossroads between the Red Sea, Arabian Sea and the Indian Ocean, was recognized as a regional center of biodiversity. The Archipelago is rich in biodiversity with spectacular endemic species, more than 37% of plant species are endemic [39], but also rich in traditions that conserve this biodiversity until today. The landscape changes over the last centuries and/or millennia have rarely been studied. Paleoclimate

studies indicate wetter periods in the Holocene on Socotra [40,41], however there is very little paleontological or data available for the reconstruction of historic and prehistoric landscapes on the island [42]. In the more recent past (decades to a century), landscape changes were investigated with relation to vegetation, using historical photographs [43], using a combination of old aerial photographs, satellite images and repeated field measurements to study changes in population of *Dracaenacinnabari* and *Boswellia elongata*, respectively [44]. More recently, Rezende et al. (2020) [45] studied land productivity on Socotra using NDVI derived from satellite images in the last 20 years, showing a highly dynamic system.

Socotra and Dragon's blood

The Socotra Dragon's Blood Tree (*Dracaena cinnabari*) is a flag-ship species of Socotra [46,47]. It was a very important tree in ancient times due to a historically highly prized product called dragon's blood, a red resin extracted for a wide range of uses including coloring and local medicine [39,48]. Some believe that the name Socotra could even be derived from "Sukkatira" or contracted from "suq qatra", where suq is the Arabic word for "market" and qatra for "dragon's blood" [49,50]. The first who mentioned *D. cinnabari* resin was the unknown author of the Periplus of the Erythrean Sea around mid-first century AD, who called it "cinnabar" [51]. Dioscorides (90 AD) mentioned the resin in his book "On Medical Material" as Kinnabari "cinnabari", brought from Africa [52].

Names of dragon's blood tree and its resin have been recorded by old Arabic literatures [53-57], by researchers who visited Socotra [49,58-61] and recently by [39,62-64].

Several local names for *Dracaena* may indicate the significance of the ethnobotanical knowledge as an important source of information which can be used for tracking the history of these names or link them to the land by studying place names (toponyms). The aim of this study is to use this ethnobotanical knowledge to explore the spatial distribution of toponyms related to *Dracaena cinnabari* tree and its potential as an information source to assess the past distribution of this unique flagship species on Socotra Island.

Material And Methods

Study area

Study areas selection

Four areas have been selected by overlapping of two maps belonging to different datasets. The first map contains the current distribution of *D. cinnabari* [47] and second map the potential distribution of *D.*

cinnabari according to its ecology [70]. The areas of the potential distribution that are not overlapped by the current distribution were selected for the study (Fig. 1).

Data collection

Survey technique and toponyms meaning

Fieldwork was carried out by visiting the areas and interviewing people resident in the area, collecting the places names and obtained the meaning directly on the spot in collaboration with a local guide. The meaning of the names was discussed in detail with the indigenous people. Positions of the places have been recorded by GPS. During the fieldwork three types of data were recorded 1) toponyms, 2) visual observation of existing *D. cinnabari* trees in nature, and 3) interview with the people about the area (in particular, the occurrence of *D. cinnabari* in the area). Three areas were visited personally (Hagher, Momi, Qataria) and due to logistic limitations, the place names for the fourth area (Ma'ala) were recorded through communication with local people. The place names recorded by fieldwork and remotely were then confirmed by sending them to other two residents to ensure the meaning. Local people also have been asked if there are any names related to the dragon's blood tree and its distribution. GIS ArcMap was used to plot the georeferenced toponyms for three areas (Hagher, Momi and Qataria) and those from Ma'ala by approximation. In addition, detailed literature review of Arabic and Western sources was carried out to investigate current and old names for dragon's blood trees and its resin. Somali names for *D. ombet* collected by direct communication with Mr. Ahmed Ibrahim Awale, and the same for Sudani names for *D. ombet* indirect communication with Dr. Iqbal Madani.

Results

Tracking dragon's blood names through history

From literature, we can distinguish three naming periods (Fig. 2). Variety of names for dragon's blood appear during the golden era in science in the Islamic Arabic world (ca. 800 - ca. 1500 AD). The last period represents the new western renaissance and scientific exploring missions especially from Europe. The described period in this study begins in the year 60 AD, with the appearance of the first name referred to dragon's blood, and ends in the year 2000 with the opening of Socotra to the outside world-the opening of Socotra International Airport. The horizontal oval shape shows that the naming was at close intervals, while the oblique oval shape indicates that the naming appeared at long intervals.

Table 1. Appearing of dragon's blood names (resin/tree) from 1st century AD - 2000 AD

| No. | Author | Referred to | Dragon's blood Name | Year | Notes |
|-----|---------------|-------------|-----------------------|------|-------------|
| 1 | Breasted | Marchant | indian cinnabar | 60 | Resin |
| 2 | Breasted | Dioscorides | kinnabar | 90 | Resin |
| 3 | Abu Hanifa | Al-sulaik | edah | 605 | Resin |
| 4 | Ibn Manzur | Al-asmai | andam | 800 | Resin |
| 5 | Ibn Manzur | Al-asmai | dum al-akhawin | 800 | Resin |
| 6 | Ibn Sallam | | shian | 838 | Resin |
| 7 | Ibn Sallam | | baqam | 838 | Resin |
| 8 | Abu Hanifa | | shian | 869 | Tree |
| 9 | Al-hamadani | | katir | 941 | Resin |
| 10 | Ibn Manzur | Ibn Bari | al-huraifah | 1165 | Tree |
| 11 | Ibn Al-baitar | | dum al-tinnin | 1248 | Resin |
| 12 | Ibn Al-baitar | | dum al-thuban | 1248 | Resin |
| 13 | Al-Firuzabadi | | dum al-akhawin | 1410 | Tree /Resin |
| 14 | Al-Firuzabadi | | edah | 1410 | Tree/ Resin |
| 15 | Al-Firuzabadi | | andam | 1410 | Tree/ Resin |
| 16 | Wellsted | | dum khoheil | 1835 | Resin |
| 17 | Wellsted | | dragon's blood | 1835 | Tree /Resin |
| 18 | Wellsted | | moselle | 1835 | Resin |
| 19 | Balfour | B.C.S | kharya | 1835 | Tree |
| 20 | Breasted | Bent | blood of two brothers | 1893 | Resin |
| 21 | Forbes | | arhib | 1899 | Tree |

Depending on the amount of sources for each time, frequency of names can be limited (e.g., few 1st century AD sources). Most common are occurrences of edah, dum al-akhawin and dragon's blood, medium frequency words such as cinnabar, andam and katir, other names are in low frequency. Most of the names referred to the resin and few referred to the tree (shian, al-huraifah and kharya). The two names for the resin appearing in the first period (Fig. 3) were treated as one name because they came from the same origin "cinnabar". Four common names for the dragon's blood tree appear, "dum al-akhawin", "edah", "al-huraifah" and "shian", besides the English name "Dragon's Blood Tree" of course.

