Species

Reinstatement of the name *Alysicarpus monilifer* var. *venosa* (Fabaceae) and their IUCN Red List Assessment

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ABSTRACT

Alysicarpus monilifer (L.) DC. var. *venosa* Blatt. & Hallb. is reinstated. It used to be treated as a synonym of *A. monilifer* (L.) DC. but morphological characters of stem, inflorescence, and fruits support the reinstatement. These two varieties, together with *A. vaginalis* (L.) DC., make up a small group that is distributed in sandy-gravel desert area and have similar morphological characters. The present paper deals with re-instatement of an endemic variety with detailed discussion including a taxonomic key and finalized their IUCN Red List Assessment.

Keywords: Reinstatement, *Alysicarpus monilifer var. venosa*, Endemic, Rediscovery, Rajasthan

1. INTRODUCTION

The genus *Alysicarpus* was first recognized by Necker, (1790) and Desvaux, (1813) was published validly. The genus is belonging to the tribe Desmodieae, under family Fabaceae represents approximately 30 species in Old World and distributed in tropical and subtropical regions (Lewis et al., 2005). The genus is represented by approximately 27 species in India Sanjappa, (1992), Pokle, (2002), Gholami et al., (2016), Mao and Dash, (2020) and nine species and three varieties in Rajasthan (Bhandari, 1978; Shetty and Singh, 1987). *Alysicarpus monilifer* (L.) DC. var. *venosa* is an endemic variety of Rajasthan, it was initially described by Blatter and Hallberg from the gravel area of Bada Bag, Jaisalmer in the Flora of Indian Desert Blatter and Hallberg, (1918) and cited two specimens *Blatt. & Hallb. 7225, 7226* but not designated holotype.

Later, Santapau, (1959) selected *Blatt. & Hallb. 7226* as the lectotype of this variety *venosa,* which was later included in other publications Bhandari, (1978), Shetty and Singh, (1987), Kumar and Purohit, (2015), Purohit, (2020), Purohit et al., (2020) based on Blatter & Hallberg's collections made in November 1917 and housed in BLAT (Herbarium of St. Xavier's College, Mumbai). This variety was later transferred to *Alysicarpus vaginalis* based on pod characters and shape & size of leaves. Pokle, (2002) suggested that var. *venosa* shows more affinity with *A. monilifer* rather than *A.*

vaginalis and established var. *venosa.* Due to few specimens available for examination, Gholami et al., (2016) reduced it to a synonym of *Alysicarpus monilifer* (L.) DC., without a study of Type specimens. This treatment has been accepted in recent publications (Mao and Dash, 2020).

2. MATERIAL AND METHODS

During the survey of Flora of Todgarh-Raoli wildlife sanctuary, the first author found the presence of venation on joints of pods, margin of calyx ciliate, tubercle-based hairs present on the stem of plant *Alysicarpus monilifer var. venosa* but absent in *Alysicarpus monilifer.* In 2016, the first author visited the type locality but could not trace the plant. After that, author visited to Todgarh-Raoli wild life sanctuary and collected specimens with mature pods. After critical study and scrutiny of relevant literature Blatter and Hallberg, (1918), Bhandari, (1978), Shetty and Singh, (1987), Sanjappa, (1992), Mao and Dash, (2020), Purohit, (2020) and herbaria (BSJO, BSA, RUBL, JAC, BLAT, DCH, CAL), this plant samples were identified. These collected herbarium samples were deposited at the Botanical Survey of India, Jodhpur (BSJO).

3. RESULT AND DISCUSSION

Reinstating *Alysicarpus monilifer* (L.) DC. var. *venosa* Blatt. & Hallb.

First author visited to Todgarh-Raoli wild life sanctuary and collected specimens with mature pods. After carefully examined the type specimens and newly collected specimens of both species, we found that pods and leaves to be significantly different i.e. the stem of *var. venosa* is clothed with bristly tubercle-based hairs (Figure 1A, B), while the stem of *var. monilifer* is clothed with deciduous bristly hairs. Inflorescence in *var. venosa* is axillary raceme, while inflorescence in *var. monilifer* is axillary and terminal raceme (Figure 1C, D, E). The margin of calyx *var. venosa* is ciliate, while the margin of calyx in *var. monilifer* is not ciliate (Figure 1F).

