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Full Length Research Paper

Use of ethnobotanical criteria for conservation assessment of plants used for respiratory diseases in Lake Victoria region, Tanzania

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The focus of the paper was to use an ethnobotanical approach to identify for conservation, priority medicinal plants used for respiratory diseases in Lake Victoria region of Tanzania. Recent incidences of respiratory diseases profoundly affect plant diversity as they lead to selective consumerism of plant species. Trend of respiratory diseases in Lake Victoria region is alarming due to highest HIV prevalence. Likewise, a trend in exploitation of medicinal plants for management of respiratory diseases is alarming. Open ended questionnaires and focus group discussions were used for collecting ethnobotanical information from 37 traditional health practitioners on the use of herbal remedies against various respiratory diseases. Guideline by the international union for conservation of nature (IUCN) medicinal plant specialist group was used to assess qualitative distribution of indicator species through ethnographic methods. A protocol for conservation assessment management plan was used to prioritize limited number of species for *ex-situ* conservation. Ethnobotanical parameters, *value – index* and *legislation-index* were used for scoring in two-dimensional manner. Scoring analysis highly prioritized non-timber plants including *Rubia cordifolia, Crassocephalum manii* and *Pavetta crassipes* for conservation over timber species. From the findings, it was recommended that conservation assessment of medicinal plants could be appropriately achieved by considering local uses of plants in participatory manner.

Key words: Ethnobotany, conservation assessment, Lake Victoria region, medicinal plants, respiratory diseases, Tanzania.

INTRODUCTION

Indigenous knowledge on the use of medicinal plants offer a wide range of subsistence and cultural benefits by providing affordable means of primary health care especially in impoverished rural areas. Rural communities of various cultures in the world lived in harmony with plant species through systems of rules and norms that did not require formal enforcement as they were embodied in the moral cultures of all the people (Food and Agriculture Organization of the United Nations (FAO), 1990). Harvesting of plants including medicinal plants for subsistence rarely resulted in species-specific overexploitation (Chamberlain et al., 1998).

However, with contemporary upsurge in economic and

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market value of natural products, rural communities in many parts of the world are increasingly losing self-sufficiency as medicinal plants are harvested and transported to distant markets (Chamberlain et al., 1998). Medicinal plants are threatened by environmental and socio-economic changes. Recent incidences of some contagious diseases profoundly affect diversity of medicinal plants because they lead to selective consumerism of some specific plant species. Loss of one species affects integrity and functions of ecosystem. This study focuses on plant species used for local management of respiratory diseases in Lake Victoria region. The area has the highest human immunodeficiency virus (HIV) prevalence in the East African due to concentration of commercial farms, fishing and mining that escalate social dynamic interactions. High rates of HIV transmission and poor working conditions further increase the risk of TB among miners (international food policy research institute (IFPRI), 2011). Before the patient is clinically diagnosed for active respiratory disease in the region, they are attended-to by traditional health practitioners (THPs) whose major *materia medica* is plant based. This has been due to easy availability and sometimes only source of fast available health care (Adhikari, et al., 2010).

In East African region, lists of plants used to treat respiratory diseases exist. These include work by Schultes (1986), Adjanohoun et al. (1993) and Tabuti et al. (2010). However, until now no systematic study have been undertaken to identify priority species for conservation. Plants used for respiratory tract infections may be wiped out by human activities before they are identified. The objective of the study was to use an ethnobotanical approach to identify for conservation, priority medicinal plants used for respiratory diseases in Lake Victoria region of Tanzania. The information narrows to very important medicinal, but neglected and locally threatened plants that require immediate conservation measures.

METHODS

Research design

Open ended questionnaires and focus group discussions were used for collecting ethnobotanical and plant species information. The study reached 37 THPs on the use of herbal remedies against various respiratory infections.

For each listed medicinal plant species, current qualitative diversity and distribution was assessed according to the guideline by the IUCN medicinal plant specialist group (MPSG) (2007). The technique involved mentioned medicinal plants as indicator plants through ethnographic methods.