Table 2. Dragon's blood names (resin/tree) frequency from 1st century AD - 2000 AD

| No. | Name | Frequency | | | Authors |
|-----|-----------------------|-----------|---|-----|---------------------|
| | | R | T | T/R | |
| 1 | Cinnabar | 3 | | | [51,71] |
| 2 | edah | 9 | 1 | 1 | [53–58,72–77] |
| 3 | andam | 5 | 1 | 1 | [53,55–57,74,78,79] |
| 4 | dum al-akhawin | 19 | 2 | 1 | [53,55–57,72–86] |
| 5 | shian | 7 | 2 | | [53,57,73–78,86] |
| 6 | baqam | 1 | | | [53] |
| 7 | katir | 4 | 1 | | [57,60,72,75,83] |
| 8 | al-huraifah | | 1 | | [55] |
| 9 | dum al-tinnin | 1 | 1 | | [57,78] |
| 10 | dum al-thuaban | 3 | 1 | | [57,74,77,78] |
| 11 | dum khoheil | 1 | | | [58] |
| 12 | dragon's blood | 4 | 2 | 2 | [49,51,58,59,71] |
| 13 | moselle | 1 | | | [58] |
| 14 | kharya | | 1 | | [58] |
| 15 | blood of two brothers | | | | [51] |
| 16 | arhieb | | 1 | | [49] |
| 17 | dum al-gazelle | | 1 | | [57] |

The contemporary names (Table 3) are written according to where they occur in the references; names from Yemen, Saudi Arabia and Sudan were written in simplified English by the author. The names represent four species of *Dracaena* distributed in the Arab World, and present five languages (Socotri, Arabic, Hadandawa, Somali and Amazigh). All the names in the table are for dragon's blood tree and the names of the resin "emsello" and "iydah" are added from Socotri. The word "dum al-akhawin" is used as a name for the tree and for the resin.

Table 3. Contemporary Arabic names of dragon's blood (tree/resin) in Arabic [39,62–64,87]

| Area (<i>D. species</i>) | Dragon's blood names (tree/resin) | | | | | |
|---------------------------------|-----------------------------------|---------|---------------|-------------------|----------------|-----------------|
| Socotra (<i>D. cinnabari</i>) | a'arhiyib | iydiha* | emzolah* | ahrieb | dum al-akhawin | |
| Yemen (<i>D. serrulata</i>) | airob | kasar | kasl | arrab | khwas | faliqat al-gawz |
| Saudia (<i>D. serrulata</i>) | arab | khazm | khazami | arrab | khaws | azaf |
| Oman (<i>D. serrulata</i>) | areeb | | | ariab | ayrob | |
| Sudan (<i>D. ombet</i>) | embet | emet | ras al-shitan | shagart al-Tinnin | | |
| Somalia (<i>D. ombet</i>) | dinaw | mooli | | | | |
| Morocco (<i>D. draco</i>) | ajgal | | | | | |

* Dragon's blood resin

Toponyms

A total of 301 toponyms were recorded from the four study areas in Socotra Island (Table 4), which characterize how the Socotri people view their landscape. Toponyms were clustered in six broad categories based on their meaning:

- Animal: place name referring to animals such as livestock, birds, other
- Human; place names referring to human body parts, names, feeling, interaction, tools
- NA: place name with unknown meaning
- Plants; place names referring to plant species, density
- Terrain; place names referring to the shape and color of the landscape
- Water: place names referring to water such as rain, streams

Table 4. Distribution of the toponyms among categories and areas

| Category/Area | Hagher | Ma'ala | Momi | Qataria | Total |
|---------------|--------|--------|------|---------|-------|
| Animal | 7 | 8 | 6 | 5 | 26 |
| Human | 26 | 15 | 17 | 15 | 73 |
| NA | 9 | 7 | 10 | 6 | 32 |
| Plant | 17 | 8 | 6 | 10 | 41 |
| Terrain | 43 | 21 | 24 | 25 | 113 |
| Water | 7 | 0 | 6 | 3 | 22 |
| Total | 109 | 59 | 69 | 64 | 301 |

Most toponyms were recorded from the Hagher, the lowest number recorded from Ma'ala as this was through indirect communication.

It is clearly visible (Fig. 4), the most represented toponyms were related to terrain (37.5%). People describe the topography of the land such as mountain, hill, flat and rock but also describe the general view of those areas such as open, narrow, protected, high and low, they describe also the soil and color of the land. Terrain toponyms are followed by names referring to Human characters and activities (24.3%). Interestingly, most of these names referred to human activities such as playing, jumping, relaxing or giving and that can be related to a once frequent activity in the place, yet they also use feeling such as hunger and afraid, parts of the body like ears, neck and teeth if they resembled the topography by human parts. There are no naming places after people except two names for the tribes. Plant names represent 13.6%, varying between 8.7% and 15.6% among study areas (Fig. 5). These three categories have a higher percentage within all study areas (Fig. 5). Toponyms related to animals and water have a lower percentage of 9% and 6.9% respectively, and there are names of unknown meaning (10.6%).

Given the importance of plants for people in Socotra, it is not surprising that the names referred to plants come in the third position. Based on further analysis we divided the plant names into five subcategories (Table 5) based on their meaning;

- Unidentified: place names referring to the unidentified plant species
- Identified: place names referring to the identified plant species such as the Socotri word "Tayf" for Aloe
- General: place names referring to the word "plant" without any specification
- Density: place names referring to the plant density
- Grass: place names referring to grassland

Table 5. The frequency of place names in individual sub-categories of the phytotoponyms

| Sub-category | Unidentified | Identified | General | Density | Grass |
|----------------|--------------|------------|---------|---------|-------|
| Number | 5 | 22 | 6 | 6 | 2 |
| Percentage (%) | 12.2 | 53.7 | 14.6 | 14.6 | 4.9 |

We found six records of phytotoponyms related to *D. cinnabari*, which represent 2% from all toponyms recorded, 14.6% from the phytotoponyms and 27.3% from the subcategory of phytotoponyms referring to identified plant species (Figs 6 and 7).

Reconstruction of Dragon’s blood tree distribution

Among the six phytotoponyms referring to *Dracaena* (Fig. 7), one is located in the far end of Mala’a Mountains and two in the eastern edge of Momi plateau, far from the currently known *D. cinnabari* distribution. The other toponyms include three localities in Qataria where few remaining trees are known (Madera et al. 2019) and one in the Hagher, at the border of the current distribution of *D. cinnabari*. People in those areas have been interviewed individually, within group discussion and communication and the result is presented in the map (Fig. 8). People from Hagher speak about possible sites for *D. cinnabari* close to the areas of current distribution and people in Qataria and Momi speak about the possible sites for *D. cinnabari* in the cliffs towards the sea, however we could not confirm this during the study visit. During the fieldwork we recorded new sites with *D. cinnabari* (Fig. 8) where the trees have been observed. Both possible and new sites need further research.

