



Ecological and conservation status of high-altitude medicinal plant: *Dactylorhiza hatagirea* (D. Don) Soo in Pindari Valley, Western Himalaya

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Abstract

The present study was conducted to evaluate the current status, population density and availability of *Dactylorhiza hatagirea* in different microhabitat. This work also focused on the threat and conservation status. The population density of *Dactylorhiza hatagirea* was ranged from 0.2 - 0.9 ind/m². According to the microhabitats, the density of *Dactylorhiza hatagirea* was varied in the present study sites. In the open grass land habitats the highest recorded density was (0.9 ind/m²) whereas disturb/ waste land was contained least density (0.2 ind/m²). A total of 58 plant species belonging to 51 genera and 31 families were recorded from the different microhabitats. We found that, the least density of *Dactylorhiza hatagirea*, because of some major factors like over exploitation for mainly local uses and trade, unsustainable grazing and trampling as well as the higher density of weedy and invasive species in the present study area.

Keywords: conservation; critically endangered; *Dactylorhiza hatagirea*; microhabitat; pindari valley; sustainable

1. Introduction

A significant proportion of the Himalayan flora has medicinal value, and the region is recognized as the global hub of medicinal plants. *Dactylorhiza hatagirea* (D. Don) Soo is one of the high valued medicinal orchids widely used in Ayurveda. *Dactylorhiza hatagirea* commonly known as Hathajadi or Salampanja, occurred throughout the Himalaya region and extended from 2800 m- 3900m asl elevation. *D. hatagirea* belongs to the orchid family Orchidaceae, a family of monocots which is morphologically diversified. Orchidaceae is considered to be the second largest flowering plant family after Asteraceae. Tuber of *D. hatagirea* is used in traditional medicine in various parts of the Himalaya for its aphrodisiac properties and sexual stimulant [1, 2]. Root powder helps to prevent wound bleeding [3]. The tuber is also used extensively for fever, cough, and bone fractures [4]. In last two decade, the natural resource over- extraction, economic pressure, inadequate forest management policies, insufficient knowledge and improper legislative initiatives on the sustainable use of biological resources have been increased [5, 6] that led to deterioration of biodiversity [7]. Species with habitat specificity and a small range of microhabitats are at higher risk of extinction than those with a wide variety of habitats [8, 9]. The occurrence and distribution ranges of orchids have declined rapidly in recent years [10]. Presently, the demands of *Dactylorhiza hatagirea* has been increased in international market lead to illegal harvesting, overexploitation, thereby reducing plant population in their microhabitats in the study area. The species is therefore threatened, and various anthropogenic influences are currently confining the species to small, isolated populations. To highlight these critical issues this present study is aim to (i) assess the current status and threats to *Dactylorhiza* populations, (ii) identify its

microhabitat characteristics and presence of associate species, and (iii) develop recommendations for its conservation and management strategies.

2. Materials and methods

The present study conducted from May 2018-2019 in Pindari valley, Bageshwar district in Uttarakhand, Western Himalaya. The total area of the valley is 339.39 km² at latitude 30° 15' N and longitudes 79° 13' to 80° 02' E. We conducted intensive field surveys with elevations from 3000-3500m asl in different parts of the valley. Phytosociological data for herbs were quantitatively analyzed in five microhabitats viz., open grass lands, moist / marshy, alpine meadows, rocky slopes and disturb/ waste lands habitat have been selected. In each plot, the density of *Dactylorhiza hatagirea* was determined by using 20 random quadrats. Within each quadrat, we noted the microhabitat inhabited by *Dactylorhiza* and mentioned the individuals of associated species. Density, frequency and abundance data were analyzed [11, 12].

3. Results and discussion

3.1. Density of *Dactylorhiza hatagirea*

The population of *D. hatagirea* was observed between the 3000-3500 m asl elevation. A total of 58 plant species belonging to 51 genera and 31 families were recorded from the different microhabitat (Table 1). In this, a total of five microhabitats were identified for *D. hatagirea*. The open grass lands habitat recorded highest density was (0.9 ind/m²) followed by moist/marshy (0.6 ind/m²), while, in the disturb/waste lands the recorded least density was (0.2 ind/m²) (Table 2). The reason of least density of *D. hatagirea*, it is because of the higher density of weedy and invasive species viz., *Impatiens sulcata* and *Polygonum*

polystachyum found in disturb habitat ^[13]. Additionally, most of the associated species found in the open grass land habitat (45%), followed by moist / marshy (36%), alpine

meadows (29%), rocky slopes (22%) and least found in disturb/ waste lands (21%).

