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Taxonomical description, nativity, and endemism with particular reference to threatened ethno-medicinal plants of Almora district of western Himalaya

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ABSTRACT

Without taxonomy, one cannot gives shape to bricks and systematically tells how to put them together, and that's why the house of biological science is a meaningless jumble without it. Taxonomy is the foundation of the study of biodiversity. Most of these botanical explorations were aimed mainly at building the herbaria and writing the floristic account of the areas explored, but recent explorations seem to be putting emphasis on the nativity of threatened floras. The present manuscript deals the taxonomical description with nativity and endemism of threatened ethno-medicinal plant of Almora district of Uttarakhand.

KEY WORDS: Almora district, endemism, ethno-medicine, nativity, taxonomy, threatened

INTRODUCTION

May (1990) has expressed very succinctly that without taxonomy one cannot gives shape to bricks and systematically tells how to put them together, and that's why the house of biological science is a meaningless jumble without it. Taxonomy is the foundation of the study of biodiversity. It is the method which classifies and organizes the vast diversity of living things on this planet in an effort to understand the evolutionary relationships between them. Modern taxonomy originated in the mid-1700s when Carolus Linnaeus published his multi-volume Systema Naturae. In the 20th century, the major publications on floristic aspect were given by Stewart, 1917; Blatter, 1927-1929; Kachroo, *et al*., 1977; Sharma and Kachroo, 1981; Dhar and Kachroo, 1983; Rawat and Pangtey, 1987; Naithani *et al*., 1992; Pangtey *et al*., 1993; Samant and Pangtey, 1995; Hajra and Balodi, 1995; Samant, 1994, 1999; Samant *et al*., 1993, 2000, and 2002; Tewari *et al*., 1994; Kala *et al*., 1998; Bhattacharya, 1999; Tewari and Bankoti 2003; Tewari *et al*., 2008; Kumari *et al*., 2009; Upreti, 2010; Giri, 2008; Tewari *et al*., 2010. The history of plant collection in district Almora begins with work of Edward Madden, who made collections from different parts of the district in 1846. In 1920, H.G. Champion also made some important collections from Almora district. Recently, Pande and Samant, 2001; Joshi and Joshi, 2001; Kumari et al., 2009; Tewari *et al*., 2008, 2010 have contributed to the flora of Almora and Bageshwar districts of Uttarakhand.

Most of these botanical explorations were aimed mainly at building the herbaria and writing the floristic account of the areas explored, but recent explorations seem to be putting emphasis on the nativity of threatened floras. Nativity of the species denotes the place of origin/first record of the species (Anonymous, 1883-1970; Samant *et al*., 1998). "Native" refers to a species that occurs naturally in an area, i.e. whose introduction has occurred independently of deliberate human activities. While the "Non-Native" refers to a species or race that has not previously occurred at that area or it's dispersal into the area that has been done through anthropogenic activities. Endemism refers the restricted distribution of species in a particular biogeographically province or a single island or mountain top or even in a single rock outcrop (Huston,

1994; Samant *et al*., 1998). The areas with high percentage of native and endemic species indicate the conservation value of that particular area. However, due to habitat degradation and overexploitation of such species, their richness is decreasing day-by-day (Samant *et al*., 1998).

It has been realized that introduction of non-native species has an adverse effect on native vegetation, including genetic variation, reduction in distribution, and abundance of native plant species and also affects other ecological aspects (Mooney and Drake, 1984). Once a native and endemic species is lost, a global loss of species occurs (Nayar, 1997). Few studies related to nativity and endemism of the species from various regions of IHR are available (Pant and Samant, 2007; Samant *et al*., 2000).

The present study records 187 species of ethno-medicinal plants representing 80 families (Kumari, 2011). The analysis of the status of the species indicated that 67 are rare, 85 are common, and 35 are cultivated. 21 out of 67 rare species have been identified as threatened species which are as follows: *Taxus baccata* Linn., *Thalictrum foliolosum* DC., *Berberis aristata* DC., *Baliospermum montanum* Will., *Thymus serpyllum* Linn., *Coleus forskohlii* Will., *Bergenia ciliata* (Haworth.) Sternb., *Clerodendrum serratum* Linn., *Oroxylum indicum* Linn., *Valeriana hardwickii* Wall., *Valeriana jatamansii* Jones, *Celastrus paniculatus* Will., *Malaxis acuminata* D. Don, *Habenaria intermedeia* D. Don, *Habenaria edgeworthii Hook*. f. ex. Collett. Hook. f. ex. Collett, *Costus speciosus* (Koenig ex Retz.) Smith., *Dioscorea deltoidea* Wall., *Curculigo orchioides* Gaertn, *Gloriosa superba* Linn., *Polygonatum cirrhifolium* (Wall.) Royl, *Polygonatum verticillatum* Linn.