Discussion

Tracking dragon’s blood tree phytotoponyms

Names through history

According to the estimates based on genetic research, Socotra was inhabited ca. 6,000 years BP [88]. From the old manuscripts, cinnabar, derived from ancient Greek name for red mineral (mercury sulfide HgS) and adapted as the scientific name for Socotra dragon’s blood tree (*Dracaena cinnabari*), has no relation to Arabic current or historical names only perhaps by color. Arabic literature [53,55,80,82] use dum al-akhwin as a common Arabic name for dragon’s blood resin and sometimes for the tree without specification of the sources and sometimes for the resin brought from Socotra and this name continued to be used from the past until today. “Edah” is the only local Socotri name that appears significantly in Arabic literature [54,83] especially for the resin of dragon’s blood tree due to its famous use in medicine. Other Arabic old names for dragon’s blood such as “andam” [78,79], “dum al-thuban” [78] and “shian” [73] is used for other products for example “andam” used for logwood. “Dum al-tinnin” [78] is the Arabic translation of dragon’s blood and “katir” is the general name for drops. The first record for the local name

of dragon's blood tree was in 1899 by Forbes (1903) [49] but edah and emsello ("moselle") have been mentioned also by Wellsted (1835) [58]. Cabo González and Bustamante Costa (2001) [89] suggested that there is a weakness in dictionaries and confusion of terminology related to dragon's blood names and give an example of "andam" and "baqam", however andam with its red color can bring some confusion but baqam before 1500 AD rarely mentioned in Arabic literature, in my review just once by Ibn Manzur (1290) [55] from their review "shian" is a popular name for dragon's blood in Morocco which comes from Persian origin, however, the translation of dragon's blood to Persian is "khun-siawshan" which appears in 1205 by Abi Umran [75], who divided the names by area; Arabic "dum al-akhawin and edah", Morocco "shian" and Persian "khun-siawshan". In their review, three other names of dragon's blood appear "litr mansham", "Hagun" and "Tabdigha" referenced to Abu al-khair (ca 1200) [74] and according to them, "Tabdiga" is from Amazigh language.

There is no sign of loss of cultural knowledge as a consequence of Arabic intervention. Only one name appears from Arabic (name of the plant) and that could be from an individual prospective or newly named, but there are still names that can't be explained by local people and that show their ancient roots. Although a large part of Socotra is uninhabited intensively by people - around 100 thousand inhabitants in 3,625 km² - and many spaces have no urbanization. The human interaction is very clear by giving names for each patch of land (personal observation) and the huge walls "eggehon" dominated the landscape especially in the higher altitudes; this confirms that Socotri people have strong knowledge, understanding, interactions and connection with places, and has been claimed as circumstantial evidence that the wall system on Socotra might be a sign of past historical intensive farming activities for incense, dragon's blood, or aloes [90].

Current Names

There are four dragon's blood trees in the Arabic speaking regions, *D. cinnabari* in Socotra, *D. serrulata* in Yemen, Oman and Saudi Arabia, *D. ombet* in Saudi Arabia, Sudan, Egypt, Ethiopia and Somalia, and *D. draco* subsp. *ajgal* in Morocco. We have seven groups of names according to the area (Table 2). Ahrieb with its different form of writing and pronunciation is the common local name for all dragon's blood tree species in Arabic (Yemen, Socotra, Oman and Saudia Arabia) [39,62-64,87]. Although different names appear such as "Ajgal" in Morocco in the Amazigh language and "Embet" in Sudan in the Hadandawa language and "Mooli" in Somalia in the Somali language. In Socotra, there is only one local name for the dragon's blood tree which is "ahrieb"; other names "emsello" for the pure product or "edah" is the mixed product with tree bark [39,62,64] and due to the difference in dialect, people of western Socotra call it "ahrieb" Socotra. Other current Arabic local names linked the leaves and its similarity with palm leaves such as "khwas" and "khazm", the same is used for the leaves of dragon's blood tree in Socotra "sa'af" which are also used for the palm leaves. The names in Morocco, Sudan and Somalia aren't linked to Arabic, "ajgal" and "ombet" are in local languages and have been used for the scientific name.

Toponym

The use of geographical/ecological-based toponyms stands as a potentially useful tool for the aiding the reconstruction of historical changes. Toponyms have rarely been used as a biogeographic indicator of species or vegetation type occurrences [35]. Analyzing the toponyms (Fig. 5) shows a high frequency of names referring to terrain. Zeini et al. (2018) [91] study in Sinai (Egypt) classified 69.9% of their recorded place names as referring to landforms followed by names that referred to water. Human place names are typically metaphorical, alluding to a resemblance between some physical feature of a site and shape of the organ after which it is named [13]. In Socotra, the human place names describe where things happen, places where people harvest, gather the goats, collect water or play and they have a general name for a whole area or landmark (like a mountain). Plotting of the distribution of plant names in Socotra is another way to appreciate and display the ecological niche and knowledge.

Plant names (phytotoponyms), which are our focus in this research, come in the third position with a frequency of 13.6%. Most of the phytotoponyms that are for general names or uses, while 53.7% of all phytotoponyms could be identified to scientific names and 12.2% we couldn't identify scientific names (Table 4). This shows a strong connection between the people and the plants. The identified plants are important for food, fodder and fire wood (*Phoenix*, *Tamarix*, *Punica*), famous with their products such as (*Dracaena* and *Aloe*) [39]. Similarly, Shi et al. (2015) [28] mentioned that plant names often used in daily life appear frequently in phytotoponyms. In Socotra, trees and large shrubs easily distinguished in the landscape such as *Commiphora* and *Maerua*, represent land marks (Wolf 1998: Camarda 2005 cited by Pinna et al. 2017) [37] and these categories give a good sign for orientation and recognizing the landscape. Water was in the last position, with 5.3% names related to water existence or its amount. Comparing within areas we found out that eastern sites have more place names related to water than western site and that looks logically with a higher amount of water in eastern Socotra than in the western areas [42]. Names related to cows and goats represent the main animal toponyms because they are the main livestock on the island. All areas have a similar percentage of names referring to animals that can be explained by the fact that grazing is common in the selected areas and on the island in general. Names with unknown meaning could be linked to ancient language as suggested also by Wagner (1960-1964) cited by Pinna et al. (2017) [37].

Potential implications for past dragon's blood tree distribution

Dragon's blood tree name appears 6 times which represent 14.6% of the phytotoponyms, four occurrences in western Socotra with two different variants and two in eastern Socotra with also two different variants. Pérez (2003)[92] also noted three different variants of the phytotonym "drago" in Canary Islands, exploring the local dialects. All the names in the west of the island are not single name but linked to other words, *D. cinnabari* pool, *D. cinnabari* sign, *D. cinnabari* place and *D. cinnabari* stand.

The six names included two names associated with existing *D. cinnabari* tree, one name associated with a place close to *D. cinnabari* trees and there having been trees before, one name associated to a place close to *D. cinnabari* tree but nobody remembers that there was tree before, one name with no tree near, but according to local people it could exist and one name with no trees and historically nobody know of trees existence on the area.