Study sites and period

Data was collected over a period of eight months from March to October 2010 among various ethnic communities in Musoma, Bunda, Magu, Geita and Sengerema Districts in Tanzania. These districts were selected purposively based on high incidence of respiratory diseases and tuberculosis (TB) in particular due to high HIV prevalence in the region. Traditional health practitioners were asked to identify respiratory diseases by using local symptoms they knew. Voucher specimens were collected in duplicates and deposited at the herbarium of the Institute of traditional medicine.

Ethnographic data analysis

Analysis of Variance (ANOVA) and t-test were used to test the relationship between ethnographic factors and the knowledge of respiratory diseases in the region.

Prioritization process of medicinal plants

The general protocol for conservation assessment management plan was used for prioritising plant for *ex-situ* conservation whereby ethnobotanical parameters were used for scoring in two-dimensional manner. The ethnobotanical practices considered to have severe effect on plants diversity were assigned “1” value, or else “0” score. The sum total scores for each species were added to *value – index* (Importance of species) and the *legislation-index* (adequacy of legislation provisions). A high index value was a sure indication of the need to protect a species and vice-versa.

Approaches for the scoring and prioritization process

Scoring of medicinal plant species with focus to ethnobotanical significance

Designated scores were assigned to each species on the checklist based on the knowledge of researchers, as well as on support material from data sets, books and other literature as presented in Table 1. Scoring against *value-index* and *legislation-index* was based on the following: (Table 2).

Red list status/biodiversity status

The extent to which the species is considered threatened or potentially threatened with extinction according to the IUCN Red List system of categories and criteria

Importance as a keystone species

The importance of the species in relation to ecosystem functioning, particularly fragile ecosystems, or the extent to which important fauna and other flora are dependent on the species.

Sustainability of use

The commercial significance of the species in relation to formal and informal economies, and whether the species is being utilised in a sustainable manner

Cultural/spiritual value

The social importance of the species in relation to sustaining spiritual or cultural values, and the importance of the aesthetic value in landscapes.

Table 1. General criteria used for ethnobotanical scores.

S/N	Ethnobotanical criteria	Score	Score justification
1	Roots, corms and bulbs used for medicine	1	Excessive harvesting or girdling of barks kills plants
2	Bark used for medicine	1	
3	Leaves used for medicine	0	Leaves can easily regenerate
4	flowers, fruits used for medicine	0	Has less effect
5	Total uprooting when doing harvesting	1	Uprooting a plant or extracting a tap root
6	Ring barking girdling	1	Girdling intercept down flow of nutrients to the roots
7	Total harvesting of flowers and fruits for herbs	1	Total harvesting may impede future regeneration, uprooting of a herb is scored 1 even for leaves, flowers and fruits as the whole plant is killed except when the herb population is too great.
8	Short shelf life of medicinal preparation	1	Increases frequency of harvesting
9	Number of patients > 30 per month	1	Large amount is harvested
10	Medicine stored in powder form	0	Reduces frequency of wildcrafting
11	Medicine only in liquid form	1	Not stored long, hence increase frequency of wildcrafting
12	Multiple respiratory diseases	1	
13	Used for commercial timber extraction	1	increase amount removed from the wild
14	Used for making charcoal	1	

Table 2. Criteria used for scoring value and legislative criteria.

S/N	Value and legislation index criteria	Score	Score justification
1	Is in red list of threatened species	0	Species is adequately protected under legislations
2	Endemic species	1	Need protection
3	Found in well protected forests	0	Encroachment is controlled
4	Found in fragile habitats	1	For protecting the fragile habitat
5	Cultivated	0	No need of conservation
6	Found in restricted environment	1	Most fragmented ecosystems prevent genetic flow
7	Exposed to deforestation and other economic land uses	1	Need protection
8	Difficult to propagate	1	May fail to regenerate
9	Sensitive to fire and exposed to fire prone areas	1	Regeneration may be affected
10	Has high commercial value	1	Risk of over harvesting
11	Use is restricted by local rules	0	Strict local rules prevent depletion
12	Free access	1	Risk of over harvesting
13	High spiritual value	0	People observe norms
14	High aesthetic value in the land scape	1	High environmental value
15	Accessible roadway in the area	1	Accessible roads sensitize commercialization

Legislative provisions

The extent to which the species is adequately protected in terms of national legislation and provincial ordinances.

