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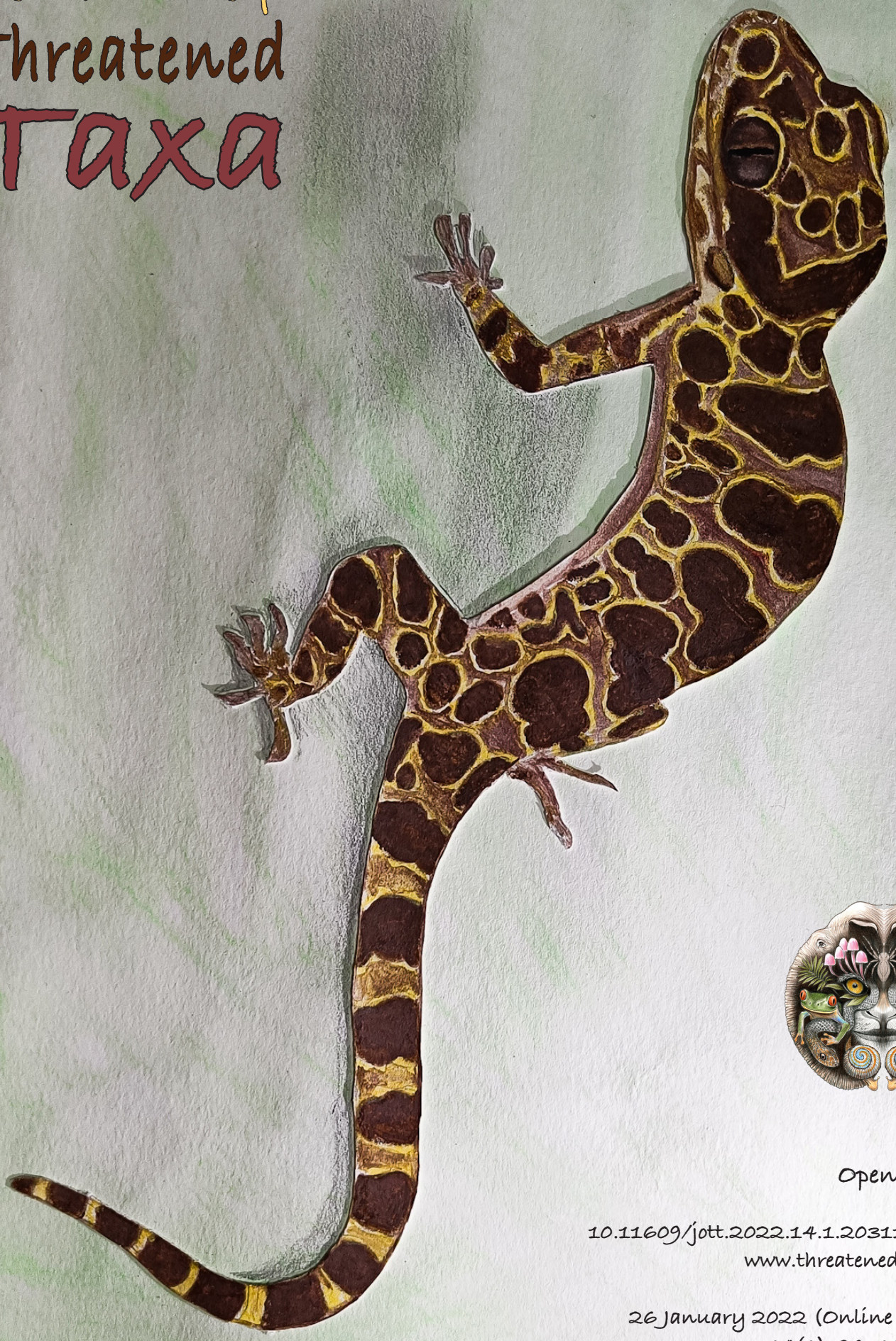

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Caption: *Cyrtodactylus myintkyawthurai*, endemic to Myanmar. Medium: Water colours on watercolor sheet. © Aakanksha Komanduri

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NOTE

Counting the cost: high demand puts *Bunium persicum* (Boiss.) B.Fedtsch. in jeopardy

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The mighty Himalaya has been identified as one of the 36 biodiversity hotspots due to its immense hoard of endemic species as well as the ever-increasing threats looming upon this region (Mittermier et al. 2004). The highly adapted and fragile ecosystems are rich in biodiversity, of which vegetation forms an important component. The stretch of Himalaya that constitutes the Indian Himalayan region (IHR) harbours ca. 11,157 species of flowering plants belonging to 2,359 genera under 241 families (Singh et al. 2019). IHR, an abode to various medicinal and aromatic plants (MAPs) accounts for >1,748 species of medicinal plants (23.4% of India) comprising 1,685 species of angiosperms, 12 gymnosperms, and 51 pteridophytes that have traditional and modern therapeutic uses (Samant et al. 1998). Owing to their high medicinal value, most of MAPs are at high demand and hence face immense pressure that has led to a decline in their wild populations, for instance Goraya & Ved (2017) enlisted 36 Himalayan medicinal plant taxa that are in high commercial demand by the herbal industries.