Pod of *var. venosa* is moniliform & joints of pod reticulately veined with finely downy with minute hairs, in contrast, the pod of *var. monilifer* is moniliform with joints of pod not veined with pubescent (Figure 1G, H). Single seed in each joint of the pod in *var. venosa,* while two seeds in each joint of the pod in *var. monilifer*. Considering these significant differences (Table 1), the name *Alysicarpus monilifer* var. *venosa* should be reinstated and characters of the variety amended.

Alysicarpus monilifer (L.) DC. var. *venosa* Blatt. & Hallb. in J. Bomb. Nat. Hist. Soc. 26(1): 240. 1918.

Lectotype: Rajasthan, Jaisalmer, Nov. 1917, *Blatter & Hallberg* 7226 (BLAT) (Figure 2).

Specimen examined: India, Rajasthan, Todgarh-Raoli wildlife sanctuary, Raoli range, Jinjhiyadi, 29.07.2016, 25°47'182''N, 73°52'332'' E, 458m, C.S. Purohit 38294 (BSJO), (Figure 3).

A slender, much-branched, prostrate annual. Stem terete, clothed with deciduous, bristly tubercle-based, spreading hairs when young, sulcate. Leaves 8–19 × 5–13 mm, oblong-elliptic to sub-orbicular, rounded, mucronulate as apex, glabrous above, more or less hairy on beneath; base rounded, often cordate; petioles 3–5 mm long; petiolules 1mm long, both glabrous; stipules 5–6 mm long, broadly lanceolate, pale, scarious, striate. Flowers 5–6 mm long, in 4–10 flowered axillary racemes. Calyx 4–5 mm long, hairy, tube 1.5 mm long, teeth narrow, lanceolate, very acute, striate, margin ciliate. Corolla 5–6 mm long, purple. Pods 18–30 × 2–3 mm, moniliform, 4–8 jointed; joints turgid, erect, reticulately veined, finely downy with minute, aculeate hairs. Pods with single seeds in each joint (Figure 1).

Flowering & Fruiting

July – November (Blatter & Hallberg collected this plant in flowering condition during November month, but the first author collected this plant in flowering condition during the last week of July month, so its flowering time extension also reported here).

Ecology

Prostrate herb growing in gravel area associated with *Balanites aegyptiaca* (L.) Delile, *Heliotropium zeylanicum* (Burm.f.) Lam., *Melanocenchris jacquemontii* Jabu. & Spach., *Securinega virosa* (Roxb. ex Willd.) Baillon, *Momordica charantia* L., *Monsonia senegalensis* Guill. & Perr., *Dichrostachys cinerea* (L.) Wight & Arn., *Pupalia lappacea* (L.) Juss. and *Tetrapogon tenellus* (Koen. ex Roxb.) Chiov.