Table 1: List of plant species with their average density found in different microhabitats of the study area.

S.N.	Total Species	Family	Average density (ind/m ²)
1.	<i>Allium humile</i>	Amaryllidaceae	0.30
2.	<i>Anaphalis nubigena</i>	Asteraceae	0.60
3.	<i>Anemone tetrasepala</i>	Ranunculaceae	0.45
4.	<i>Anemone vitifolia</i>	Ranunculaceae	0.20
5.	<i>Angelica glauca</i>	Apiaceae	0.30
6.	<i>Aquilegia pubiflora</i>	Ranunculaceae	0.10
7.	<i>Arisaema propinquum</i>	Araceae	0.20
8.	<i>Arnebia benthamii</i>	Boraginaceae	0.30
9.	<i>Bergenia stracheyi</i>	Saxifragaceae	0.20
10.	<i>Caltha palustris</i>	Ranunculaceae	0.60
11.	<i>Carex nivalis</i>	Cyperaceae	0.60
12.	<i>Corydalis cashmeriana</i>	Papaveraceae	0.40
13.	<i>Corydalis meifolia</i>	Papaveraceae	0.40
14.	<i>Cremanthodium arnicoides</i>	Asteraceae	0.20
15.	<i>Cynoglossum glochidiatum</i>	Boraginaceae	0.30
16.	<i>Dactylorhiza hatagirea</i>	Orchidaceae	0.50
17.	<i>Danthonia cachemyriana</i>	Poaceae	0.27
18.	<i>Epilobium latifolium</i>	Onagraceae	0.30
19.	<i>Fragaria nubicola</i>	Rosaceae	0.70
20.	<i>Galium aparine</i>	Rubiaceae	0.50
21.	<i>Geranium wallichianum</i>	Geraniaceae	0.77
22.	<i>Hackelia uncinata</i>	Boraginaceae	0.47
23.	<i>Impatiens sulcata</i>	Balsaminaceae	1.17
24.	<i>Iris kumaonensis</i>	Iridaceae	0.25
25.	<i>Juncus himalensis</i>	Juncaceae	0.30
26.	<i>Kobresia royleana</i>	Cyperaceae	0.40
27.	<i>Ligularia amplexicaulis</i>	Asteraceae	0.30
28.	<i>Lilium oxypetalum</i>	Liliaceae	0.35
29.	<i>Maianthemum purpureum</i>	Asparagaceae	0.60
30.	<i>Meconopsis aculeata</i>	Papaveraceae	0.20
31.	<i>Morina longifolia</i>	Caprifoliaceae	0.20
32.	<i>Nardostachys jatamansi</i>	Caprifoliaceae	0.20
33.	<i>Origanum vulgare</i>	Lamiaceae	0.53
34.	<i>Pedicularis oederi</i>	Orobanchaceae	0.20
35.	<i>Phleum alpinum</i>	Poaceae	0.90
36.	<i>Phlomis bracteosa</i>	Lamiaceae	0.90
37.	<i>Polygonatum verticillatum</i>	Asparagaceae	0.40
38.	<i>Polygonum affine</i>	Polygonaceae	0.75
39.	<i>Polygonum amplexicaule</i>	Polygonaceae	0.70
40.	<i>Polygonum polystachyum</i>	Polygonaceae	1.40
41.	<i>Potentilla argyrophylla</i>	Rosaceae	0.75
42.	<i>Potentilla atosanguinea</i>	Rosaceae	0.20
43.	<i>Potentilla microphylla</i>	Rosaceae	0.20
44.	<i>Primula denticulata</i>	Primulaceae	0.20
45.	<i>Primula reidii</i>	Primulaceae	0.20
46.	<i>Prunella vulgaris</i>	Lamiaceae	0.80
47.	<i>Rhodiola wallichiana</i>	Crassulaceae	0.20
48.	<i>Roscoea procera</i>	Zingiberaceae	0.20
49.	<i>Rumex nepalensis</i>	Polygonaceae	0.73
50.	<i>Selinum wallichianum</i>	Apiaceae	0.30
51.	<i>Sibbaldia purpurea</i>	Rosaceae	0.20
52.	<i>Swertia chirayita</i>	Gentianaceae	0.15
53.	<i>Taraxacum officinale</i>	Asteraceae	0.30
54.	<i>Thymus linearis</i>	Lamiaceae	0.30
55.	<i>Trachydium roylei</i>	Apiaceae	0.50
56.	<i>Urtica dioica</i>	Urticaceae	0.50
57.	<i>Veronica cana</i>	Plantaginaceae	0.20
58.	<i>Viola biflora</i>	Violaceae	0.25