In the western Himalaya, the relative isolation and remoteness of high-altitude regions have made the ethnic communities the last bastions of traditional medicinal knowledge. MAPs serve as one of the major sources of subsistence and income generation for local communities and have found use in many culinary and medicinal practices since time immemorial. These ethnic communities inhabiting harsh environmental conditions practice unique traditions and customs including ethno-botanical dependence, thus, hold substantial ethno-botanical knowledge due to the regular use of medicinal plants for treatment of diseases, wounds, fractures, and other ailments (Samant et al. 1998; Samant & Palni 2000). The local traditional healers known as 'Larjee' or 'Amchi' practice traditional health care systems such as the Tibetan system of medicine (Sowa-Rigpa) for the treatment of various ailments based on their traditional knowledge.

With the rising growth in the demand and market of herbal medicines, the herbs-based healthcare wellness sector across the world including India is booming. This in turn has resulted in higher demand and thus puts higher pressure on the medicinal plant resources, both

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wild and cultivated (Goraya & Ved 2017). Unfortunately, due to the absence of sustainable harvesting and collection protocols, and cultivation tools and techniques, the MAPs are harvested indiscriminately (Kumar et al. 2021). In some cases, though there are no locally known uses of the MAPs, they are harvested unsustainably, solely to be sold in the market, the trade of which serves as a lucrative source of income for the plant collectors (Dorji 2016; Mathela et al. 2020). Hence, the heavy and increased demand on high value MAPs in the wild, coupled with destructive harvesting and competitive wild collection has resulted in the rapid decline of the wild populations (Goraya & Ved 2017). The market prices at which these MAPs are sold can easily paint a picture of the demand, for instance, *Fritillaria cirrhosa* D.Don (Jangli lehsun) sells at 12,000–15,000 INR kg^{-1}, *Aconitum heterophyllum* Wall. ex Royle (Kaur) 3,000–4,000 INR kg^{-1}, *Pichrorhiza kurroa* Royle ex. Benth (Kadu) 900–1,500 INR kg^{-1}, and *Dactylorhiza hatagirea* (D.Don) Soó (Hathajadi) 2,200–6,000 INR kg^{-1} (Mathela et al. 2020; Mathela et al. 2021; Kumar et al. 2021). Due to the extremely high demand, increased illegal trade, destructive wild collection and dwindling populations, these MAPs are threatened and many are on the brink of extinction from the wild (Goraya & Ved 2017; Mathela et al. 2020). The unorganized and illegal trade is increasing day by day in the western Himalayan region in spite of strict government instructions on the trade and transportation.

Noticeably, in the recent decade, there have been several reports of medicinal species being reported in peril in the western Himalaya, such as well-known insect fungus *Ophiocordyceps sinensis* (Berk.) G.H. Sung, J.M. Sung, Hywel-Jones & Spatafora commonly called 'Keerajadi' and 'Yartsagunba' with multiple medicinal uses, which received high attention in terms of increased trade, excessive harvesting, and dependency of local communities, especially in Uttarakhand (India), Nepal, and China. The increasing exploitation has led to rising pressure on the species leading to decrease in the wild population (Yadav et al. 2019). Similarly, the population of *Nardostachys jatamansi* (D.Don) DC. has declined by 60–80% in the wild from IHR, hence categorized as endangered in Arunachal Pradesh, Sikkim, & Himachal Pradesh and critically endangered in Uttarakhand as per CITES. Another species with high market demand and dwindling wild population is *Trillium govanianum* Wall. ex D.Don (Nagchatri) native to the western Himalaya. Another species worth mentioning is *Dactylorhiza hatagirea* commonly known as 'Salampanja' or 'Hathajadi', which is in high medicinal demand in national and international markets. The annual demand of Salampanja has been recorded at ca. 5,000 tons (Bhatt et al. 2005). The regeneration capacity of this orchid is rather poor due to pollinator specificity and requirement of mycorrhizal association, therefore, over-extraction from the wild poses a serious threat (Pant et al. 2012).

Image 1. *Bunium persicum* flowers. © G.S. Goraya.

Image 2. *Bunium persicum* seeds. © Sipu Kumar.

Keeping the sudden spurt in price and high demand of yet another highly threatened MAP *Bunium persicum* (Boiss.) B.Fedtsch. commonly known as 'Kalazeera' or black cumin of Himachal Pradesh in view, the current communication attempts to raise high conservation concern to preserve the species in the wild (Images 1–4). Based on intensive market surveys and individual interactions with the local populace and traders comprising 255 respondents in the Lahaul and Pangi landscape of Himachal Pradesh covering 12 villages, namely, Sural Bhatori, Hundan Bhatori, Chasak Bhatori, Killar, Punto, Mindhal, Sechu, Ghisal, Kuthal, Sach, Dharwas & Karyas of Pangi and five villages, namely, Khanjar, Udaipur, Urgos, Tindi, & Thanpattan of Lahaul; the predominant factors that pose a major threat to


Image 3 & 4. *Bunium persicum* in trade. © Himanshu Bargali.

the wild populations of the species include high market demand, increased illegal trade, destructive harvesting, relentless collection of seeds, competitive wild collection and its restricted population. Due to high medicinal and aromatic properties, the species is facing tremendous population decline from the wild and has been reported to sell like hot cakes in the markets. The species also faces identity crisis as it is often mistaken with *Carum bulbocastanum* (L.) W.D.J.Koch or *Carum carvi* L. Also, it is often adulterated with *Cuminum cyminum* L. (Bansal et al. 2018). Additionally, according to Sofi et al. (2009), low productivity mainly due to the poor crop management practices, inadequate planting density, high weed incidence, diseases, insect damage, low germination percentage of seeds, uncertain quality and lack of trade standards are the other issues responsible for its vulnerability in the Himalayan region.