Half of the *D. cinnabari* place names occurs in Qataria, the area with the few limited isolated trees. Qataria is the farthest western site of current *D. cinnabari* distribution on the island and the place names of *D. cinnabari* are near and around the remnant *D. cinnabari* trees. According to the local people in the area, there is a possibility of small dragon's blood trees in the cliffs towards the sea, which provides an opportunity for discovering new *Dracaena* sites in the area. This area is the western end of the ridge stretching from the central Hagher Mts. and it indicates that the entire ridge could be likely covered by *Dracaena* forests in the past, even though Attorre et al. (2007) [70] did not assign most of this area to the model of potential *Dracaena cinnabari* distribution. The second area in Momi on the eastern side of the island, there is a *D. cinnabari* place name but also according to the local community there is also possibility of *D. cinnabari* trees on the cliffs towards the sea. In fact, this area is not far from recent *Dracaena* population and was included in the potential *Dracaena* occurrence made by Attorre et al. (2007) [70].

The third place is Ma'ala (in the west), where is a *D. cinnabari* place name but no more information and there was no opportunity for visiting the site. This finding is the most important because is the furthest from recent *D. cinnabari* distribution. In entire western part of Socotra, there is no one current record of *Dracaena* occurrence beyond Qataria [47] and this toponym would also confirm the model of potential *Dracaena* occurrence in the Ma'ala's Highland published by Attorre et al. (2007) [70].

The last *D. cinnabari* place name in the Hagher is close to *D. cinnabari* population but the name is for a place without *D. cinnabari* trees and they don't know presence of tree in the place, another *D. cinnabari* place name was also recorded from Hagher towards To'ahor's campsite-outside or study area (communication with local people).

In all investigated areas, there are still preserved some plant species accompanying dragon's blood tree woodlands as *Boswellia ameero*, *B. elongata*, *Buxanthus pedicellatus*, *Commiphora planifrons*, *Euphorbia socotrana* or *Euryops arabicus* [93-99]. Occurrence of these plants can serve as an indirect indicators of previous *D. cinnabari* distribution according to the plant communities.

Generally, the *D. cinnabari* place names seem to be associated with the current and potential distribution. The similar result was obtained by Pérez (2003) [92] for *Dracaena draco* on Gran Canaria, in his map, there are 42 phytotoponyms; 2 names associated with existing *D. draco* occurrence, others are close to the current distribution of individual trees or in area of potential distribution. The population decline of *Dracaena draco* is much larger than thus documented on Socotra island by many authors [43,70,100-103]. Overgrazing destroying the natural regeneration [104] and very slow growth of recruitment [105] do not

allow the trees to escape from browsing zone [47,48,106]. Therefore, these are known as the main reasons of population decline. The loss of each tree leads to the decrease in biodiversity, dragon's blood trees are important nurse trees [46] and habitats for the animals [107,108] also. The loss of dragon's blood trees may also affect the hydrological cycle as these plants capture horizontal precipitation [109].

Conclusion

In Socotra, luckily the landscape still has its original characteristic with relatively little human interventions [69], although the natural and human landscape are rapidly changing [110]. Ethnobotanical knowledge has been preserved within its unique language [39]. We can summarize our conclusions in seven main points:

1. *Dracaena cinnabari* toponyms exist in Socotra and seem related to areas where currently no trees are present, yet they were historically a feature of the place; this could support the argument that the distribution of *Dracaena* was larger in the past [70].
2. The *cinnabari* trees could be distributed to the whole medium to higher altitude areas on the Island, potentially from the west in Ma'ala to the east in Momi, before humans inhabited the Island.
3. Currently the Arabic common name for dragon's blood resin is "dum al-akhawin", for the tree is "ahrieb" and can be generalized.
4. The local name that appeared in history for the main product is "edah" (Mixed-cooked dragon's blood) and this can be a sign that "edah" was the main product exported from Socotra.
5. There could be potentially new areas for finding *cinnabari* trees especially in cliffs areas towards the sea in Qataria and Momi, also the northeastern slopes of Hagher towards Momi plateau in the east and Noged plain to the North.
6. This result can be an important part of conservation efforts and those areas with *cinnabari* toponyms could be potential areas for future reforestation of this species, where the ecological conditions allow.
7. The study has stressed the need for documenting place names and knowledge related as part of preserving the cultural heritage related to plants of Socotra Archipelago and the importance of using this knowledge for sustainable resource management. This study is just a first step for further use of toponyms and can be repeated for other important species or historical land use.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests

The author declare that he has no competing interests

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Authors' contributions

One Author

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The Author have been living and working in Socotra Island for more than 20 years, the author work in natural conservation especially with local communities.

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Figures

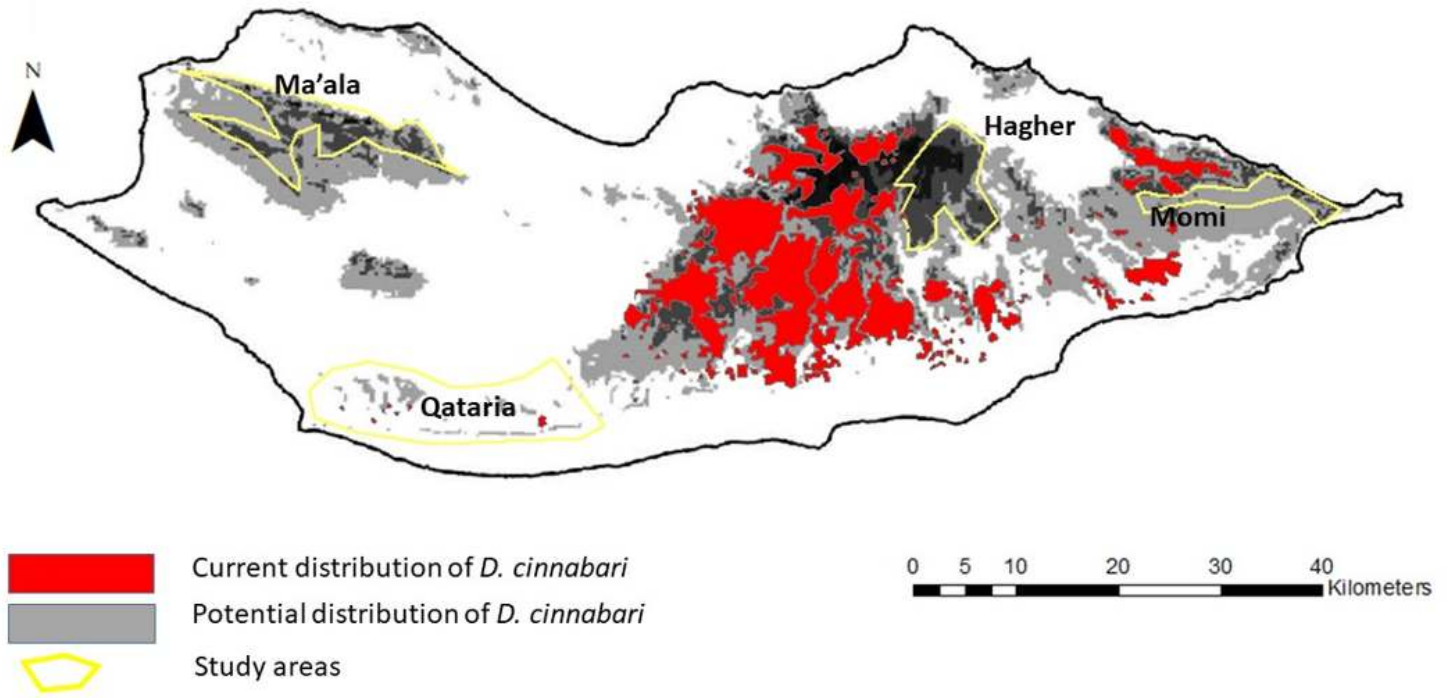


Figure 1

Map showing the study areas (Hagher, Momi, Qatanin, Ma'ala) in integrating two maps with the current and potential distribution of *D. cinnabari* according to Maděra et al. (2019)[47] and Attorre et al. (2007) [70], respectively.