Table 2: Density of *Dactylorhiza hatagirea* in different microhabitats

Microhabitat	Associated species (%)	Density (Ind/m ²)
Open grass lands	45	0.9
Moist / marshy	36	0.6
Alpine meadows	29	0.5
Rocky slopes	22	0.3
Disturb/ waste lands	21	0.2

**Fig 2:** A plant of *Dactylorhiza hatagirea*

4. Discussion

Dactylorhiza hatagirea has exhibited highest density in the open grass lands in alpine region. Species with restricted habitat have higher potential for extinction than species with wide habitat range [14]. The density of *D. hatagirea* is very low ranged from 0.2 - 0.9 ind/m² in microhabitats which was similar to the earlier reported density of *D. hatagirea*, i.e., 0.2 ind/m². [15,16] The earlier study showed that the population of *D. hatagirea* is declining from its natural habitat because of different levels of disturbance, the destruction of the number of economically important plants in alpine meadows begins to deteriorate [17]. In addition, cattle trampling and grazing have also been reported as a significant factor in the loss of its population in natural habitat. Some other studies have been described the over-collection and grazing pressure, trampling, mainly responsible for low density and persistent decline of the plant population in higher altitudes [2, 18, 19]. Likewise [20], also reported that irregular extraction and increasing unsustainable grazing pressure were primarily responsible for reducing population of *D. hatagirea* in the Central Himalaya. In the present study area the similar high grazing pressure was observed. In addition, it is reported that over extraction and habitat loss is over the years led to the decline of highly valued medicinal plant viz, *D. hatagirea* [21].

Due to the high anthropogenic pressures on *D. hatagirea* has been categorized in different threat categories such as critically endangered [18], rare [22] and listed under appendix II of CITES [23], critically endangered [24].

5. Conclusion and Recommendations

The present study reveals that the density of *D. hatagirea* in Pindari valley is under higher degree of threats. The major associated species were *Allium humile*, *Anemone tetrasepala*, *Angelica glauca*, *Danthonia cachemyriana*, *Selinum wallichianum*, *Viola biflora*, etc. Although, the collection and trade of *Dactylorhiza hatagirea* is strictly restricted, however, due to increased pressure of over

extraction, grazing and trampling, therefore, the availability of *D. hatagirea* is continuously declining.

The following conservation and management steps are recommended for *D. hatagirea*:

1. Identify suitable habitats and stable populations of *D. hatagirea* through research and, and ensure its conservation and protection through policies and management.
2. Mitigate human intervention in the microhabitat of *D. hatagirea* by means of legislation which will allow the species to regenerate without stress.
3. Extraction of immature plants should be prohibited. Continuous monitoring will promote better growth and species regeneration.
4. Awareness and restoration programs should be organized among the inhabitants to sustainable uses and maintain or increase the availability of *D. hatagirea* in the degraded microhabitats.
5. Unsustainable grazing needs to be banned and rotational grazing should prefer.

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7. References

1. Thakur M, Dixit VK. Aphrodisiac activity of *Dactylorhiza hatagirea* (D. Don) Soo in male albino rats. Evidence-Based Complementary and Alternative Medicine. 2007; 4(1):29-31.
2. Giri D, Tanta SA. A general account on traditional medicinal uses of *Dactylorhiza hatagirea* (D. Don) Soo. New York Science Journal. 2010; 3(2):78-79.
3. Pant B, Raskoti BB. Medicinal orchid of Nepal. Himalayan map house Pvt. Ltd., Kathmandu, 2013.
4. Kumar R, Arya D, Chandra Sekar K. Diversity, utilization patterns and conservation of ethnomedicinal plants in Pindari Valley, Uttarakhand Himalaya. Asia Pacific Journal of Research, 2020; 1:1-11.
5. Wickens GE. Management issues for development of non-timber forest products. Unasylva. 1991; 165(42):3-8.
6. Uniyal A, Uniyal SK, Rawat GS. Commercial extraction of *Picrorhiza kurrooa* Royle ex Benth. in the Western Himalaya. Mountain Research and Development. 2011; 31(3):201-208. <http://dx.doi.org/10.1659/MRD-JOURNAL-D-10-00125.1>.
7. Badola HK, Aitken S. Potential biological resources for poverty alleviation in Indian Himalaya. Biodiversity. 2010; 11(3-4):8-18.
8. Brys R, Jacquemyn H, Endels P, Blust GD, Hermy M. Effect of habitat deterioration on population dynamics and extinction risks in previously common perennial. Conservation Biology. 2005; 19(5):1633-1643.
9. Samant SS, Dhar U, Rawal RS. Conservation of rare endangered plants: The context of Nanda Devi Biosphere Reserve. In: Ramakrishnan PS, Purohit AN, Saxena KG, Rao KS, Maikhuri RK, editors. Conservation and Management of Biological Resources