Globally, Kalazeera is distributed in Baluchistan, Afghanistan, and India. In India, it is distributed in Kashmir and the high-altitude regions of Himachal Pradesh including the Padder valley, Chamba, Kinnaur, Lahaul, Pangi, and Spiti at elevations ranging between 1,500–3,500 m (Chauhan 1999; Gupta et al. 2012; Ravikumar et al. 2018). It grows mainly in grassy slopes and low alpine pastoral lands (Sofi et al. 2009). As a whole plant, it is an economically important culinary crop that is cultivated for its seed which matures in the months of late July to August (Chauhan 1999). The seeds are darkish-brown, ribbed with pointed ends and have a deep aroma (Image 2). *B. persicum* has been kept under red-listed Himalayan forest species and is listed amongst the 100 species of conservation concern in commercial demand for use as a herbal raw drug in India (Goraya & Ved 2017). Interestingly, it is also among the few wild species in the western Himalaya which has been recommended for commercial cultivation (Singh et al. 2009). This species with considerable knowledge and literature on its usage, is harvested and traded extensively in Himachal Pradesh. Owing to low volume, high value, and as a non-perishable commodity, it is one the most preferred species for indigenous use and trade in Lahaul and Pangi valley (Singh et al. 2009). The species has diuretic, digestive, anticonvulsive, and anthelmintic effects (Stappen et al. 2017). Owing to these properties, the plant finds use in several medicinal, culinary, and aromatic practices (Sofi et al. 2009), the seeds are widely used as a food additive, tea making condiment and a popular spice and flavoring agent. Due to its therapeutic effect on digestive and urinary tract disorders, it is used for chronic cholangitis and kidney stone, and is useful in treating diabetes (Hassanzadazar et al. 2018), diarrhea, dyspepsia, curing fever, flatulence, stomach-ache, haemorrhoids, and obstinate hiccups (Chauhan 1999). *B. persicum* has been traditionally used as an appetizer, to reduce cholesterol, anxiety, depression, to alleviate indigestion, bronchitis, diseases of blood & ear, leprosy, convulsions, foul breath, joint pain, lumbago, and weak memory (Singh et al. 2009).

Kalazeera is facing enormous threats not only due to the illegal trade and unscientific harvesting it is subjected to, but also due to loss of its habitats, featuring unique topography and climatic conditions, due to development and degradation resulting in drastic decline in the wild populations (Kala 2000; Goraya & Ved 2017). According to Chauhan (1999), the market price of Kalazeera was 300–400 INR kg^{-1} in the state of Himachal Pradesh, whereas the report of 2,200–4,200 INR kg^{-1} as per Kumar et al. (2021) indicates that the price has increased 10 fold in the last 20 years. According to Goraya & Ved (2017), the estimated annual trade of Kalazeera in

Himachal Pradesh was <10 metric tonne (MT). The Himachal Pradesh State forest department issues permits for regulating the collection of medicinal plants, however, the illegal trade in terms of hidden markets is posing a threat to the species. Therefore, it is submitted that competitive collection, increased illegal trade may inevitably lead to the decline in wild populations of *B. persicum* in the near future if appropriate conservation and mitigation measures are not taken. The species, therefore, requires urgent management interventions for its conservation, sustainable availability to the herbal sector, and continuous cash income to thousands of wild gatherers. Further, the species can be put in 'Action Lists' for proactive action towards its conservation, building of their wild population and developing sustainable harvesting practices as envisaged by Goraya & Ved (2017). The first step towards its conservation is identifying the existing population base, species distribution and abundance, therefore it becomes important to conduct such studies on an urgent basis. Identification of best cultivation practices, research, and development to reduce long-gestation periods, cost effective technology, organic-farming, buy-back mechanisms, policy-revision in the interest of stakeholders, protocols for post-cultivation management, quality-control and awareness training would be the practical solution in this direction. Recently, the species has been granted the Geographical Indication (GI) tag by the Government of Himachal Pradesh. This is an important step towards conserving this plant and plant-based products and can further improve its market potential, boosting the region's economy by giving better returns at the grassroot levels. Additionally, a major step towards species conservation can be the strengthening of the Biodiversity Management Committee and spreading awareness on the dwindling populations among the various stakeholders. Identifying and building the capacities of stakeholders including respective forest department, locals, traditional healers, and local plant traders can help in community based natural resource management.

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