METHODS

The study is based on extensive and intensive field surveys conducted in Almora district. The old knowledgeable persons including village Vaidhyas and traditional healers from each study areas were interviewed, and information was gathered on their local names, indigenous uses of the species. They were interviewed using a structured questionnaire to obtain information about the all documented species. Standard field methods were adopted for collection of proper voucher specimens of medicinal plants (Jain and Rao, 1977). During the field surveys, notes on habitat and color of flowers, flowering/fruiting periods together with ecological notes and local names of these plants are recorded. The specimens collected were identified with the help of local floras, published literature of Himalayan medicinal plants (Gaur, 1999; Naithani, 1984-1985; Osmaston, 1927) and Regional Research Institute of Himalayan Flora, Tarikhet. The voucher specimens of the medicinal plants are deposited in the herbarium of Regional Research Institute of Himalayan Flora, Tarikhet.

The nativity of the species has been identified by the following Anonymous (1883-1970), Samant and Dhar (1997), Samant (1999), and Samant *et al*. (2000a). The species having an origin in Himalayan region have been considered as natives. In the case of pteridophytes the endemic and near-endemic species have been considered as native to the Himalayan region, whereas remaining species have been considered under other categories. Endemism of the species has been identified based on the distribution of species (Dhar and Samant, 1993; Dhar *et al*., 1996; 1997; 1998 (a and b); Samant *et al*., 1996, 1997, 1998 2000; Samant and Dhar, 1997; Samant, 1999). The species restricted to IHR have been considered as endemic, whereas those with extended distribution to neighboring countries/states considered as near-endemic.

ENUMERATION OF THREATENED SPECIES

Baliospermum montanum Will. Muell. - Arg. In DC., Prodr. 15.2: 1125. 1866; Babu, Herb. Fl. D.Dun 455. 1977

Deciduous undershrub or herbs, to 1.5 m height; stem softly pubescent at apex. Leaves variable in shape and size, ovate-oblong or elliptic-lanceolate, lowermost 3-5 lobed, 4.5-16 cm × 2-11.5 cm, rounded, subcordate or cuneate at base, acute or acuminate, sinuate-toothed, glabrous or hairy; petioles 2-12 cm long, with a pair of stipular glands at base. Flowers small, greenish-yellow in axillary or terminal panicles; male flowers terminal, many female flowers few, basal; bracts ovate, acute. Perianth segments 4-5, green, glabrous or hairy, rounded to ordicular, white margined. Stamens 15-25. Female flowers axillary, solitary; ovary 2-3 lobed; style stout, smooth. Capsules subglobose, 1-1.2 cm long, hairy, 3-valved; seeds oblong, and smooth.

Berberis aristata DC., Syst. Nat. 2: 8. 1821; Hook.f.77 and Thomson in Fl.Brit. India 1: 110.1872

Shrubs, 1-3 m tall; stem pale-brownish to yellow, terete; spines solitary toward apex, 2-3 fid at base. Leaves obovate or elliptic, 3-6 cm× 2-3 cm, subsessile, cuneate at base, mucronate or acute at apex, entire or few spines along margins, prominently veined. Inflorescence a drooping raceme, 4-6 cm long. Flowers dense, bright yellow.

Outer sepals, ovate-lanceolate; inner ones obovate. Petals 6, obovate to oblong, cuneate at base with two glands, entire. Stamens 6, shorter than petals; connective apiculate. Ovules 3-5. Berries ovoid to oblong-ovoid, 6-10 mm × 5-8 mm, bright red, slightly pruinose blue; style prominent.

***Bergenia ciliata* (Haworth) Sternberg, Rev. Saxifr. Suppl. 2: 2. 1831; C.B.Clarke in Hook. f., Fl. Brit. India 2: 398. 1878**

Perennial herbs, with thick, rhizomatous rootstocks; stem very short. Leaves mostly radical, shortly stalked, broadly ovate or suborbicular, 6-14 cm × 4.5-12 cm or sometimes quite large, margins and both surfaces covered with red-brown, erecto-patent hairs, base cordate, apex obtuse. Flowers pinkish, 1.2-1.5 cm across, on slender, one sided, spreading, 3.5-18 cm long, cymose-panicles. Calyx tube glabrous, deeply 5-lobed; teeth ovate, pinkish-green. Corolla 5-18 mm long; petals 5, orbicular, pinkish-white. Stamens 10. Ovary 2-celled. Capsules subglobose, 1.2-1.8 cm long, with long persistent styles, surrounded by erect calyx lobes; seeds elongate, numerous, smooth.

***Celastrus paniculatus* Will., Sp. Pl.1: 1125. 1797; Lawson in Hook. f., Brit. India 1: 617. 1875**

Deciduous, scandent shrubs; stem rough, specked with pale lenticels. Leaves variable in shape and size, alternate, obovate, orbicular or broadly elliptic, 6-10 cm × 1.5-6 cm, crenate, shortly acuminate, glabrous, lateral nerves 4-6 pairs; petioles 1.2-1.8 cm long. Flowers yellowish-green, 3-6 mm across, in loose, large, drooping, pubescent panicles. Sepals rounded, pointed. Petals oblong. Ovary free, stigma simple. Capsules globose, bright orange-yellow when ripe, 3-celled; seeds 1-2 in each cell, black, enclosed in red aril.

