



***Monochoria africana* N.E.Br. [Family Pontederiaceae]: Probable Reasons for Limited Distribution of This Rare Species in Kenya**

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Authors' contributions

This work was carried out in collaboration among both authors PKN and JKM. Both authors designed the study, carried out fieldwork and wrote the first draft of the manuscript. Author PKN managed the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/APRJ/2020/v6i130116

Editor(s):

(1) Dr. Msafiri Yusuph Mkonda, Sokoine University of Agriculture, Tanzania.

Reviewers:

(1) Sergio Adrián Murillo Montoya, Secretaria de Educación de Caldas, Colombia.

(2) Rodrigo Martins dos Santos, São Paulo State University (UNESP), Brazil.

(3) Smita Kolhe, Savitribai Phule Pune University, India.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/58957>

Short Communication

Received 10 May 2020
Accepted 17 July 2020
Published 05 August 2020

ABSTRACT

Monochoria africana N.E.Br. is an extremely rare plant with limited distribution in Kenya. Rare plant species are often specialists for a rare microhabitat and there is all likelihood that *Monochoria africana* is a habitat specialist. Our research on distribution of this species in Kenya has so far located it in a very small isolated microhabitat in the Tana River delta, coastal region of Kenya. So far, this plant has only been located in one community farm in a small village called Ozi, near Kipini, Latitude 2°30'33"S and Longitude 40°27'20"E. The methodology used in this study entailed direct observations, line transects, meander and patterned searches in its narrow area of endemism. In this short communication, the authors hypothesize various reasons for the limited distribution of this rare species. Viz: diverse edaphic factors, inbreeding depression, low levels of seed set, genetic bottlenecks, specialized pollination systems etc. At the Jomo Kenyatta University of Agriculture and Technology (JKUAT) department of Botany greenhouses, we have embarked on some studies to try and unravel probable reasons for rarity of *Monochoria africana*.

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Keywords: *Monochoria africana*; limited distribution.

1. INTRODUCTION

Factors that influence distribution of plant species are extremely varied and dynamic in nature. They could be inherently biological, anthropogenic, environmental, edaphic, physical and chemical. They could also be as a result of biotic factors (Competition, parasitism, symbiosis, commensalism etc.). Studies of existing plant community patterns provide only correlative evidence for the agents that control plant distribution. Field and greenhouse experiments are a valuable additive to studies on restricted distribution of plant species but seldom tell whether factors such as symbiosis and competition are adequately sufficient to account for observed restricted distributions.

Monochoria africana (Fig. 1) is a robust annual (or perhaps sometimes perennial), erect, aquatic herb about (0.6-1 m tall). The stems are short and corm-like, and the juvenile leaves are submerged, extremely variable in size and shape, scale-like to linear. Adult leaves are emergent, differentiated into petiole and blade; blade elliptic to ovate, up to \pm 85-100 mm; petiole erect, \pm 500 mm long. The inflorescence is elongated, spike-like, with 25-45 \pm equally spaced, blue flowers, and the peduncle is erect, 20-40 mm long. Petals 6, blue, 14.5-3.5 mm, persistent and enveloping ripe fruit. There are 6 stamens, of 2 kinds: 5 with simple filaments up to 5 mm long, and yellow, 1.8-4 mm long anthers. The sixth anther is blue, at least one quarter longer than the yellow ones with a longer filament (up to 5.5 mm long) and has an appendage attached to the filament that curls up along the side of the large blue anther. All six anthers arise from the perianth, opening by an apical pore, which later splits downwards. Capsules are ellipsoid to ovoid, \pm 9 mm long; style 1.5-2.5 mm in fruit, opening by 3 valves but normally released as a unit and opening later. Seeds are numerous, ellipsoid to barrel-shaped, \pm 0.80 mm long, with 10 narrow, longitudinal ribs or wings, dispersed in mud and by water [1].

In this study, we embarked on ascertaining the existence of *M. africana* at Ozi village, Tana River county, Kenya since it was first reported there in the late 1950's as a rare species that is narrowly distributed. The authors also looked at its conservation status. The authors ultimately hypothesize probable reasons for its limited distribution in its area of endemism.



Fig. 1. The rare *Monochoria africana* in bloom (photo taken by John K. Muchuku)

2. MATERIALS AND METHODS

2.1 Study Area

The study area is located in Kenya coastal region in Tana River County, at Ozi village irrigation scheme, astride the Indian Ocean and at the Tana River's main channel to the ocean, near Kipini (Fig. 2). The village is located at the lower Tana flooding plains and lies between Latitude 2°30'33"S and Longitude 40°27'20"E. The Map by Duvail, Médard, Hamerlynck, & Nyingi was used to locate the village during the present study field excursion [2].