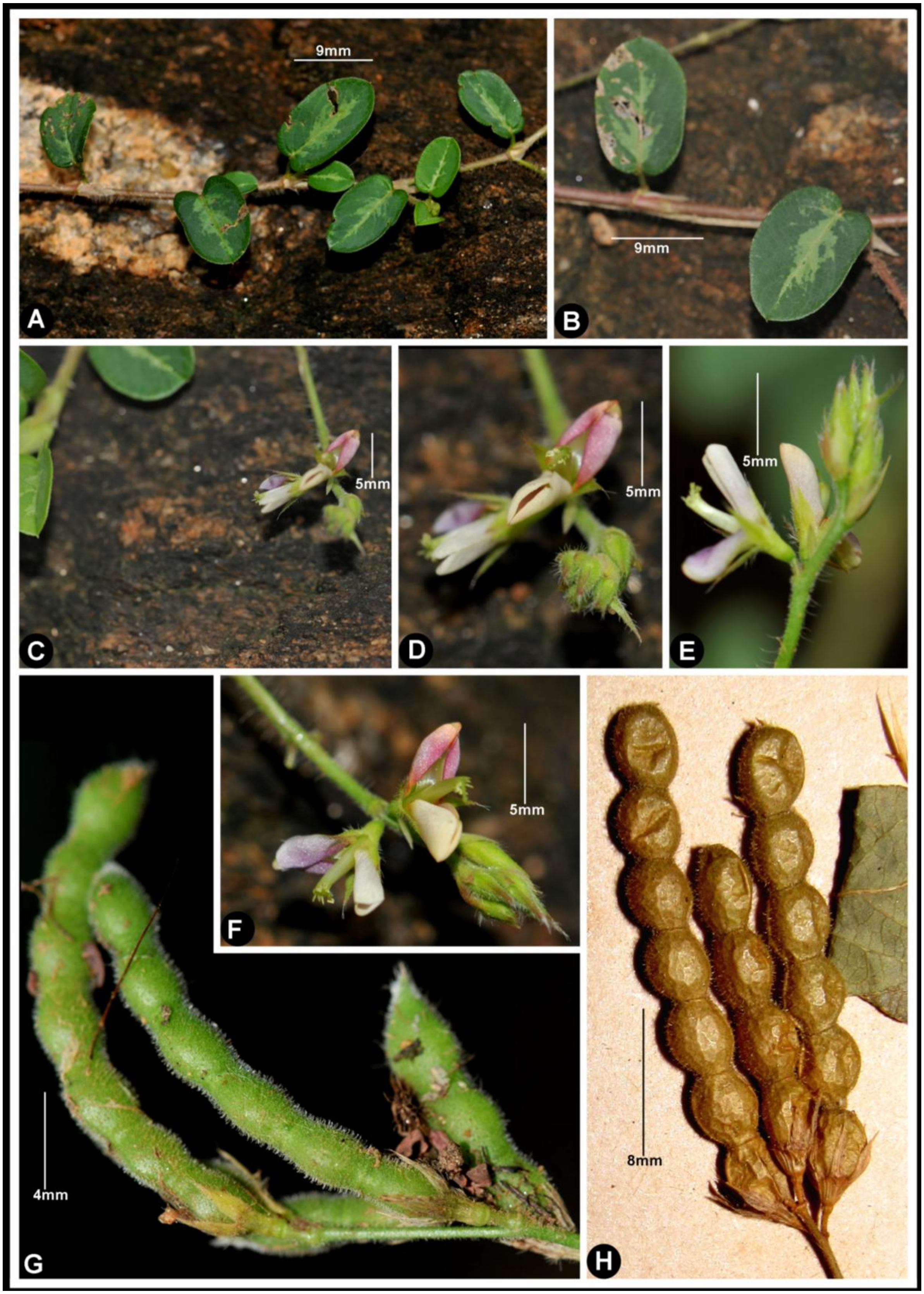

Figure 1 *Alysicarpus monilifer* var. *venosa*: photo plate showing A– Natural location at Todgarh-Raoli wildlife sanctuary; B–close-up of leaves; C to F– different views of flowers & buds; G– moniliform fruits; H– dry fruits showing reticulate venation on joints

Distribution note

Alysicarpus monilifer (L.) DC. var. *venosa* is an endemic variety of Rajasthan, was initially described by Blatter and Hallberg, and housed in BLAT (Herbarium of St. Xavier's College, Mumbai). Thereafter, no herbarium collections record were available either from any herbarium of Rajasthan or from any other state herbarium of India. Thus, it is worthwhile to mention that this species is extremely rare in our country and confined only to the state of Rajasthan and rediscovery after 99 years [Todgarh-Raoli wildlife sanctuary (Jinjhiyadi), Jaisalmer (Bada Bagh)] (Figure 4).

Key to the *Alysicarpus monilifer* and morphologically similar concerns

1a. All leaves 1-foliolate	2
1b. Upper leaves 3-foliolate, lower one or tri-foliolate	*A. heterophyllus*
2a. Pods moniliform	3
2b. Pods not moniliform	4
3a. Joints of pods reticulately veined; calyx margin ciliate	*A. monilifer var. venosa*
3b. Joints of pods not veined; calyx not ciliate	*A. monilifer var. monilifer*
4a. Leaflets suborbicular; Pods compressed, indented	*A. hamosus*
4b. Leaflet elliptic-oblong; Pods turgid, not indented	*A. vaginalis*

Table 1 Distinguished characters between *Alysicarpus monilifer* var. *monilifer* and var. *venosa*

Characters	***A. monilifer* var. *venosa***	***A. monilifer* var. *monilifer***	***A. vaginalis***
Habit	Much branched, prostrate herb	Prostrate perennial herb;	Decumbent, ascending, perennial
Stem	Terete, clothed with deciduous bristly tubercle-based hairs	clothed with deciduous bristly hairs	Glabrous or slightly pubescent;
Leaf	Oblong-elliptic to sub-orbicular, glabrous above, hairy beneath	Oblong to sub-orbicular; glabrous above, beneath hairy on nerves;	Ovate-oblong or oblong-lanceolate; glabrous above, hairy beneath;
Flower	Axillary raceme; 4-10 flowered; Pink	Axillary & terminal racemes, longer than leaves; Pink	Raceme axillary or terminal; 6-12 flowered; Red, reddish-purple, purplish blue or yellow
Calyx	Shorter or as long as the first joint of pod; teeth narrow; margin ciliate;	Shorter or as long as the first joint of pod; teeth lanceolate, striate; margin glabrous	Equaling or little longer than first joint; teeth linear; margin glabrous;
Pods	Pods moniliform, 4–8 jointed; joints of pods reticulately veined, finely downy with minute, aculeate hairs;	Pods moniliform, joints of pods not veined	Pods slender, not moniliform; Joints 4 – 9, not veined;
Seeds	Single seed in each joint	Two seeds in each joint	Single seed in each joint;