***Clerodendrum serratum* Linn. Moon, Cat. Ceylon Pl. 46. 1824; Sprengel, Syst. Veg. ed. 16.2: 758. 1825; C.B. Clarke in Hook. f., Fl. Brit. India 4: 592. 1885.**

Deciduous shrubs, to 2 m high, with thick woody rootstock. Leaves opposite or in whorls of 3, sessile, elliptic-oblong, 9.5-24 cm × 2.5-7.5 cm, subcordate or rounded base, distantly serrate, glabrous. Flowers violet or white-tinged mauve, in terminal cymes, forming 10-22 cm long, leafy panicles. Calyx cup-shaped, 6-7 mm long, adpressed hairy; minutely 5-toothed. Corolla tube 0.8-1.5 cm long, narrow, cylindrical, hairy within, mouth oblique, 2-lipped; lobes 1-1.5 cm long, oblong. Stamens 4, hairy at the base. Drupes 5-6 mm across, subglobose, pyrenes dark-purple or black.

***Coleus forskohlii* Will. Briquet in Engler, Pflanzenfam. 4.3a.: 359,1897; Babu, Herb. Fl. D. Dun 407. 1977. *Plectranthus forskohlii* Will., Sp. Pl. 3;169.1800 (as forskalaei)**

Annual-perennial, erect, pungent-aromatic herbs; stem much branched from the woody base, patently-hairy, 30-60 cm high; rootstock tuberous-fusiform. Leaves ovate or obovate, 3-12 cm × 1.5-6 cm, obtuse, crenate, glandular-hairy; petioles 5-8 cm long. Flowers in distant whorls of 6-8, arranged in slender, 10-25 cm long, interrupted spicate racemes; bracts 2.5 cm long, ovate, acute deciduous, overlapping in bud. Calyx 2-lipped, hairy, bell-shaped; upper lip rounded-ovate, acute; lower lip lanceolate, acute to acuminate, deflexed in fruits. Corolla purple or pale-blue, to 2 cm long; corolla tube 7-10 mm long, longer than calyx, 2-lipped; lower lip boat-shaped, entire; upper lip 3-lobed, reflexed, shorter than lower lip. Stamens in unequal pairs.

***Costus speciosus* (Koenig ex Retz.) J.E. Smith, Trans. Linn. Soc. 1:249. 1791; Baker in Hook. f., Fl. Brit. India 6:249. 1892; Babu, Herb. Fl.D.Dun 500. 1977**

Stout, erect, leafy herbs, 1-2 m high; with creeping tuberous rootstock. Leaves subsessile, spirally arranged; obovate-oblanceolate to oblong, 15-35 cm × 6-10 cm, acuminate-caudate, glabrous above, silky beneath, sheathing at base. Flowers white, to 4 cm long, funnel-shaped, with yellow tinge at the throat, in terminal globose spikes; bracts bright red, ovate, 1.5-4 cm long. Calyx with 3 oval segments, 2-posterior lobes smaller. Corolla 2.5-4 cm long, tube shorter than calyx; lip white, crispy-serrate, with yellowish, hairy throat, hairy along the median creamy band, 5-7 cm across.

***Curculigo orchioides* Gaertner, frut. Sem. 1:63. T. 13. 1788; Hook f. In Fl.Brit. India 6: 279. 1892**

Perennial herbs, with tuberous rootstock and fleshy roots. Leaves radical, sessile or narrowed to a short petiole; lanceolate or oblong-elliptic, 10-50 × 2-5 cm, acute or acuminate, plicate, glabrous or sparsely hairy. Scapes stout, 4-7 cm long, clavate, hairy. Flowers sessile, distichous, yellow; bracts white, membranous, lanceolate, acuminate. Perianth tube produced above the ovary. Stamens 6, Shorter than the perianth segments. Ovary hairy, 6-8 ovuled. Berries up to 1.4 cm long.

***Dioscorea deltoidea* Wallich ex Grisebach in Martius, fl.Brasil.3:43. In nota 1842; Hook.f.in Fl.Brit. India 6:291. 1892**

Glabrous, slender, twining herbs. Leaves alternate variable in shape, and size, ovate-lanceolate, 5-15 × 3-10 cm,

acuminate, base cordate; basal lobes rounded, projecting; petioles 5-20 cm long. Spikes usually solitary. Male spike 7-30 cm long; flowers small, indistinct clusters; stamens 6, all fertile. Female spikes 8-12 cm long.Tepals broadly ovate, oblong. Capsules broadly rounded, 2-2.5 cm long, winged.