2.2 Preliminary Study

M. africana preliminary study was based on a review of flora of Kruger [3] and Flora of Tropical East Africa (FTEA) family Pontederiaceae [1]. These two flora highlighted an extremely limited distribution of this species in South Africa and Kenya respectively. The authors of the current paper then set out to approve or disapprove this hypothesis of limited distribution in Kenya.

At the beginning, the authors established contacts with Ozi village, Tana River County, Kenya through one university student (studying Plant Ecology and Environmental sciences) who is a resident in the village. It was then possible to get in touch with local leaders and rice farmers. The authors explained the study objectives to the leaders and the rice farmers and the student assisted in translations to the locals through the indigenous language prevalent in the area.

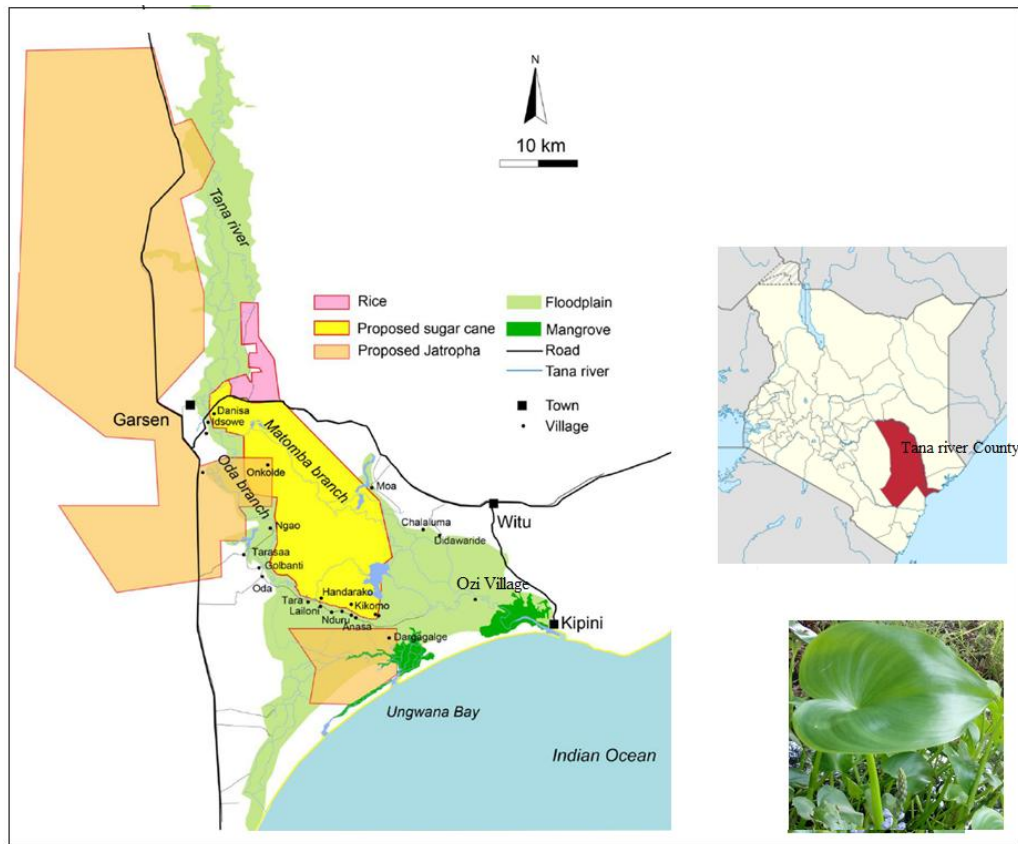


Fig. 2. Location of Ozi village in Tana River County (Modified from Map by Duvail, Médard, Hamerlynck, & Nyingi 2012)

Local guides were recruited to facilitate in movement and collection of samples in the study area using snowball method [4].

2.3 Site Surveying Techniques to Determine Distribution and Habitats

The entire irrigation scheme was surveyed and explored for presence and distribution *M. africana*. Data were collected using the following methods

1. Direct observations and photography using a digital camera
2. Line-transects, Meander and Patterned searches
3. Interviews
4. Voucher specimen and field data collection

The line-transects [5] meanders walks and patterned searches [6] methods were employed to increase chances of recording all fragmented *M. africana* sub-populations. Line-transects, meander and patterned searches were arranged

in many designs to determine population size, habitat threats and entire population's morphological characteristic variation in the entire study area. Specimens of each sub-population were identified *in situ* with the help of the *Flora of tropical East Africa* (FTEA) family Pontederiaceae and other available publications [3,1] Photographs were taken to represent the plant in its original context. Voucher specimens were also collected, dried, poisoned, and mounted at JKUAT Botany Department herbarium. All mounted voucher specimens were deposited in the herbarium. Life specimens of every sub-population were collected for conservation and future studies at JKUAT Botany Department greenhouses.

