



Artemisia sieversiana (Asteraceae): A Wild Sagebrush Presumably Extinct Rediscovered from Kashmir Himalaya

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Abstract

Artemisia sieversiana Ehrh. ex Willd., a plant belonging to the Asteraceae family, has been rediscovered in the Gurez valley of Kashmir Himalaya, India, after a hiatus of more than 50 years. This reappearance not only highlights the resilience of this species but also underscores the importance of continuous exploration and documentation of biodiversity. Understanding its habitat requirements and the reasons for its disappearance could offer valuable insights into the conservation of not only this specific species but also other endangered plants in the Himalayan region. The present study's approach, including a detailed taxonomic description, photographs showcasing diagnostic characters, and an identification key, serves as a robust method to validate our research and resolve past taxonomic uncertainties.

Keywords: *Artemisia sieversiana*; Asteraceae; Biodiversity; Himalaya; Rediscovery; Taxonomy

Abbreviations: POWO: Plants of the World Online; IH: Index Herbariorum.

Introduction

Artemisia L., one of the largest genera in *Asteraceae* family, comprises 380 [1] to 522 taxa [2]. The genus is distributed primarily in the temperate zones of Northern hemisphere, though few species are found in the Southern hemisphere as well [2].

In India, the genus *Artemisia* is represented by 40 species, primarily distributed in the Himalayan region [3-5]. During our recent field surveys to document diversity of *Artemisia*, we collected a specimen of *Artemisia* from Gurez valley in Kashmir Himalaya. On detailed study of micro- and macro-morphological characters of the collected

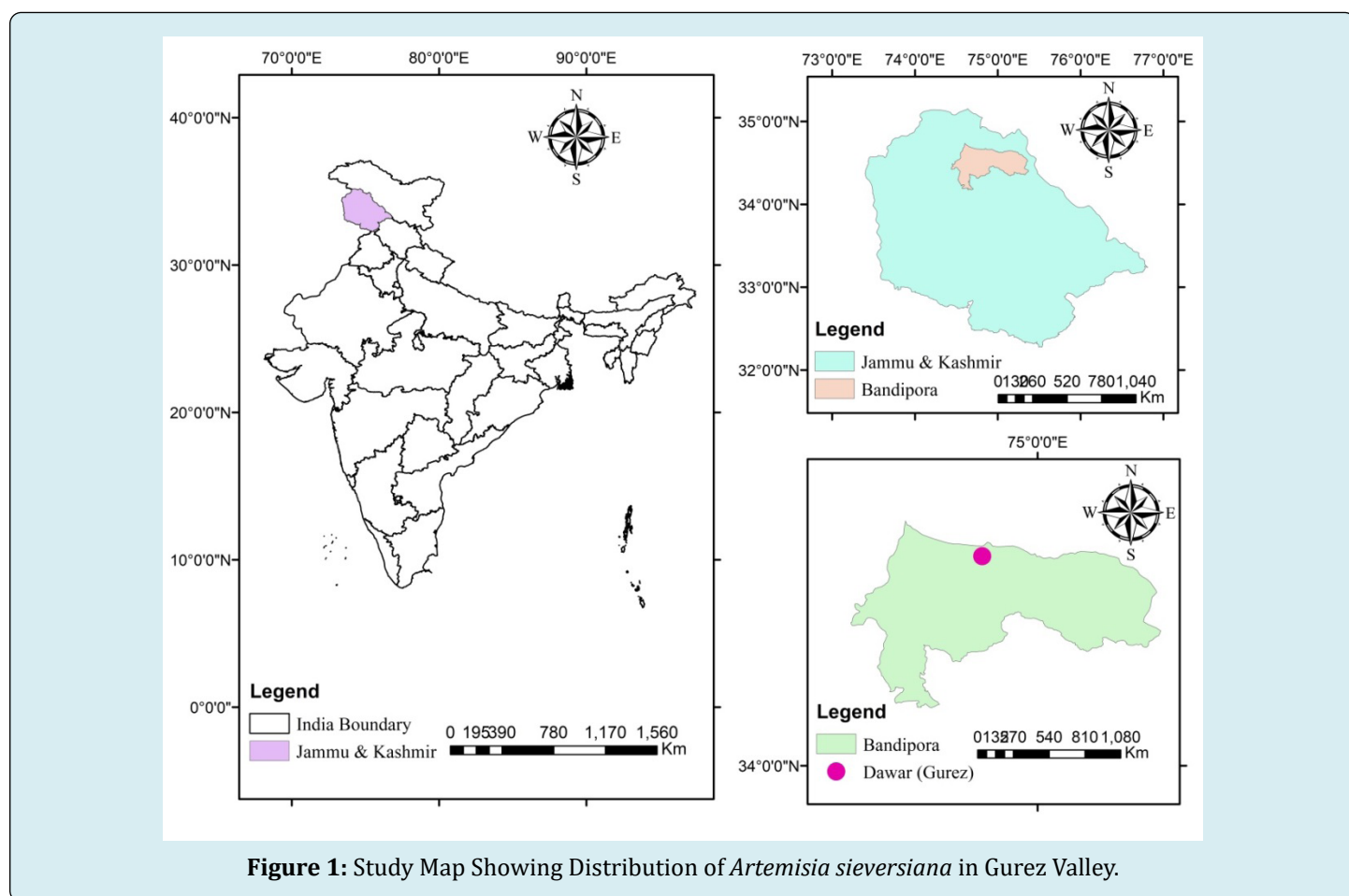
fresh plant material, and a review of taxonomic literature Mabberley DJ [1], Hooker JD [6], Ghafoor A [7], we identified these specimens as *A. sieversiana* Ehrh. ex Willd., a taxon previously recorded from Kashmir valley by Stewart, Kaul, et al. [3]. Certainly, the absence of a taxonomic record of *A. sieversiana* from the Gurez valley, as indicated by Ara, et al. [8], Dad, et al. [9] further emphasizes the significance of the current research. In the course of the present study, it was observed that the species of *A. sieversiana* does not grow commonly across the Kashmir Himalaya, contrary to what was reported by Stewart. This new finding challenges previous understanding and highlights the importance of updated research in botanical studies. Understanding the precise distribution of plant species is essential for accurate biodiversity assessments and conservation strategies in the region.