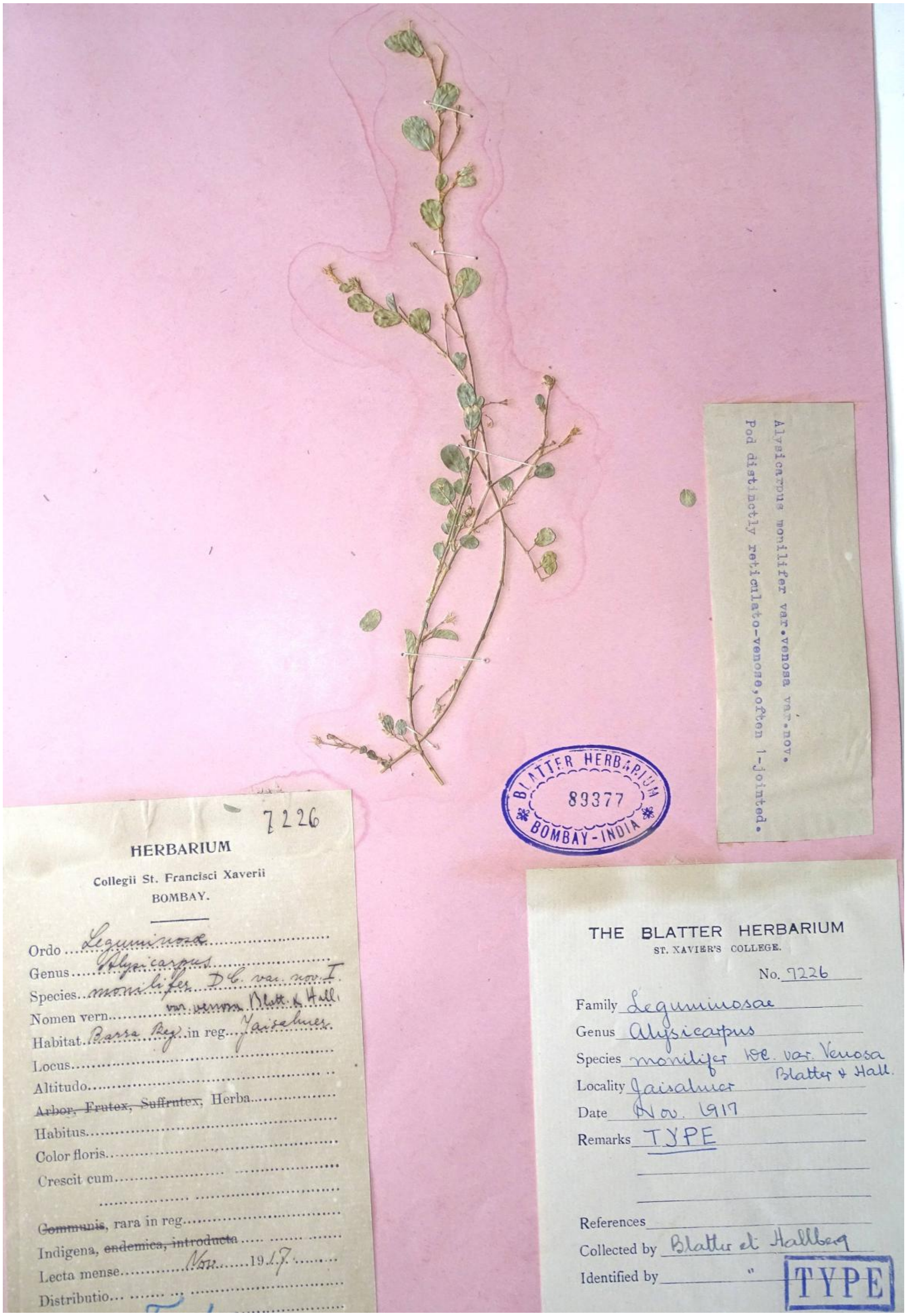

Figure 2 *Alysicarpus monilifer* var. *venosa*: Type specimen (photo courtesy: Principal, St. Xavier College, Mumbai and In-charge, Herbarium, BLAT, Mumbai)