***Gloriosa superba* Linn. Sp. Pl. 305.1753; Hook. f. in Fl. Brit. India 6: 358. 1892; Babu, herb. Fl. D. Dun 519.1977; Naihani, Fl. Chamoli 2: 651.1985; Gaur, Fl. Garhwal 712.1999.**

Climbing or scrambling, glabrous herbs with fleshy cylindrical tubers. Leaves sessile, alternate or opposite, ovate-lanceolate, 10-15 cm × 2-4 cm, acuminate in the form of the tendril-like apex, solitary, auxiliary, or subcorymbose at tip; pedicels 8-15 cm long.Tepals 6, lanceolate, acuminate with crispy-undulate margins. Stamens 6; filaments stout; anthers linear, versatile, extrorse. Capsule ellipsoid-oblong, 4.5-1.6 cm, green, septicidal.

***Habenaria edgeworthii* Hook. f. ex. Collett, Fl. Siml.. 504.f. 166. 1902.**

Stout, erect herbs, 30-70 cm high. Leaves alternate, stem-clasping at the base, ovate or oblong-lanceolate, 4-10 cm × 2-4 cm, upper ones gradually smaller, fleshy, acute or acuminate. Flowers yellow, 1-1.5 cm across, crowded, deflexed in the bud, on 8-25 cm long, spicate racemes; bracts lanceolate, acuminate, shorter than ovary. Sepals green, pubescent, margins ciliate, laterals longer than odd sepal. Petals yellow, erect, thick, apex curved, forming a hood with the odd sepal. Lip yellow, longer than sepal. Spur twice as long as ovary, yellowish-green, curving upward.

***Habenaria intermedeia* D. Don, Prodr. Fl. Nep. 24. 1825; Hook.f.in Fl. Brit. India 6: 138.1890.**

Stout, erect, glabrous herbs, 20-50 cm high. Leaves alternate, sessile, crowded in the middle, ovate-lanceolate, 4-7 cm × 2-4 cm, acute, 5-nerved; base stem sheathing, rounded or cordate. Flowers white or greenish-white, 5 cm across, in 2-6-flowered racemes; bracts leaf-like, broad-lanceolate, equaling or exceeding the ovary. Sepals green, persistent, 2-2.5 cm long, ovate-lanceolate, recurved at apex; lateral spreading, acuminate, 5-7 nerved. Petals white, strongly 5-nerved, margins ciliolate. Lip deeply 3-lobed, longer than sepals. Spur 5-6 cm long, stout, exceeding the ovary. Capsules linear-ovoid, to 3.5 cm long.

***Malaxis acuminata* D. Don, Prodr. Fl. Nep.29. 1825; Hook.f.in Fl. Brit. India 5: 686. 1890**

Terrestrial herbs, 10-25 cm high; bulbous at base covered by old leafy scales. Leaves 3 (4), ovate-lanceolate 10-15 cm × 5-6.5 cm, acute, undulate margins, membranous. Flowers pale-green tinged purple, shortly stalked, 1-1.2 cm across, on many flowered, 8-10 cm long spikes; bracts linear, minute. Sepals oblong; lateral broad and short with recurved margins. Petals linear, longer than sepals. Lip shield like, broadly ovate, somewhat convex, tip notched, auricles at base straight or overlapping. Pollinia 4, waxy. Capsules ovoid.

***Oroxylum indicum* Linn. Ventenat in Decne., Gen. Nov. 8. 1808; Kurz, For. Fl. Burma 2: 237. 1877; C.B. Clark in Hook. f., Fl. Brit. India 4: 378. 1884.**

Deciduous, slender, straight trees, to 8 m high. Leaves opposite, 203 pinnate; pinnae 3-4 pairs; leaflets broadly ovate or elliptic, 6.5-14 cm × 2.6-8 cm, entire, acuminate, glabrous, dark green-shining above, pale beneath, terminal long stalked. Flowers dull-purple, fleshy in large, erect, stout, terminal, pedunculate racemes; peduncle and pedicels rough with raised lenticels. Calyx about 2.6 cm long; lobes fleshy. Corolla 5-7 cm long, campanulate, fleshy; mouth 5-8 cm wide; lobes subequal, round. Stamens 5; anthers glabrous. Capsules large, flat-linear, septicidally 2-valves, 30-60 cm × 5-8 cm, incurved, woody, red-brown; seeds winged.

***Polygonatum cirrhifolium* (Wall.) Royle, Illus. Bot. Himal 1:380. 1839; Hookf. In fl. Brit. India 6:322. 1892**

Tall, erect, weak herbs, with stout, creeping rhizomes; stem 60-120 cm height, terete, grooved. Leaves in whorls of 3-6, linear to narrowly lanceolate, 6-15 cm long, margins enrolled, apex coiled, tendril-like. Flowers white, tinged purple or green, in short stalked clusters of 2-4, from the leaf axils. Perianth 6-parted, somewhat reflexed.