Materials and Methods

Gurez valley is located in the north-western part of the Himalaya. Plant specimens were collected from Gurez valley of Kashmir Himalaya (Figure 1). Standard taxonomic procedures were followed for collection, drying and further processing of the herbarium specimens [10]. To identify the species, the collected plant specimens were compared with the protologue [11] as well as with the type specimen (HAL0135097). High resolution images of all the Himalayan species of *A. sieversiana*, available at following herbaria i.e., HAL, GDC, K, PE, KASH and RRLH, were also examined (Index Herbariorum; abbreviations as in Holmgren, et al.) [12]. For studying and measuring macro- and micro-morphological characters, 20 capitula of the taxa were used. The capitula were kept in FAA solution for 24 hours and then the samples

were rinsed with water, different parts of inflorescence were placed on slide and Hoyer's solution were used for microscopic studies [13]. Finally, both ray and disc florets were dissected for detailed morphological characterization and were photographed under stereo microscope (Make: Leica S9D Germany), integrated with image processing software (LASX).

The map showing the distribution of *A. sieversiana* was prepared using QGIS software, version 3.20 [14]. For construction of keys to the species of subgenus *Absinthium*, we used Flora of China (www.floraofchina.org) and the global occurrence records for the species were obtained from Plants of the world Online [15].



Results

Taxonomic Treatment

Artemisia sieversiana Ehrhart ex Willdenow, Sp. Pl. 3: 1845. 1803 (Figure 2).

Herb, annual, or biennial, 60–200 cm tall, aromatic,

glabrescent (to \pm grey pubescent). Stem solid, grooved longitudinally, much branched. Leaves green, both on adaxial and abaxial surfaces, glabrescent to \pm tomentose, apices of leaf segments obtuse to sub-obtuse, occasionally acute, lobules linear or linear-lanceolate to oblong-lanceolate. Basal leaves petiolate; 3–9(–12)cm long, leaf blade triangular ovate, 5–8(–14) \times 4–6(–8)cm, 2 or 3 pinnatisect, segments