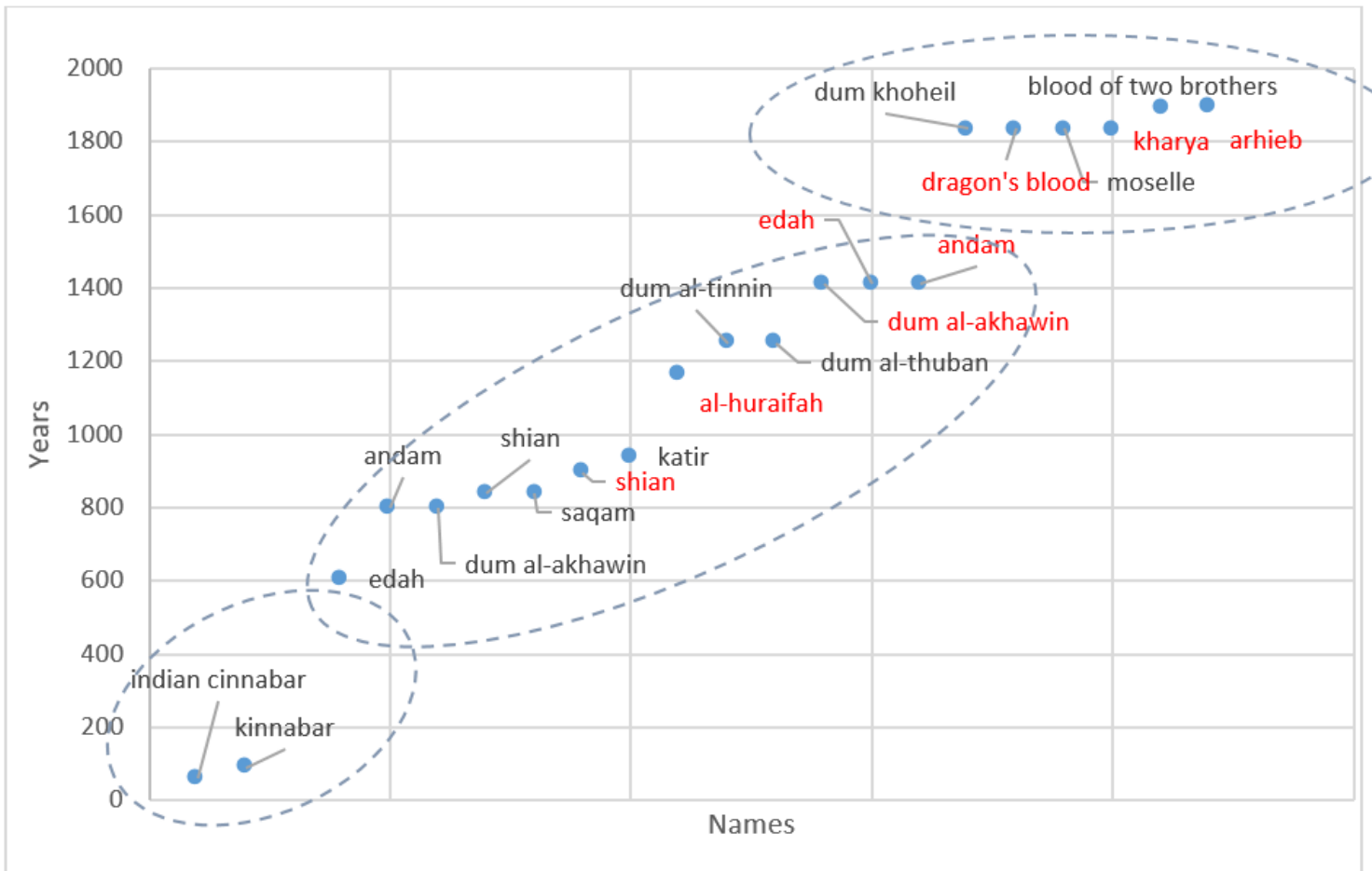


Figure 2

Map showing the study areas (Hagher, Momi, Qatanin, Ma'ala) in integrating two maps with the current and potential distribution of *D. cinnabari* according to Maděra et al. (2019)[47] and Attorre et al. (2007) [70], respectively.