RESULTS

Respiratory diseases as recorded from 37 THPs and the average number of patients per month in Lake Victoria basin in Tanzania is summarized as; TB (ranged from 1 to 5 patients per month), asthma cases ranged from 1 to 30, Cough from 10 to 70 and one case for both pneumonia and bronchitis. The following were the most frequently mentioned signs of respiratory diseases; signs of TB were coughing sputum and coughing blood, signs of Asthma were coughing and whistling breathing, signs

of Pneumonia were labored and prickly inbreathing and signs of Bronchitis were dry and persistent cough.

The analysis of variance that involved tuberculosis as dependent variable found that there was significant relationship between the level of knowledge of plant species used to treat tuberculosis and the sex of the THPs (P≤ .001) and the age of THPs (P≤ .001). Male THPs had better knowledge than the female counterparts. The results further showed that although sex and age were crucial determinants of indigenous knowledge on herbal treatment, it also had a negative impact. This negative impact implies that indigenous knowledge was mainly confined to the older members of the community.

Medicinal plants used to manage respiratory diseases

Various plant species were used to manage respiratory disease in Lake Victoria region Table 3 presents the most commonly used species.

Compilation of the preliminary list

A preliminary checklist of all plant species as mentioned by traditional health practitioners for management of respiratory diseases was developed (Table 3).

Local perceptions on the distribution of plants used for respiratory diseases

As long as all species were from the same eco-region of Lake Victoria mosaic, one could expect even distribution of plants in all surveyed districts, however, because a plant could be used as medicine by one community in one district and not the other, the record on availability was scewed toward the districts where particular medicinal plant was recorded for local management of respiratory diseases (Table 4). This does not justify absence of the same plants in other districts.

Results of scoring analysis of ethnobotanical and use-value index criteria

The overall scores for each species were obtained by summing scores for ethnobotanical criteria, use-value and legislation indices criteria. The sum scores ranged from 22 to 2 as follows. *Rubia cordifolia* scored 22, *Crassocephalum manii* (21). *Warburgia ugandensis* (20), *Pavetta crassipes* (18), *Cordia africana* (17), *Albizia versicolor* (16), *Bridelia micrantha* (16), *Crassopterix febrifuga* (15), *Zanha africana* (15), *Zanthxylem chalybeum* (15), *Albizia anthelmintica* (15), *Diospyros fischeri* (13), *Entada abyssinica* (13), *Afrormosia angolensis* (13), *Albizia sieberiana* (12), *Balanites aegyptiaca* (12), *Erythrina abyssinica* (12), *Croton dichogamus* (11), *Dalbergia stuhlmanii* (11), *Acacia brevispica* (10), *Boscia angustifolia* (10), *Securidaca longipenduculata* (10), *Friesodielsa obovata* (9), *Dichrostachys glomerata* (7), *Ficus cycomorus* (7), *Hoslundia opposita* (5), *Moringa oleifera(5), Cajanus cajan* (3) and *Trichodesma zylanicum* (2).

DISCUSSION

Knowledge of respiratory diseases by traditional health practitioners

The symptoms of respiratory diseases according to traditional health practitioners were partially similar to the general clinical allopathic symptoms though disparities exist in details. In most cases there was mixing up as most respiratory diseases initially express themselves alike. THPs mentioned loss of body weight and coughing blood as the common symptoms of TB, while the common symptoms of respiratory tuberculosis according to published literatures includes malaise, weight loss, fever and night sweats, over three weeks cough, breathlessness chest pain (Schneider, 2006). THPs mentioned coughing and whistling breathing as the common sign of asthma, while the major clinical symptoms according to Schneider (2006) are cough, wheezing when inbreathing and breathlessness. Only one traditional healer claimed to know symptoms of bronchitis as dry and persistent cough, while clinical symptoms includes high temperature, chest pain, especially on coughing and expectoration (Schneider, 2006). Symptoms of pneumonia according to THPs were prickly pains when inbreathing. Clinical signs may be persistent cough and dyspnea, stabbing pains in the side, shivering, headache, coughing up dark sputum, cold sore, bluish skin and mucous membrane (*ibid*)

Number of patients managed by THPs and its impacts on medicinal plant use

Respiratory diseases managed by majority of THPs was cough (>30 patients per month), asthma less than 30 patients per month and tuberculosis less than 10 patients per month. Large number of plant species about 19 were used for management of cough, 15 for asthma and 11 for tuberculosis (Table 3). Early sign of most respiratory diseases was coughing that progresses depending on the root of the disease, and consequently, at early stages, patients are managed the same way with the same medicinal plants. As the condition of respiratory diseases worsen, only few and mostly older and experienced THPs are approached. In this case, plant species that are not in public domain such as *Crassocephalum manii, Codia africana, Crassopterix febrifuga, Warburgia ugandensis*

Table 3. Common Plant Species Used to treat respiratory diseases in Lake Victoria region.