2-3 pairs. Middle cauline leaves; petiole 3.5-8 cm long, leaf blade triangular ovate, 2-3 pinnatisect, (6-)8-14×3.5-8 cm, segments 2-3 pairs, lobules 3-5 x 1-2 cm. Upper cauline leaves and leaf-like bracts sessile, linear, entire, 3-6(-7) cm. Capitula globose to hemispherical, 4-6.10×4-6 mm, nodding, bracteole; linear, linear-lanceolate to linear-oblong, densely pubescent, apices obtuse; peduncle, 0.5-4.15 mm, sparsely pubescent. Involucre 4(-5)-seriate, phyllaries sparsely to densely puberulent, Outermost linear-oblong, densely tomentose, hyaline appendage at the base and the tip; median phyllaries elliptic-ovate to hemispheric, hairy tomentose, hyaline margins from middle to tip, 2-4×0.4-1.6 mm; inner phyllaries broadly

ovate-hemispherical, broad hyaline margins, tomentose to glabrous, 1.8-4×0.3-2.5 mm. Florets numerous, all fertile, yellow; marginal female florets 14-16(-57), corolla conical, 1.3-1.5 mm, 3-4-toothed, style branches exerted with 2-2.5 mm, style 1.6-3 mm; Disc florets 55-84, corolla 5-toothed, 3-4×1.3-1.4 mm, cuneate, anther lobe 3-4 mm long, anther apices appendage long triangle, anther base appendage obtuse, anther filaments free, 1-1.2 mm; pistil style branch 1-1.2 mm long, hair appendages on the tip of style branches 0.1-0.5 mm long, style 3-3.3 mm long. Receptacle conical, densely long white pubescent. Achene brown, obovoid, 1.7-2.4×0.4-0.8 mm long, finely striated with terminal corolliform scar.