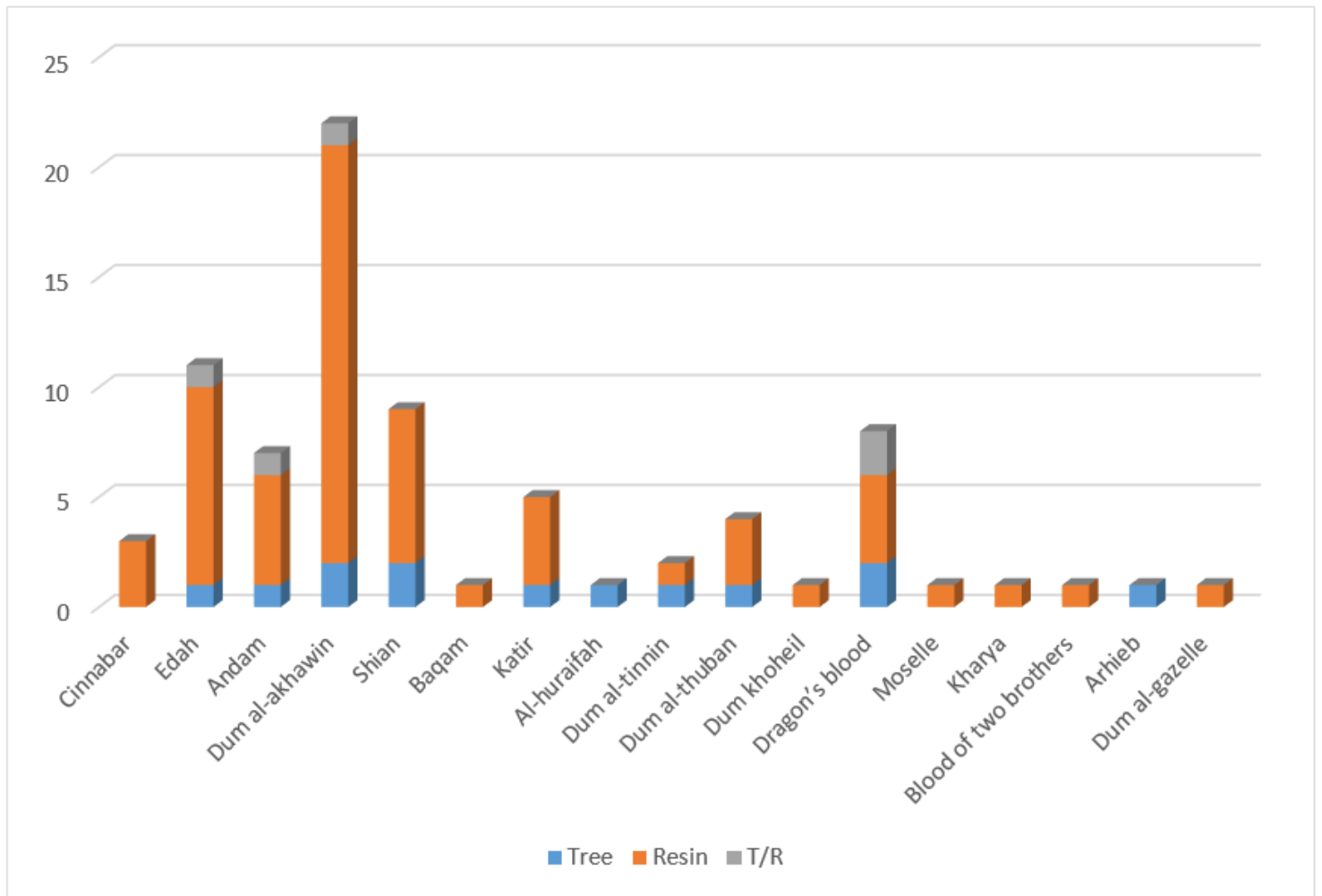


Figure 3

Frequency of appearing of dragon's blood (tree and resin) names in literature from 1st century AD to 2000 AD, T/R means that the name is given to both the tree and to the resin, references listed in Table 2.

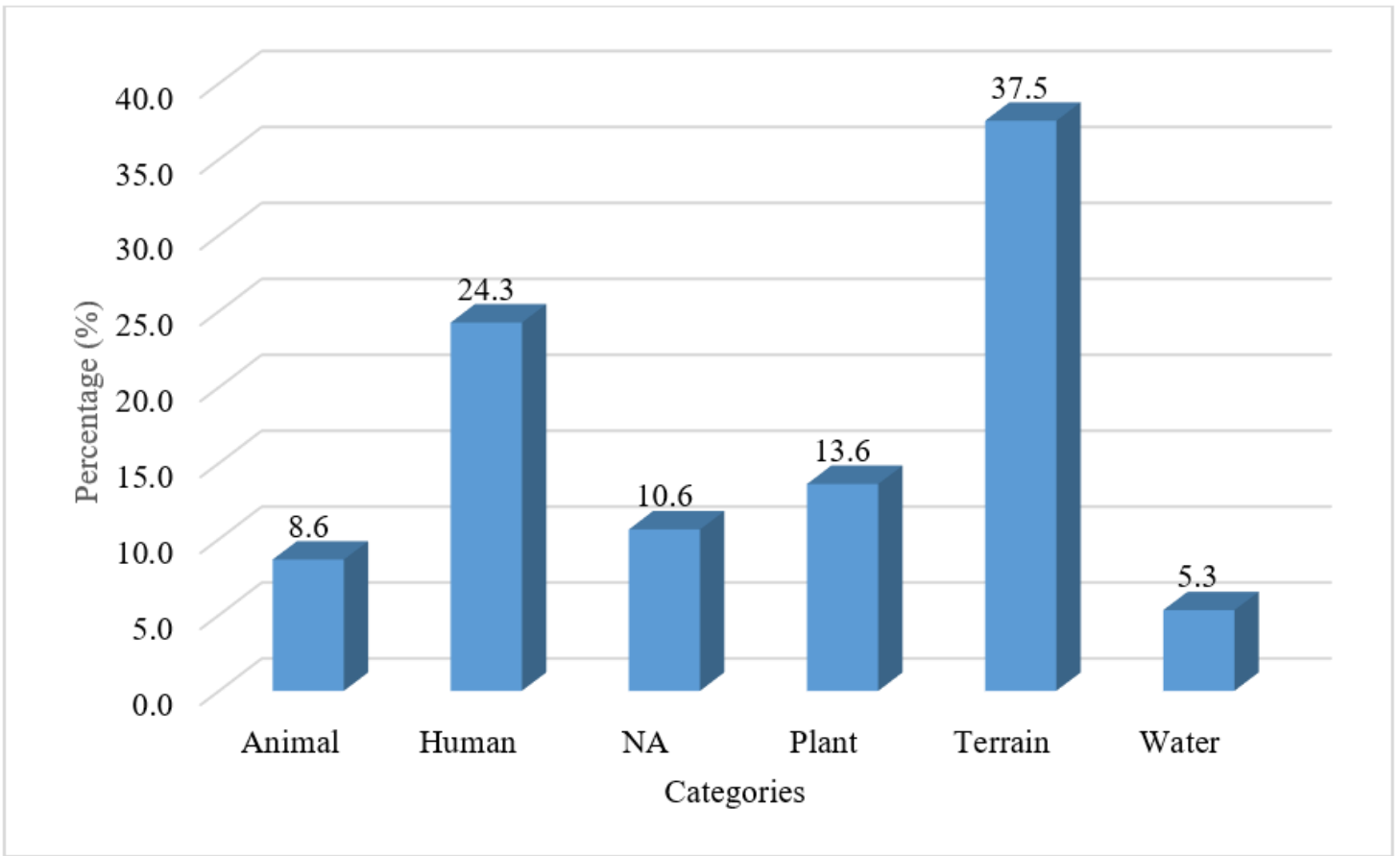


Figure 4

Frequency of toponym categories in the four selected areas on Socotra, summary of 301 names.