Scientific name	Disease	Part used	Preparation
Acacia brevispica Harms	TB/cough	Root bark	Decoction of *A. brevispica* (Root bark) + *W. ugandensis* (Stem bark) + *C. febrifug*a (Root bark) + Lusunga root in hot water. 1 spoon full + 3 daily till recovery
Afrormosia angolensis Baker	TB	Root bark	Powder in hot water, 1tsp x 3
Albizia anthelmintica Brongn.	Asthma /Cough	Bark	Powdered bark boil in water; 1cup × 3(Asthma), 1cup × 4 (cough)
Albizia sieberiana DC.	Bronchitis	Roots	Boil roots
Albizia versicolor Welw	Cough	Root	Grind and cook root with a lizard called *gemwambuli*; 1tsp × 3
Balanites aegyptiaca L.	Cough	Bark	Powder in hot water plus salt; 1cup × 3, or lick powder + salt
Boscia angustifolia A. Rich	Cough	Bark	Stem bark boiled in water; 1tsp × 3
Bridelia micrantha Hochst..	Cough	Inner bark	Chew inner bark + salt
Cajanus cajan (L.) Druce	Cough	Leaves	Dry leaves in hot water; 1tsp × 3
Cordia africana Lam.	Cough,TB, asthma	Root	Management not given
Crassocephalum manii Hook.	TB, Asthma	Root	Boil roots with a soup of sheep Used fresh, 1cup × 3.very short shelf life of 3 days
Crossopterix febrifuga Benth.	TB, cough	Root bark	Root powder of *C. febrifuga* and *C. africana* are soaked in hot water; 1 table spoon × 3 till cure, or Root powder of *D.glomerata* and *A. versicolor* are boiled in water + *Piper nigrum* + Ginger. Dosage not given
Croton dichogamus Pax	Asthma	Root bark	Decoction; cup × 3 till recovery. Or smoke dry leaves
Dalbergia stuhlmannii Taub	Asthma	Root bark	Soak powdered root in cold water, 1 table spoon × 3 daily
Dichrostachys glomerata Chiov.	TB/asthma	Root bark	Boil mixed root powder of *D.glomerata* and *A. versicolor* + cow liver. Dozage not given
Diospyrose fischeri Hochst	Asthma &Cough	Leaves	Soak pound leaves in fresh cold water; 1 cup x 3 till cured
Entada abyssinica Steud. ex A.Rich.	Asthma, TB,Cough	Root bark	Powder in boiled in water, oral: Doze 125 ml × 3 till cure
Erythrina abyssinica Lam.	Cough	Root	Powder in hot water; 1tsp × 3
Ficus sycomorus L.	TB	Leaves, Bark	Fresh leaves boiled in water, 1 cup × 3 for TB, bark powder soaked in hot water for cough
Friesodielsia obovata (Benth.)	Asthma	Root bark	Root soaked in cold water, cup × 3
Hoslundia opposite Vahl	Asthma, cough	Roots	Powdered roots, boil in water; 1tsp × 3
Moringa oleifera Lam	TB	Leaves	Fresh leaves boiled + lime juice+ *piper nigrum*+table salt; 1cup × 3
Pavetta crassipes K.Schum.	TB	Root	Grind dry/fresh roots + chicken soup. Period no given
Securidaca longipenduculata Fres	Asthma, Cough	Root bark	Powdered root boil in water; 1tsp × 3
Rubia cordifolia L.	Cough	Roots	Not stated
Sterculia africana (Lour.) Fiori	Asthma	Root	Powdered root in hot water; 1tsp × 3
Trichodesma zeylanicum R.Br e	Cough	Shoot	Boil, dosage not given
Warburgia ugandensis Sprague	TB	Stem bark	Powder in boiled water, oral: Doze 125 ml × 3 till cure
	Cough, Asthma	Stem bark or Root	Stem bark boiled in water; 1cup × 3 for TB and asthma, or soak powdered root in cold water, 1 table spoon × 3 till cure for cough
Zanha africana (Radlk.) Exell	Asthma, cough	Bark	Lick powder 2 × day
Zanthoxylem chalybeum (Engl.) Engl	Cough, Asthma	Root bark	Powder in cold water, or Powdered root in hot water; 1tsp × 3 for cough