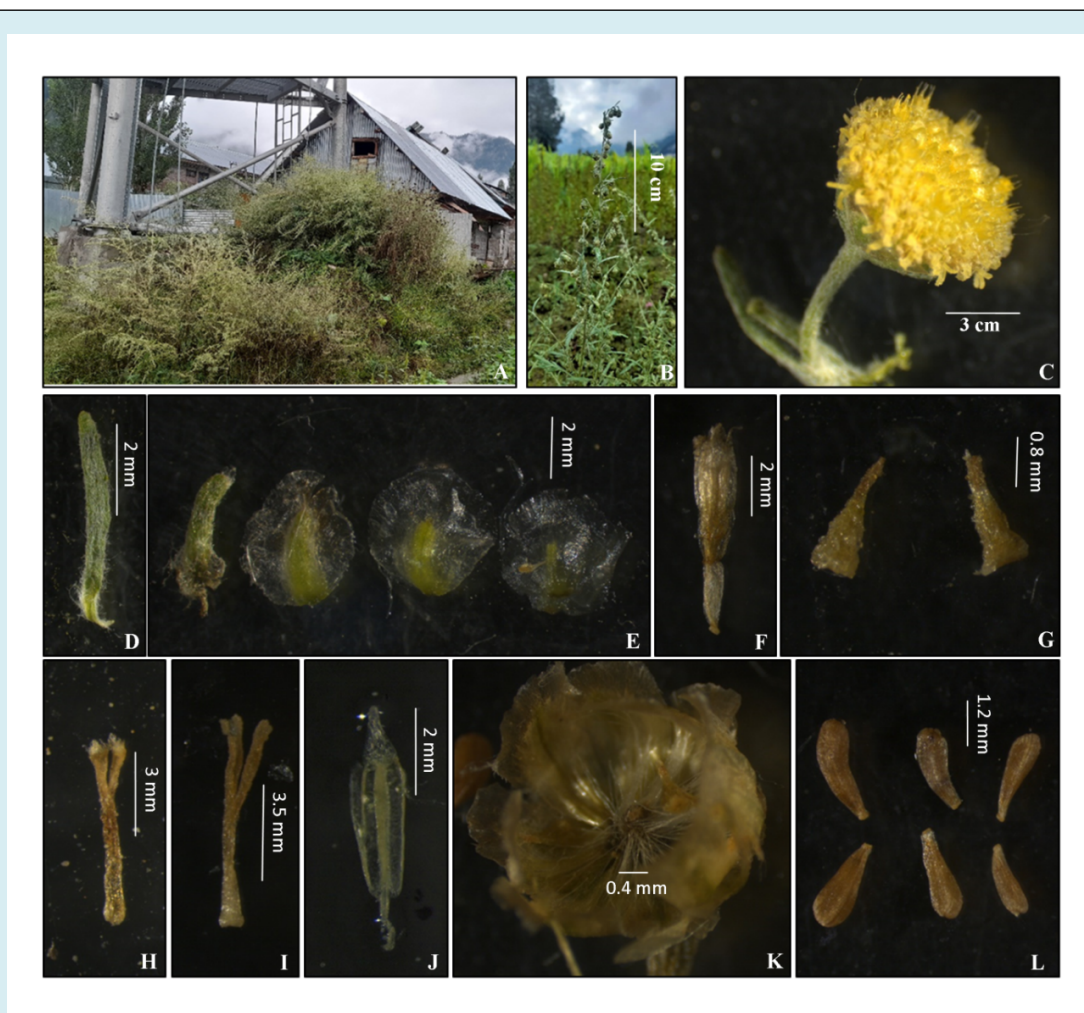


Figure 2: *Artemisia Sieversiana*: A- Habitat; B- Inflorescence; C- Capitula; D- Bracteole; E- Phyllaries from Outermost (Left) to Innermost (Right) Series; F- Disc Floret; G- Ray Floret; H- Pistil (Disc Floret); I- Pistil (Ray Floret); J- Anther; K- Receptacle; L- Achene.

Global Distribution: Native to Russia, Mongolia, Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan, Tajikistan, Afghanistan, Pakistan, India, China, Korean Peninsula, Japan.

Phenology: Flowering from June-July; and fruiting from July-

September.

Distribution and Habitat: The species grow abundantly in the lower parts of Gurez valley, along the banks of river Kishenganga and around the cultivated areas.

Conservation Status: Since the species is restricted in Gurez valley of Kashmir Himalaya. The conservation status of the species is reported here as endangered for Kashmir Himalaya.

Discussion

The accuracy of biodiversity data is crucial for understanding the distribution and abundance of various species in an ecosystem [16]. However, this accuracy can be significantly hampered by biased sampling methods and it is particularly relevant when discussing Stewart's report on *Artemisia sieversiana*, which stated that it to be commonly growing between 2000 to 4500 m (asl) in Kashmir. However, based on our recent extensive field surveys, the species prefer to grow between 2500 to 3600 m (asl). Additionally, in the Kashmir Himalaya, our extensive field and literature surveys have revealed that the species is restricted only to the Gurez valley. These findings contrasts with Stewart's report, suggesting either a significant shift in the species distribution over time or it could be a typical example of biased sampling [17]. In addition, the absence of *A. sieversiana* in the Sonamarg area of district Ganderbal highlights a notable disparity between the findings of Kaul, et al. [3] research and the results of the present study. This suggests a potential ecological pressures, possibly induced by factors like climate change, habitat degradation, or anthropogenic activities, might have led to the disappearance of this species from the touristic place of Sonamarg [18]. Absence of the species distribution record in recent studies by Ara, et al. [8], Dad, et al. [9], Dar, et al. [19] and Dar, et al. [20], followed by its reappearance during the present study from the Gurez valley, suggest that the species *A. sieversiana* is restricted in Dawar part of Gurez valley, which in turn raises concerns regarding the species conservation status in Jammu and Kashmir.

Therefore, it is recommended that the species in Jammu and Kashmir need to be evaluated as endangered status and might need to be placed under legal protection, including establishment of reserves, and restrictions on human activities in ecologically overexploited habitats [21].

It is noteworthy to mention that the observations of the present study underscore the importance of updated research methods and rigorous field exploration to accurately map the distribution of plant species. Such nuanced observations contribute significantly to our understanding of plant ecology and help refine existing knowledge of biodiversity, which ultimately ensure the accuracy of ecological data and the reliability of scientific conclusions [17,15].

The rediscovery of *A. sieversiana* has far-reaching implications for the field of conservation biology. It not only highlights the resilience of nature but also underscores the

importance of thorough exploration and documentation of biodiversity and serves as a poignant reminder of the ongoing threats faced by many plant species worldwide i.e. Habitat destruction, climate change, and human activities continue to endanger numerous plants, pushing them toward the brink of extinction [15]. This rediscovery emphasizes the urgency of global conservation efforts, urging governments, organizations, and individuals to take immediate and decisive action to protect and preserve the global biodiversity.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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