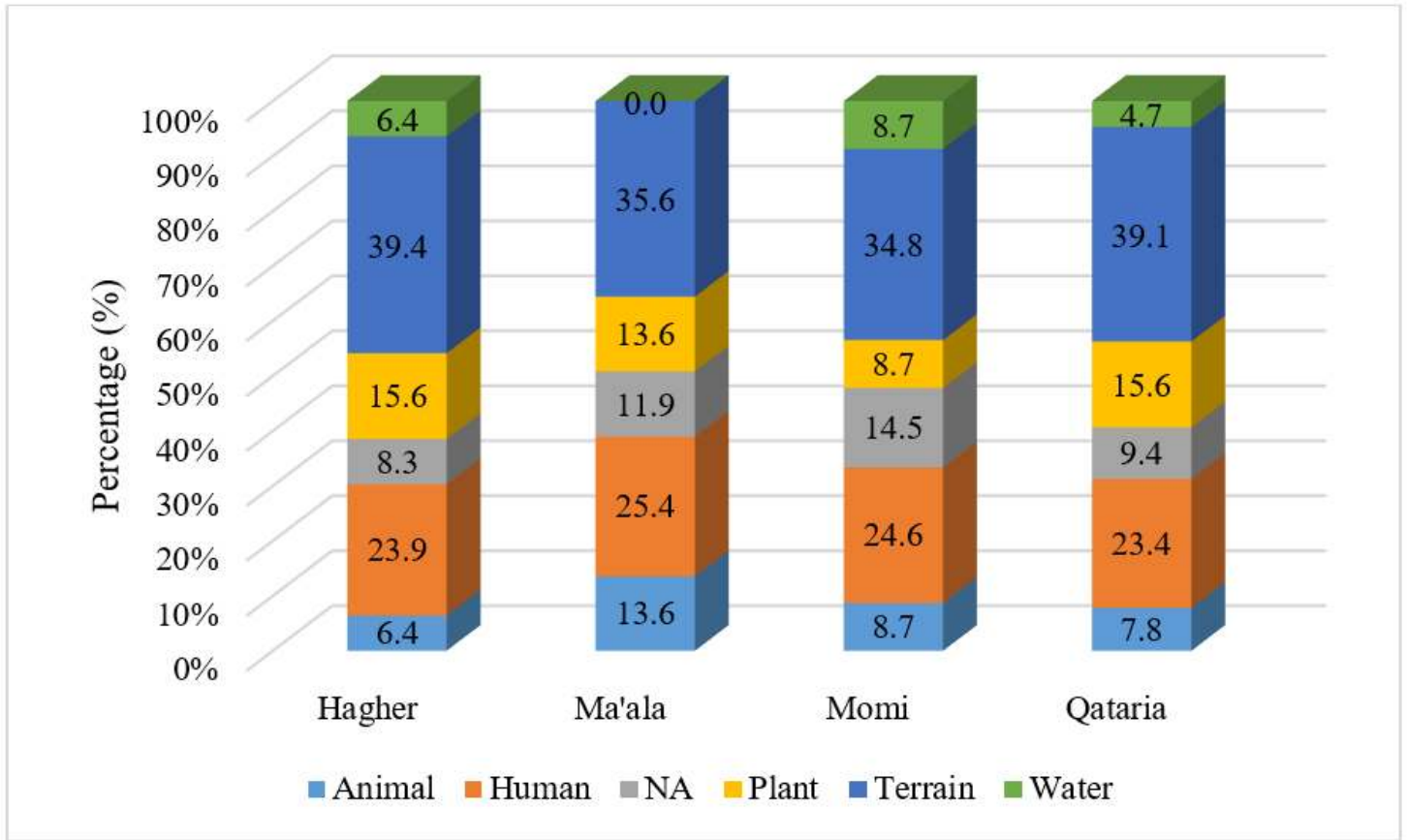


Figure 5

Frequency of toponym categories within each area

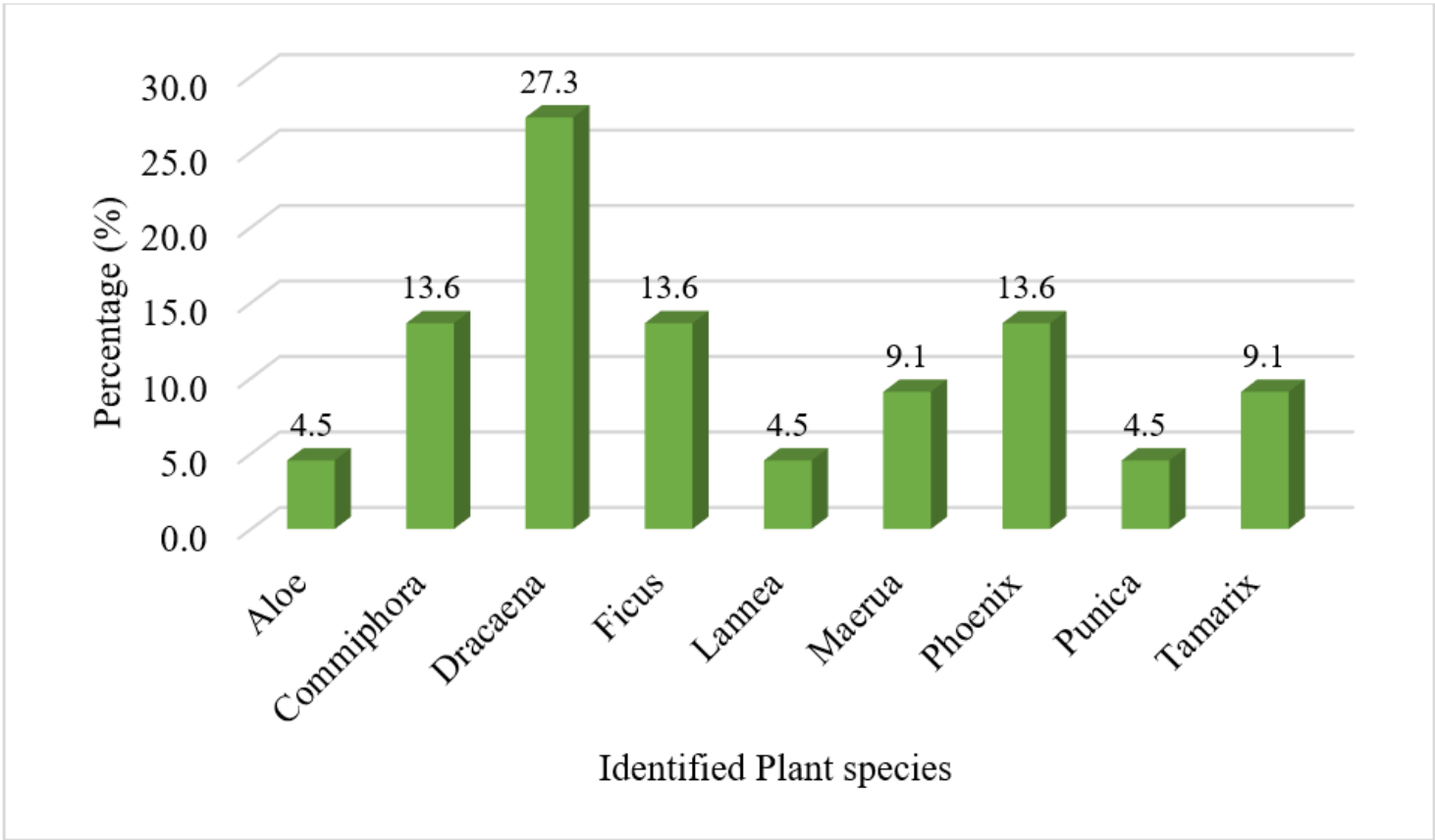


Figure 6

Frequency of phytotoponyms in the subcategory referring to identified plants (genus/species), including *Dracaena cinnabari* (27.3% of the subcategory).