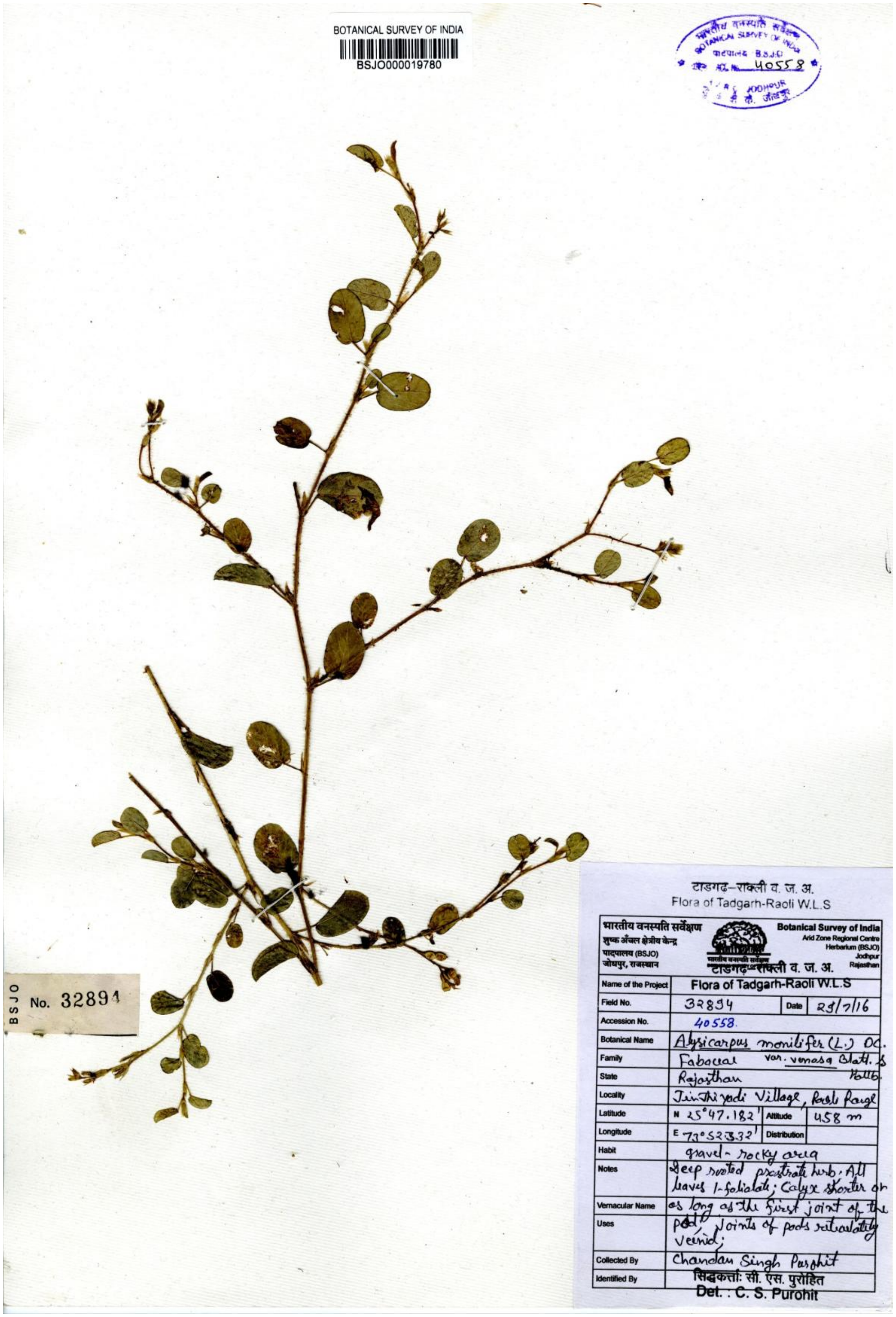

Figure 3 *Alysicarpus monilifer* var. *venosa*: Present collection from Todgarh-raoli wildlife sanctuary, Rajasthan (Herbarium at BSJO)