3. RESULTS

3.1 Preliminary Study

3.1.1 Conservation status

Very little is known about *M. africana* in East Africa. It occurs sporadically in a localized area in

Kenya, around the Tana River basin, in the Tana River County, at Ozi village near Kipini (Latitude 2°30'33"S and Longitude 40°27'20"E) and a few localized areas beyond Kenyan borders. However, no Conservation sites have been identified for this species in Kenya. Additionally, according to the rice farmers in Ozi village, they termed the species as notorious rice weed and they were using all possible methods to eliminate this plant from their rice fields. It's reported to occur in at least one protected area in South Africa. This species has a fairly limited distribution in Kenya. So far, the authors have not come across any information on occurrence of this species outside the area so far identified in the Tana River basin. With the present anthropogenic activities at the collected site and efforts by the farmers to wipe out the species in their rice farms, there is a need for conservation of the species. Without conservation the species could be locally extinct in a few years to come.

3.1.2 Distribution and habitats

M. africana population in Kenya is currently limited within community farms near the Indian Ocean, Tana river county, at Ozi village near Kipini, in Tana Delta. The species inhabit areas in either isolated marshy areas next to rice plantations or as weed of rice farm. Ozi village covers approximately 500 acres. Approximately 100 subpopulations were identified during the study covering the entire village.

4. DISCUSSION

As expected, we found out that *M. africana*, a plant species with extremely small population is found in fragmented habitats in its area of endemism. Boyce [7] highlighted that small populations are more likely to be impacted by environmental events such as diseases, floods and fires. Lande [8] states that genetic simplification that often accompanies severe population decline can reduce a species ability to adapt to changing environmental conditions, lead to higher rates of inbreeding and the expression of deleterious genes. All these are possible factors that could account for the severely limited distribution of *M. africana*.

Sometimes, extensive clonal behavior coupled with low levels of seed set show that self-incompatibility may be combining with low genetic diversity to constrain recruitment in rare plants. This is a very likely scenario for *M. africana*. Specialized pollination system is also a

likely contributor to limited distribution of *M. africana* like in the rare and endangered plant *Caladenia hegelii* (Orchidaceae) which is pollinated by only one pollinator, *Macrothynnus insignis* [9].

4.1 Other Probable Reasons for Limited Distribution in Kenya

Edaphic factors can lead to restricted distribution of plant species. Soil properties influence germination, growth and proliferation of plants. Effect of soil P^H, porosity, soil chemical composition etc all have direct effects on plant establishment [10]. Different species respond to these factors differently and in addition to other factors, these edaphic factors can influence distribution of plant species [11]. For *M. africana*, since young plantlets normally thrive submerged under water at the edges of fresh water bodies or in our case in rice plantations, it is likely that soil P^H and soil chemical composition could play a role in determining establishment of these aquatic plants.

Inbreeding in populations may lead to harmful genetic effects [12]. This is normally due to significant loss in genetic diversity. The term genetic bottleneck is used to refer to significant loss of genetic diversity. This ultimately results in reduction in numbers of individuals within a population. Inbreeding may also be associated with adaptation to highly specialized environments where only very specialized individuals can thrive.

5. CONCLUSIONS

In an attempt to conserve this rare plant, we have collected voucher specimens and live plants. They are currently being maintained in the JKUAT greenhouse. We intend to multiply them as studies on pollination, breeding systems, genetic and propagation studies are conducted. *M. africana* is perceived by farmers as a noxious rice weed and they use any available methods to remove and discard it from the rice fields. This very fact can actually lead to its extermination and hence the need for further studies on its conservation strategies.

Conserving species with limited distribution like *M. africana* should preferably focus on factors that have resulted in increased limited distribution: habitat loss and degradation, introduction or invasion of exotic species, direct human exploitation, inbreeding depression,

specialized pollination systems, edaphic factors etc.

ETHICAL APPROVAL

The field study was conducted taking into consideration the most ethical approach.

ACKNOWLEDGEMENT

We thank the landowners in Ozi village, local guides, and village elders for permission to collect specimens in their farms and information provided during the field work. Much gratitude goes to Mr. Dalmar Ahmed Abdi Aziz for his great contribution towards our field excursion at Ozi Location (Kipini) in Tana County, Kenya.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/58957>