and *Pavetta crassipes* are among plants used. This study relied on information released voluntarily by THPs; authors to this stage could not scientifically confirm their bioactivities. Some plants were being used in greater quantities depending on number of diseases and average number of patients per month such as *Warburgia*

Table 4. Distribution of medicinal species by districts in Lake Victoria region.

Scientific name	District	Propagation	Other remarks
Acacia brevispica Harms	Geita	Seeds	Abundant
Afrormosia angolensis Baker	Sengerema and Magu	Not known	Not available
Albizia anthelmintica Brongn.	Sengerema	Seeds	Available but in small sizes 15±5cm dbh
Albizia sieberiana DC.	Bunda	Seeds	Naturally in low densities and yet extracted for building poles.
Albizia versicolor Welw	Geita	Seeds	Secondary sprouts about 1 – 3 m tall
Balanites aegyptiaca L.	Bunda, Magu and Musoma	Seeds	Common plain and black soil tree in scattered stands
Boscia angustifolia A. Rich	Magu	Unknown	Found on termite mounds
Bridelia micrantha Hochst..	Bunda	Unknown	Available at the sizes of 1-2 meters tall
Cajanus cajan (L.) Druce	Widespread	Seeds	Cultivated
Cordia africana Lam.	Bunda, Magu	Seeds	Conditions for germination not known, it is rare due to habitat destruction
Crassocephalum manii Hook.	Bunda	Cuttings	Over exploited in the area, found on fragile habitats
Crossopterix febrifuga Benth.	Magu, Geita Sengerema	Not stated	Pirated for medicine via Senegal
Croton dichogamus Pax	Musoma, Sengerema	Unknown	Available
Dalbergia stuhlmanii	Magu	Seeds	Retained in farms
Dichrostachys glomerata Chiov.	Magu	Seeds	Difficult to germinate that make their planting uncommon.
Diospyrose fischeri Hochst	Magu	Unknown	Available
Entada abyssinica Steud. ex A.Rich.	Reported in all districts	Seeds	Critically locally endangered. Severely debarked for medicine
Erythrina abyssinica Lam.	Magu	Seeds	Difficult to germinate that make their planting uncommon.
Ficus sycomorus L.	Magu	Cuttings	found mainly on moist river valleys
Friesodielsia obovata (Benth.)	Sengerema	Unknown	Available
Hoslundia opposite Vahl	Magu	Seeds	Available
Moringa oleifera Lam	Magu, Geita	Cuttings seeds	Planting not yet popular
Pavetta crassipes K.Schum.	Musoma	Wildings	bush dependent and require well sheltered habitat
Securidaca longipenduculata Fres	Magu	Unknown	Rare
Rubia cordifolia L.	Musoma	Unknown	Overexploited
Sterculia africana (Lour.) Fiori	Bunda	Not stated	Available
Trichodesma zeylanicum R.Br e	Bunda	Seeds	Weed on farms
Warburgia ugandensis Sprague	Reported in Geita and Sengerema	cuttings	Overexploited from its in riverside natural habitats
Zanha africana (Radlk.) Exell	Geita, Bunda	Unknown	available in small sizes
Zanthoxylem chalybeum (Engl.) Engl	Magu	Seeds	Available as small trees. Has slow growth

uganndensis, Cordia africana and *Entada abyssinica.* Despite their multiple medicinal applications, they are among rare plant species in the area.