***Polygonatum verticillatum* Linn. Allioni, Fl. Pedem. 1: 131. 1785; Hook.f. in Fl. Brit. India 6:321. 1892**

Annual-perennial, tall, erect herbs, 80-150 cm high; stem angled or grooved. Leaves sessile, in whorls of 4-8, linear or narrowly lanceolate, 8-15 cm × 0.5-3 cm, acuminate or acute. Flowers white, arranged in the terminal, whorls of leafy racemes. Perianth oblong, 4-6 mm long, 6-parted; segments spreading. Berries globose, 5 mm across, purple-black when ripe.

***Taxus baccata* Linn., Sp. Pl. 1040. 1753; Sensu Hook.f. in Fl. Brit. India 5: 648. 1888**

Evergreen trees, to 25 m high; bark reddish-gray. Leaves distichous, linear, flattened, acute, yellowish, rusty beneath, glossy-green above, 2-3.5 cm long. Male flowers pedicelled whorls of 3-8 anther cells on the peltate scale.

Female flowers with a single erect ovule, surrounded by a disc. Fruit red, fleshy, to 8 mm long, often 1-seeded.

***Thalictrum foliolosum* DC., Syst. Nat. 1: 175. 1818; Hook. f. and Thomson in Fl. Brit. India 1: 14.1872**

Erect, branched herbs, to 2 m high, often giving a rambling habit. Leaves pinnately decompound; stipules present; leaflets broadly orbicular or ovate-oblong. Flowers polygamous, white or dull greenish-purple, in many branched panicles. Sepals obovate, caducous. Stamens many, much longer than sepals; filaments filiform; anthers mucronate or acute. Achenes 2-5, sessile, oblong, ellipsoid, prominently ribbed, shortly beaked.

***Thymus serpyllum* Linn. auct. Non L. Sensu Hook. F. Fl. Brit. Ind.4:649.1885. Collett 391; Duthie 140; Osmaston 416; Parker 40; Raizada and Saxena 1:608**

Aromatic herb, Stem procumbent, wiry, 15-30 cm tall; Leaves sensible, gland-dotted, oblong-ovate 0.6-0.8 cm. Flowers small purple, crowded in terminal spikes. Calyx hairy. Corolla tubular long as calyx. Nutlet smooth.

***Valeriana hardwickii* Wall., Prodr. Fl. Nep. 127. 1825; C.B.Clarke in Hook. f., Fl. Brit.India 4: 125.1883; Naithani, Fl.Chamoli 2: 431. 1985**

Annual herbs, 30-60 cm high; stem 4-angular, narrowly alate. Leaves opposite, shortly petiolate, lanceolate or ovate-lanceolate, 2.5-7 cm × 0.8-2 cm, 3-5 nerved, entire, acute. Flowers tetramerous, pedicellate, yellowish-green with a purple tinge, in axillary or terminal, panicled lax cymes. Calyx 4 - partite; lobes lanceolate, shorter or longer than petals. Corolla yellow to pink-purple, very short; lobes short, each with a solitary gland at the base, covered with glabrous scales. Stamens 4; filaments linear; anthers oblong. Capsules oblong-ellipsoid; seeds minute, globose, warty.

***Valeriana jatamansii* Jones in Asiat. Res. 2: 405 and 416.1790; syn. V.wallichii DC., Prodr. 4: 640. 1830; C.B.Clarke in Hook.f., Fl. Brit. India 3: 213. 1881.**

Perennial, scabigerous, pubescent herbs, 10-35 cm high, with thick, aromatic, fibrous rootstock. Radical leaves crowded, long petiolate; broadly ovate-cordate, 2.5-6.5 cm × 1.5-3.6 cm, entire, sparsely pubescent; cauline leaves few, small, linear-lanceolate, deeply 3-lobed. Flowers dioecious or 2-sexual, in terminal corymbs. Scapes many, 15-30 cm long; calyx tube short, 5-lobed. Corolla white, tinged pink, funnel-shaped. Stamens (2) 3, slightly protruding. Ovary with 1 ovule. Fruits small, pilose, tipped with pappus-like calyx.

RESULTS AND DISCUSSION

Out of 187 ethno-medicinal plants of Almora district (Kumari *et al.*, 2011), identifications, distribution, nativity, and endemic/near-endemic of 21 threatened ethno-medicinal plant species were studied. These 21 species of ethno-medicinal plants belonging to 16 families were recorded. Of these, 2 species were trees, 1 shrub, 16 herbs, and 2 climbers. The families Taxaceae, Ranunculaceae, Berberadaceae, Euphorbiaceae, Saxifragaceae, Verbenaceae, Bignonoaceae, Celastraceae, Costaceae, Dioscoreaceae, Hypoxidaceae, Valerianaceae, and Gentianaceae having single species, Lamiaceae having two species, and Orchidaceae and Liliaceae having three species were identified.

The plants with botanical name, altitudes, family, flowering and fruiting months, habitat and there accession number are presented in Table 1, and habit and their families are represented by Figures 1 and 2.