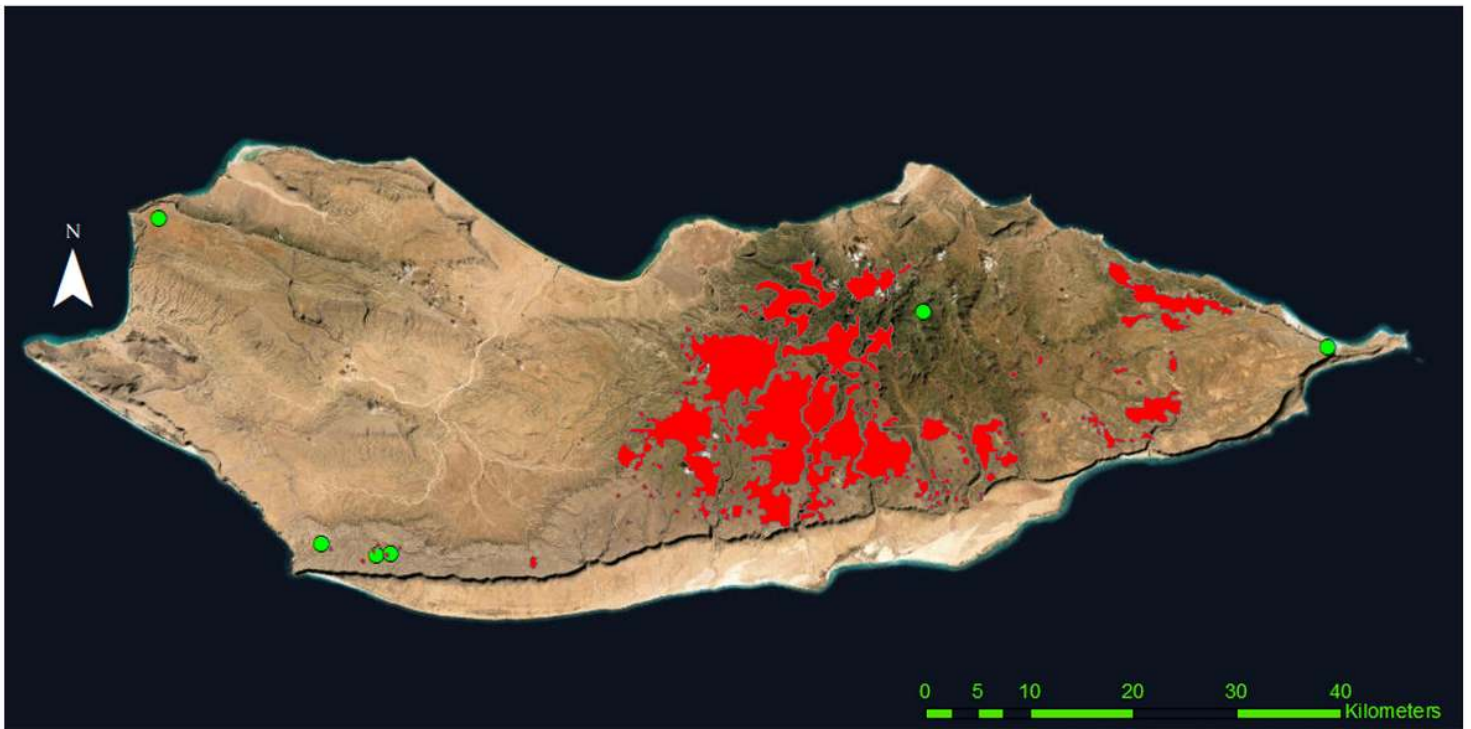


Figure 7

The map of distribution of the toponyms related to the *D. cinnabari* tree (green circles) in Socotra Island. In red, the current distribution of *D. cinnabari* by Madera et al. (2019).

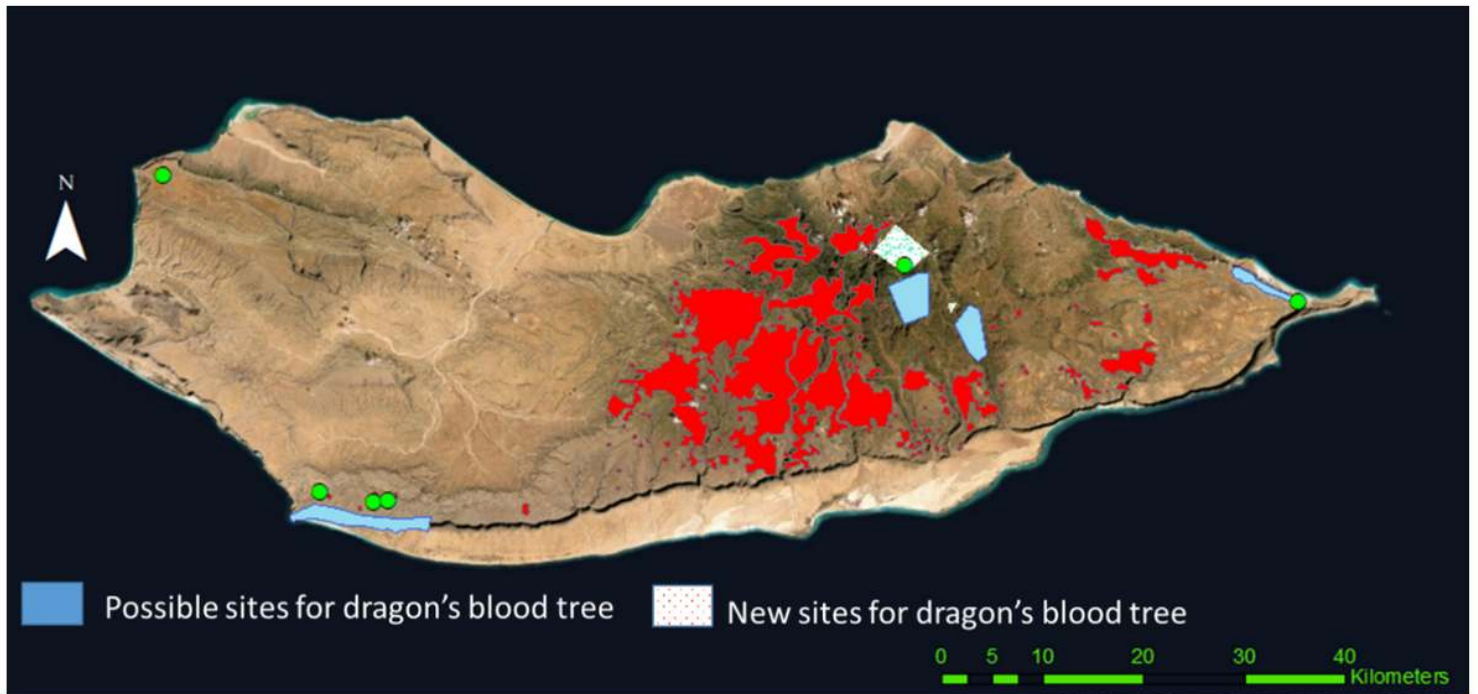


Figure 8

Map of new sites of dragon's blood tree from the field work (white polygon with dots), not published by Maděra et al. 2019 (red color) and possible sites for dragon's blood tree according to the local community for further field research (blue polygons), green points (toponyms related to *D. cinnabari*).