Use of ethnobotanical criteria for prioritizing medicinal plants for conservation

Use of ethnobotanical approach for conservation assessment results into an exceptional hierarchical order compared to conventional methods that favours timber species. The scoring analysis in this study top list non-timber species for conservation. These includes *Rubia cordifolia* (22 scores), *Crassocephalum manii* (21) and *Pavetta crassipes* (19). These have ranked higher than even trees namely *Warburgia ugandensis* and *Zanthoxylem chalybeum* that are identified by TRAFFIC (2000) as priority plants for conservation. *Rubia cordifolia*

is widely used in African traditional medicine for diverse type of diseases and also exported as powdered Indian madder for dyeing to Europe, North America and Japan from India (Oyen, 1991). In all these uses, the plant is uprooted whole. Other highly scoring species *Crassocephalum manii* and *Pavetta crassipes* are also uprooted whole for multiple medicinal uses (International Centre for Research in Agroforestry (ICRAF), 1992). Roots are the most potent parts of some plants (Storr, 1995), and uncontrolled root harvesting for medicine has severe effect to herbal plants especially when they are in low stock (Storr, 1985, Otieno, 2000). High rate of respiratory diseases due to rising HIV cases in Lake Victoria is alarming, and so does the diversity of medicinal plants used to combat respiratory diseases in Lake Victoria basin.

Some ethnobotanical activities have selective effect to the ecosystem and to the whole eco- and agro-ecosystems. Adhikari et al. (2010) reports that uprooting of *Aloe spp* and *Asparagus racemosus* for medicine caused large scale soil erosion in Maradavally forests. Unluckily, localized threat to such simple species is hardly addressed on the grounds that the effect does not conform to UICN red list criteria for declaring an organism a threatened species. The critical point of concern here is that even if a species is not categorized a threatened species to IUCN scales, its scarcity to a particular community must have local impact that deserves to be addressed locally. Rural communities in Lake Victoria region are less craving for domesticating useful threatened plants. They alternatively search for them even to great distances. Arjun et al. (2009) report the same in India where even though *R. cordifolia* has been in international market since 18th century, people are occasionally cultivating the plant. Whenever a medicinal plant become unavailable, its use is overtaken by less important species, or else, complex concoctions of unpopular medicinal plants are formulated. Newly formulated concoctions have not evolved with communities, as such are not locally proven for activity and safety through trial and error that produced very important local remedies used today.

Despite the down spirit to domesticate indigenous plants in Lake Victoria region, publications on propagation of mentioned plant species are available such as Rufo et al. (2002), Beentje (1994), Albrecht (1993), Katende et al. (1995), Bein, (1996), Baumer (1983), Vogt (1995), Bekele-Tesemma et al. (1993).

Domestication of medicinal wild varieties is constrained by number of factors including misconceptions, attitudes and unawareness on the specific propagation conditions.

For example, some assume that domestication lessen medicinal potency of wild plants.

Conclusion

Ethnobotanical approach is desirable when planning conservation assessment for management planning of plant resources as it places value on unpopular plant species for conservation most of which are non-timber plant species. Most national forest policies are biased and structured to safeguard tradable timber plant species. Medicinal plants most of which are non-timber forest products are now extensively explored for marketable products and will soon face massive exploitation to the global market. Even at local levels, abundance or rarity of medicinal plants is a matter of concern as it has adverse direct local impact on the livelihoods of communities concerned. The use of some plant species for medicine is much localized and as such has greater local impact than global.

Though rural communities are aware on various methods of regenerating some medicinal wild plant species by using different propagules, propagation of indigenous medicinal plant species in the study area is not a common practice even for widely used species. There is a gap between scientific research and indigenous knowledge on planting of some wild species as the research results do not trickle down to reach communities in rural settings who may need it most.

RECOMMENDATIONS

Assessment of herbal or simple medicinal plants with locally important medicinal value could be better achieved by considering local uses linked to these. This can be achieved by involving communities whose survival is affected by either a loss or abundance of individual plant species in their environments.

As most medicinal plants are extracted for their roots, total uprooting of non-timber plants for medicine can be reduced significantly through chemical profiling of leaves for possible presence of same active chemotypes of the roots. Harvesting of leaves for medicine can has less deteriorating effect due to fast proliferation cycles.

Medicinal plants with market value should be treated as important resources for sustainable development through commercial cultivation. *Rubia cordifolia* and *Warburgia ugandensis* are proposed for commercial cultivation.

There is a need to establish a link between communities who are dependent on plants for their primary healthcare and researchers on *ex-situ* conservation of locally important medicinal plants.

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