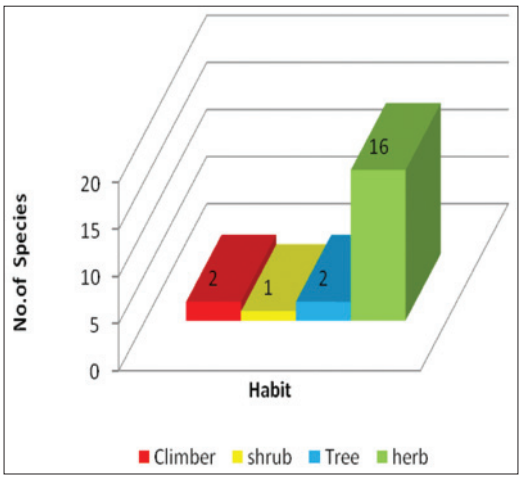

Figure 1: Habit of documented species

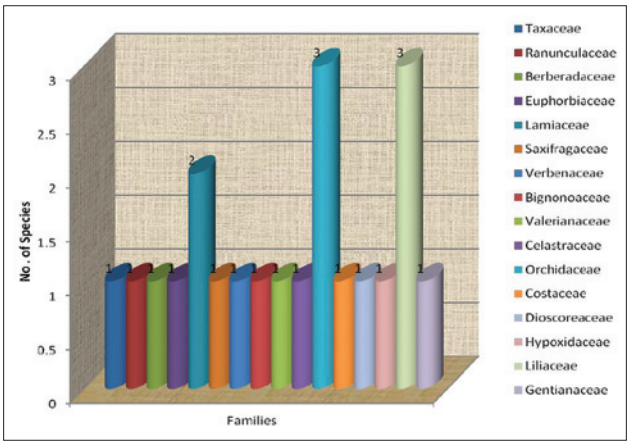

Figure 2: Species belonging to families

Table 1: Taxonomical notes with accession number of threatened plants

Plant species	Altitude (meter)	Family	Flowering and fruiting months	Habitat	Accession no. (RKT)
Baliospermum montanum Will.	500-1200	Euphorbiaceae	January-July	Forest openings, edges and wastelands	24184
Berberis aristata DC.	1700-2800	Berberidaceae	March-July	Open places, rocky places	24881
Bergenia ciliata (Haworth) Sternb.	1200-2800	Saxifragaceae	February-June	Shady and moist rocks	251224
Celastrus paniculatus Will.	500-2000	Celastraceae	March-December	Rocky substrate, open places	24655
Clerodendrum serratum Linn.	500-2000	Verbenaceae	April-November	Road side, open places	24840
Coleus forskohlii Will.	500-2000	Lamiaceae	August-October	Rocky substrate	24499
Costus speciosus (Koen. ex Retz.) Smith	500-2000	Costaceae	August-October	Marshy locations, open grassy slopes and wastelands	25180
Curculigo orchioides Gaertn	1200-2800	Hypoxidaceae	July-November	Undergrowth in moist shady areas, open shady grassy fields	25496
Dioscorea deltoidea Wall.	1200-2000	Dioscoreaceae	May-September	Open places	20617
Gloriosa superba Linn.	500-2000	Liliaceae	August-November	Along forest margins	20825
Gloriosa superba Linn.	500-2000	Liliaceae	August-November	Along forest margins	20825
Habenaria edgeworthii Hook. f. ex. Collett. Syn *Platanthera edgeworthii* (Hook. f. ex Collett)	1200-2800	Orchidaceae	July-August	Open grasslands	24503
Habenaria intermedeia D. Don	2000-2800	Orchidaceae	July-September	Open grasslands, grassy slope	24504
Malaxis acuminata D. Don	1200-2800	Orchidaceae	August-October	Moist shady places	25254
Oroxylum indicum Linn.	500-1200	Bignonoaceae	June-December	Open places	23903
Polygonatum cirrhifolium (Wall.) Royl.	2000-2800	Liliaceae	June-August	Moist shady places, forest undergrowth, stony edges	24319
Polygonatum verticillatum Linn.	2000-2800	Liliaceae	June-September	Moist substrates, open grasslands, deodar forests	24320
Taxus baccata Linn.	1600-2000	Taxaceae	April-November	Moist forest	20619
Thalictrum foliolosum DC.	1300-2800	Ranunculaceae	June-October	Open hill slopes	25101
Thymus serpyllum Linn.	1200-2000	Lamiaceae	May-October	Shady forest	25435
Valeriana hardwickii Wall.	2000-2800	Gentianaceae	July-November	Shady places, grassy slopes, forest edges	24744
Valeriana jatamansii Jones.	1200-2800	Valerianaceae	February-June	Moist places, forest floors	25263