- in Himalaya. New Delhi, India: Oxford & IBH, 1996, 521-545.
10. Kulla T, Hutchings MJ. A comparative analysis of decline in the distribution ranges of orchid species in Estonia and the United Kingdom. *Biological Conservation*. 2006; 129(1):31-39. <http://dx.doi.org/10.1016/j.biocon.2005.09.046>
 11. Mishra R. *Ecological work book*. Oxford & IBH, New Delhi, India, 1968, 1-244.
 12. Muller-Dombois D, Ellenberg H. *Aims and methods of vegetation ecology*, John Wiley, USA, 1974, 1-547.
 13. Bisht M, Chandra Sekar K, Kant R, Ambrish K, Singh P, Arya D, *et al.* Floristic diversity in Valley of Flowers National Park, Indian Himalayas. *Phytotaxa*. 2018; 379(1):1-26. <https://doi.org/10.11646/phytotaxa.379.1.1>
 14. Lomolino MV. Elevation gradient of species-density: historical and prospective views. *Global Ecology and Biogeography*. 2001; 10(1):3-13. <http://dx.doi.org/10.1046/j.1466-822x.2001.00229.x>
 15. Chandra Sekar K, Rawat B. Diversity, utilization and conservation of ethnomedicinal plants in Devikund - a high altitude, sacred wetland of Indian Himalaya. *Medicinal Plants- International Journal of Phytomedicines and Related Industries*. 2011; 3(2):105-112.
 16. Rawat B, Chandra Sekar K, Gairola S. Ethnomedicinal plants of Sunderdhunga valley, Western Himalaya, India-traditional use, current status and future scenario. *Indian Forester*. 2013; 139(1):61-68.
 17. Giri D, Arya D, Tamta S, Tewari LM. Dwindling of an endangered orchid *Dactylorhiza hatagirea* (D. Don) Soo: A case study from Tungnath alpine meadows of Garhwal Himalaya, India. *Nature and Science*. 2008; 6(3):6-9.
 18. Kala CP. Status and conservation of rare and endangered medicinal plants in Indian Trans-Himalaya. *Biological Conservation*. 2000; 93(3):371-379. [http://dx.doi.org/10.1016/S0006-3207\(99\)00128-7](http://dx.doi.org/10.1016/S0006-3207(99)00128-7)
 19. Bulpitt CJ. The uses and misuses of orchids in medicine. *QJM: an international journal of medicine*, 2005; 98:625-631. <http://dx.doi.org/10.1093/qjmed/hci094>
 20. Sharma PK, Sharita S, Prell J. *Dactylorhiza hatagirea* (D. Don) Soo - a west Himalayan orchid in peril. *Current Science*. 2005; 89(4):610-612.
 21. Singh G. Diversity of vascular plants in some parts of Kedarnath Wildlife Sanctuary (Western Himalaya) [PhD thesis]. Uttarakhand: Kumaun University Nainital, 2008.
 22. Samant SS, Dhar U, Rawal RS. In *Himalayan medicinal plants- potential and Prospects* (eds Samant S, S, Dhar U and Palni, L.M.S.) Gyanodaya Prakashan Nainital, 2001, 166-184.
 23. Uniyal SK, Awasthi A, Rawat GS. Current status and distribution of commercially exploited medicinal and aromatic plants in upper Gori Valley, Kumaon Himalaya, Uttaranchal. *Current Science*. 2002; 82(10):1246-1252.
 24. Ved DK, Kinhal GA, Ravikumar K, Prabhakaran V, Ghate U, Vijayashankar R, *et al.* Conservation assessment and management prioritisation, FRLHT, 2003, 9-11.