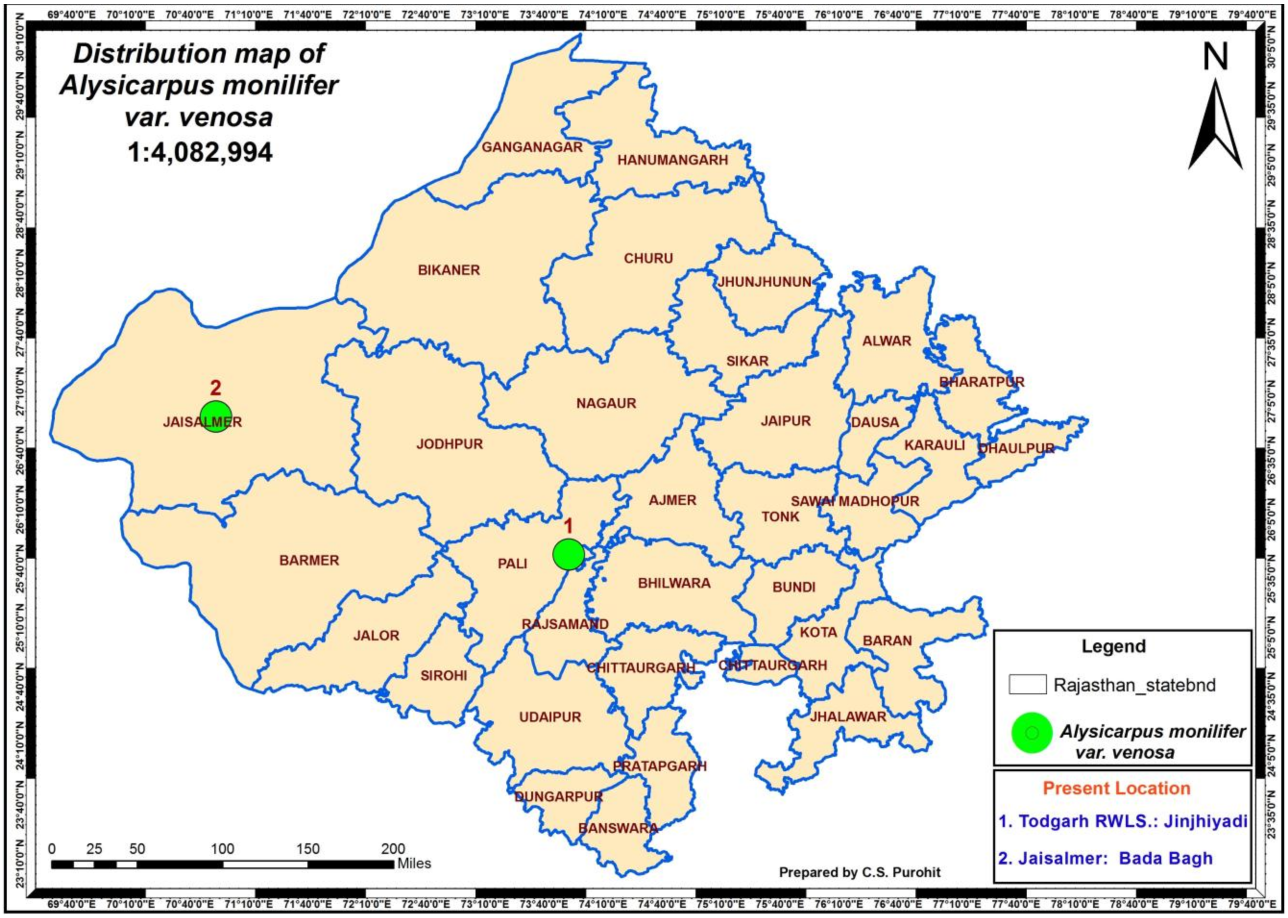

Figure 4 Map showing the occurrence and distribution of *Alysicarpus monilifer var. venosa* in Rajasthan

Conservation Assessment *Alysicarpus monilifer* (L.) DC. var. *venosa* by IUCN criteria

For the conservation assessment of *Alysicarpus monilifer* var. *venosa*, we used guidelines of IUCN red list criteria (IUCN, 2013). Due to unavailabilty of sufficient data or lack of study on this category, Criteria A has not followed. Calculation of AOO with the help of our observations, locations and Geocat online software used to calculate of exact AOO resulted as 4 km2 (Figure 5 & 6). In IUCN criteria B, AOO is less than 10 km2; therefore, it is placed under B1 Critical Endangered Category.

The population of this plant have been declined and could not trace in previously reported location and have been observed fragmented population in a one new location. In IUCN criteria B, occurrence location is single; therefore, it is placed under B2 Critical Endangered Category. Based on our observation of the last 10 years, its natural population or mature individuals are continuously decreasing in number; therefore, it is placed in B1b under the Critical Endangered category. Its AOO is steadily reducing and, its number of mature individuals also declines, so it is placed in B1+2b(ii, v) under the Critical Endangered category.