Table 2: Nativity and endemism of threatened species

Name of species	Family	Nativity	Native/non-native	Endemism/near-endemic
Baliospermum montanum Will.	Euphorbiaceae	Ind or Malaya	NN	GD
Berberis aristata DC.	Berberidaceae	Ind or	NN	NE
Bergenia ciliata (Haworth) Sternb.	Saxifragaceae	Reg Himal	N	NE
Celastrus paniculatus Will.	Celastraceae	As Trop Malaya	NN	GD
Clerodendron serratum Linn.	Verbenaceae	Ind or Burma	NN	GD
Coleus forskohlii Will.	Lamiaceae	Ind or Afr Trop	NN	GD
Costus speciosus (Koen. ex Retz.) Smith.	Costaceae	Ind or Malaya	NN	NE
Curculigo orchioides Gaertn.	Hypoxidaceae	As Trop	NN	GD
Dioscorea deltoidea Wall.	Dioscoreaceae	Ind or	NN	GD
Gloriosa superba Linn.	Liliaceae	As Trop	NN	GD
Habenaria edgeworthii Hook. f. ex. Collett. Syn. *Platanthera edgeworthii* (Hook. f. ex Collett)	Orchidaceae	Ind	NN	GD
Habenaria intermedeia D. Don.	Orchidaceae	Reg Himal	N	NE
Microstylis wallichii (Lindl.) Kuntz. Syn. *Malaxis acuminata* D. Don.	Orchidaceae	Reg Himal	N	GD
Oroxylum indicum Linn.	Bignonoaceae	As Trop	NN	GD
Polygonatum cirrhifolium (Wall.) Royle	Liliaceae	Reg Himal As Bor	NN	GD
Polygonatum verticilatum Linn.	Liliaceae	Europe As Bor	NN	GD
Taxus baccata Linn.	Taxaceae	Reg Bor Temp.	NN	NE
Thalictrum foliolosum DC.	Ranunculaceae	Reg Himal	N	GD
Thymus serphyllum Linn.	Lamiaceae	Europe AS et Afr Bor	NN	GD
Valeriana hardwickii Wall.	Valerianaceae	Reg Himal	N	GD
Valeriana jatamansii Jones.	Valerianaceae	Reg Himal	N	GD

N: Native; NN: Non-native; NE: Near-endemic; GD: Globally distributed

Nativity of a species denotes the place of origin/ first record of the species (Anonymous, 1883-1870). Identification of nativity of the species has also been emphasized in the National Biodiversity Action Plan, Agenda 21, and Convention on Biodiversity. Therefore, in the present study, an attempt was made to identify the nativity of the threatened ethno-medicinal plants of the Almora district. Since maximum number of species

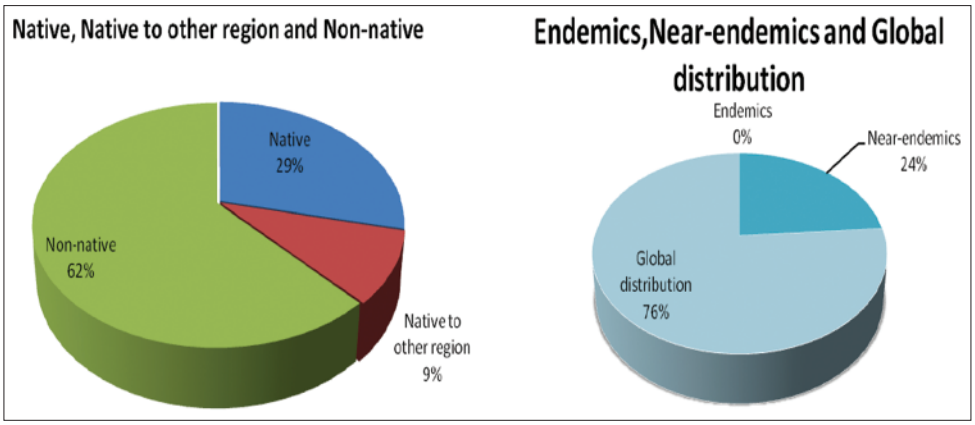

Figure 3: Percentage nativity and endemism of threatened medicinal plants

(61.90%) are native to various biogeographic regions, such as Oriental India, Tropical Asia, Malaya, Burma, Europe, Africa, and Indonasia, are considered as non-native for the Himalaya, only 28.57% species were native to Himalayan region and 9.52% species were native to Himalayan Region and adjacent countries. Out of 21 species, 5 species extend their distribution to adjacent areas, hence classified as near-endemics. Among the 21 not even a single species are identified as endemics, whereas 16 species are globally distributed shown in Table 2 and represented in Figures 3-5.