Its population size in a small pocket and continuous decline of the same, resulted in the placing this species in Category C2a under the Critical Endangered category. The number of mature individuals in each subpopulation in nature is less than 50, and there is a continuous shrinking of the population; hence it should be placed in Category C2a(i) under the Critical Endangered category. Due to unavailabilty of sufficient data or lack of study on plant under this category, Criteria D & Criteria E has not followed. Hence, its assessment using IUCN criteria best fitted it under the category Critical Endangered [criteria - CR/B1+2b(ii,v); C2a(i)].

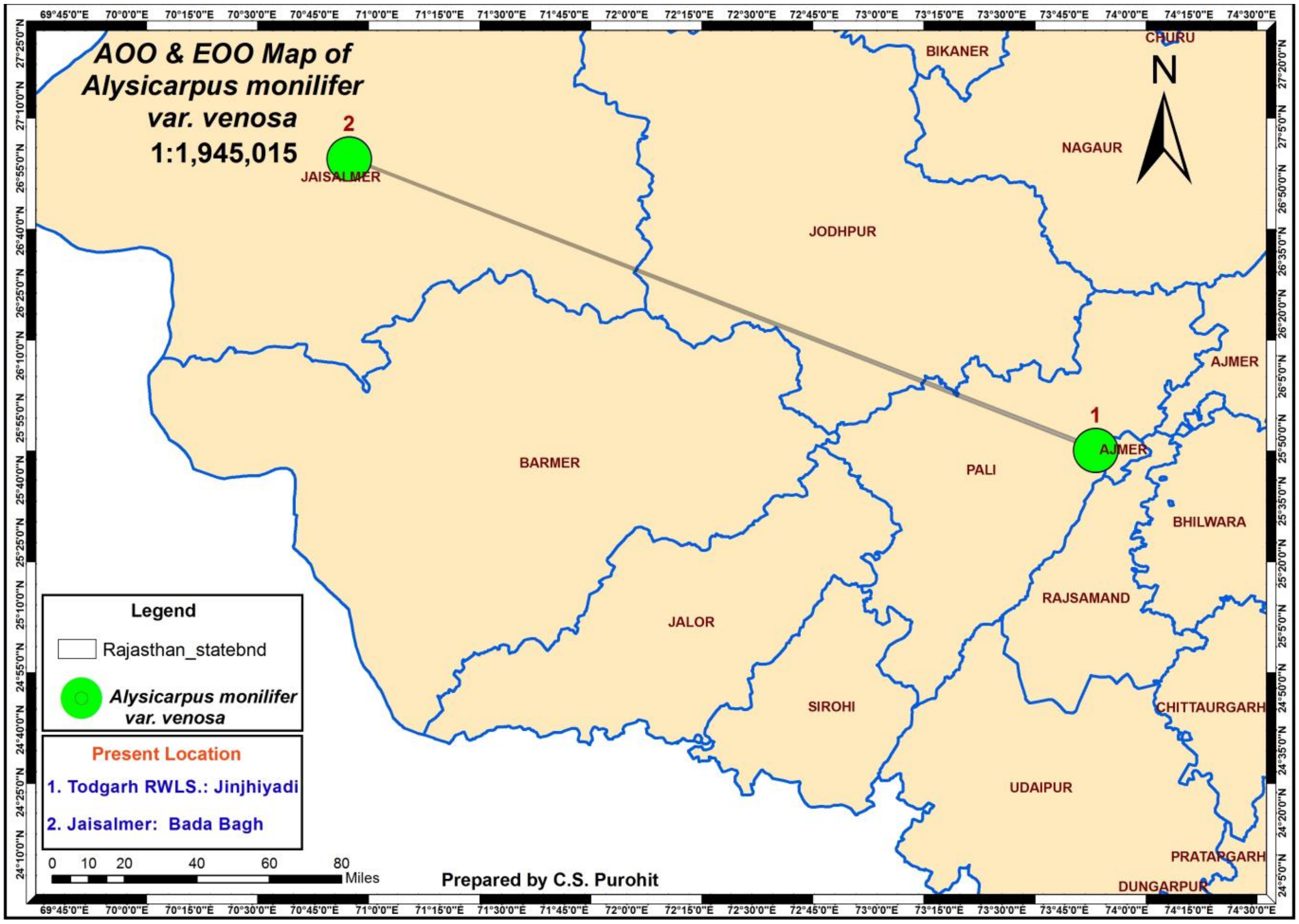

Figure 5 Map showing EOO (Extent of occurrence) & AOO (Area of Occurrence) of *Alysicarpus monilifer var. venosa* in Rajasthan desert

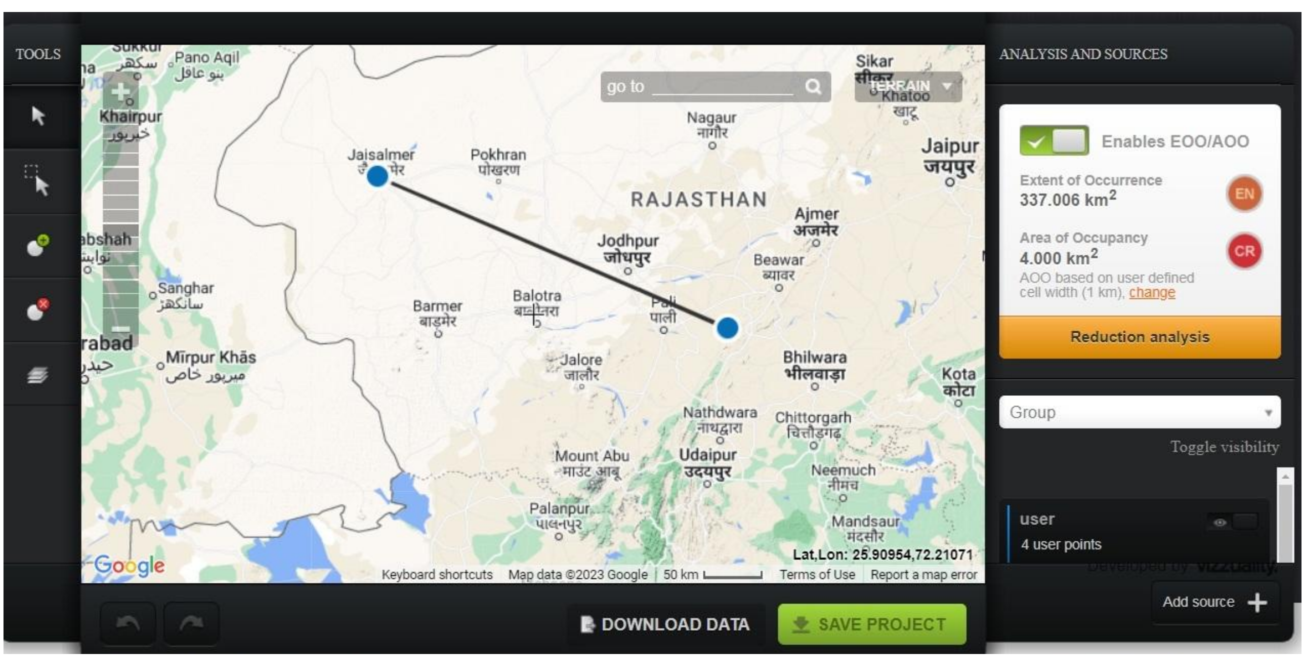

Figure 6 Convex hull of occurrence points for analysis of EOO and AOO using GeoCat

4. CONCLUSION

Critical examined the type specimens and newly collected specimens of *Alysicarpus monilifer* var. *venosa*, we found that this plant have many significantly characters i.e. stem clothed with bristly tubercle-based hairs, inflorescence axillary raceme, margin of calyx ciliate, joints of pod reticulately veined with finely downy with minute hairs, single seed in each joint of the pod. Considering these significant differences, the name *Alysicarpus monilifer* var. *venosa* is reinstated and characters of the variety amended. Its assessment using IUCN criteria best fitted it under the category Critical Endangered [criteria - CR/B1+2b(ii,v); C2a(i)].

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Ethical approval & declaration

In this article, as per the plant regulations followed in the Botanical Survey of India, Arid Zone Regional Centre, Jodhpur-342014, Rajasthan, India; the authors re-instated an endemic variety (*Alysicarpus monilifer* (L.) DC. var. *venosa* Blatt. & Hallb.) with detailed discussion including a taxonomic key and finalized their IUCN Red List Assessment. The ethical guidelines for plants & plant materials are followed in the study for species collection, identification & experimentation.

Informed consent

Not applicable.

Conflicts of interests:

The authors declare that there are no conflicts of interests.

Funding:

The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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