The widely spreading population of non-native medicinal plants indicates habitat degradation in the region leading to changes in the vegetation composition. On the other hand, native species are well-adapted to the environmental conditions and can play a vital role in tracing the evolution of the species in the region (Samant *et al.*, 1998). The harmful impacts of non-native species on native taxa can be shown in the form of habitat alteration, competition, predation, filial effects, which show potential effects on genetic diversity as well as species diversity (Manchester and Bullock, 2000). Such impacts include the extinctions during the past few 100 years of thousands of species (Vistousek, 1986). The negative effect of non-native species shows impacts on the entire ecosystem in the tropical and temperate regions. Available information in temperate families reveals that in most cases, endemism at high-altitude (alpine/sub-alpine zone) is higher as compared to estimates of entire Himalaya. This feature is particularly prominent in trans/northwest and west Himalaya (Dhar *et al.*, 1996, 1998; Dhar and Samant, 1993) suggesting thereby that high-altitude zone can be considered as one of the endemic centers. It has been suggested that an invasion will only be successful where the climate of the region being invaded is similar to that of a species native to the region (Manchester and Bullock,

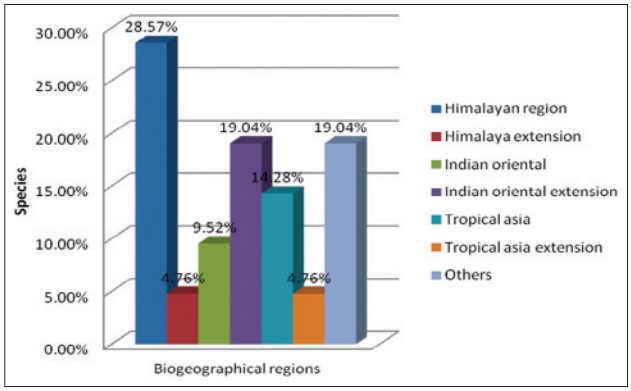

Figure 4: Nativity of threatened ethno-medicinal plants

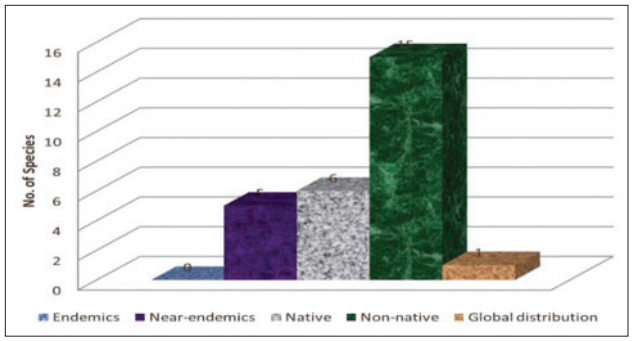

Figure 5: Native, non-native, endemic and near-endemic species

2000). The altitude, latitude, longitude play a vital role in the speciation of the species (Khoshoo, 1992). Thus, endemics are generally concentrated in a limited number of taxa and are taxonomically not a random assemblage (Major, 1990; Cowling *et al.*, 1996). This is because different taxa respond differently to the processes like speciation, hybridization, immigration, and extinction (Major, 1990).

The dominance of high percentage of native and endemic elements at high-altitudes suggests high conservation value of the zone. Therefore, this region requires adequate

Figure 6: *Bergenia ciliata* (Haworth) Sternb

Figure 9: *Habenaria edgeworthii* Hook. f.ex.Collett.

Figure 7: *Gloriosa superba* Linn

Figure 10: *Polygonatum verticilatum* Linn.

Figure 8: *Microstylis wallichii* (Lindl.)

Figure 11: *Coleus forskohli* Will.

conservation strategies so that they could maintain their present status. Where, there is, higher the anthropogenic activities, lower will be the percentage recorded of native species. Thus, to reduce the expansion of highly disturbed areas, which cause heavy damage to the vegetation including native and endemic species, there are two basic complementary strategies, i.e., *in situ* and *ex situ*. Establishment of the new protected area (PAs) Network

Figure 12: *Thymus serphyllum* Linn.

Figure 15: *Dioscorea deltoidea* Wall.

Figure 13: *Oroxylum indicum* Linn.

Figure 16: *Costus speciosus* (Koen. ex Retz.) Smith.

Figure 14: *Celastrus paniculatus* Will.

Figure 17: *Valeriana jatamansii* Jones.

or extending the boundaries of existing ones was the basic tenet of *in situ* conservation (Singh, 2002). To avoid the loss of resident species, PAs need management practices for species, populations, habitats, and communities in tune with the dynamics of the ecological changes (Heywood and Iriondo, 2003).

Figure 18: *Clerodendron serratum* Linn.

Figure 21: *Thalictrum foliolosum* DC.

Figure 19: *Curculigo orchioides* Gaertn.

Figure 21: *Thalictrum foliolosum* DC.

Figure 20: *Taxus baccata* Linn.

Figure 23: *Berberis aristata* DC

Endemics are known to occupy a range of habitats. However, their occurrence is associated with rocky cliffs and rapidly eroding sites in most of the mountain systems (Major, 1990, Dhar, 2002). In the present study area, a large amount of damage has been occurred to the habitats due to flood, grazing, trampling and overexploitation of the species, forming bare sites which provide favorable conditions for the growth of non-native species. However, in the study area, the percentage of non-native species is

relatively lower than native species; this may be attributed to the tough climatic and geographic conditions of high altitudinal regions. The photograph of threatened species and their part used are given in Figures 6-23.

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