NOTES ON SOME SPECIES OF GENUS *ARENARIA* L. (CARYOPHYLLACEAE)

Rajeev Kumar Singh and P.G. Diwakar

Botanical Survey of India, Western Regional Centre, Pune - 411 001 (Maharashtra)

Abstract: *Arenaria serpyllifolia* and *A. neelgherrensis* are closely allied, very similar and confused species, likely *A. melandryoides* and *A. melandryiformis*, *A. polytrichoides* and *A. densissima* are also very similar and posing problem in identification. After a critical study of herbarium specimens at CAL & BSI, *A. neelgherrensis* has been reduced as a variety under *A. serpyllifolia*, *A. melandryiformis* as a variety under *A. melandryoides* and *A. densissima* as a variety under *A. polytrichoides*. A key to the varieties involved, short descriptions, distribution and notes are provided. In addition to this, three endemic and endangered species are also discussed.

INTRODUCTION

Genus *Arenaria* L. (Sandwort) is represented by *c* 270 species and infraspecific taxa throughout the world (mostly in temperate and arctic regions), 24 species and one variety in India (Majumdar, 1993), 12 species and one variety in Uttarakhand (maximum no. of species diversity). In India, the species of *Arenaria* are mostly found in alpine (4000-5000m), subalpine (3000-4000m) and some in temperate Himalayas (2000-3000m), except *A. neelgherrensis* and *A. serpyllifolia* in subtropical (1000-2000m), Western Ghats (900-1400m) and also in temperate Himalayas. Flowering and fruiting period of all the 24 species of *Arenaria* in India is in between June to October, except *A. serpyllifolia* (February to September). Most of the species of *Arenaria* are annual or perennial cushion forming herbs, often tufted or matted at high altitudes on rocks, mostly in sub-alpine and temperate Himalayas but in upper alpine regions smaller stunted forms are found. Generally they are found on rocks, sandy or stony grasslands, rocky slopes, in the clefts or crevices of rocks and moist sandy riverbeds.

Checklist of species and infraspecific taxa (with complete citation and distribution) of the Genus *Arenaria* recorded / represented so far from India

1. *Arenaria bryophylla* Fernald in Rhodora 21: 5. 1919. *A. musciformis* Wall. *ex* Edgew. and Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 237. 1874, *non* Triana and Planch. (1862). *A. polytrichoides* var. *perlevis* F.N. Williams in J. Linn. Soc. Bot. 33: 405. 1898, *pp. A. polytrichoides* var. *perlevis* F.N. Williams in J. Linn. Bot. Zeits. 79: 32. 1930.

Distrib.: Nepal, Tibet and India (Jammu and Kashmir, Sikkim and Uttarakhand).

2a. *Arenaria ciliolata* Edgew. *ex* Edgew. and Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 240. 1874; *A. ramellata* F.N. Williams in J. Linn. Soc. Bot. 38: 399. 1909. var. *ciliolata*.

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim and Uttarakhand).

2b. *Arenaria ciliolata* Edgew. *ex* Edgew. and Hook.*f.* var. *pendula* Duthie *ex* F.N. Williams in J. Linn. Soc. Bot. 33: 373. 1898.

Distrib.: Nepal and India (Uttarakhand).

3. *Arenaria compressa* J. McNeill in Notes R. Bot. Gard. Edinb. 24: 118. 1962. *A. trichotoma* Royle *ex* Edgew. and Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 235. 1874, *non* Boiss. (1853).

Distrib.: Afghanistan and India (Himachal Pradesh).

4. *Arenaria curvifolia* Majumdar in Blumea 26: 446. f. 1(a-h). 1980.

Distrib.: Endemic to India (Uttarakhand, so far known from the type locality only).

5. *Arenaria debilis* Hook.*f. ex* Edgew. & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 242. 1874. *Odontostemma glandulosa* Benth. *ex* G. Don, Gen. Syst. 1: 449. 1831. *Arenaria benthami* Edgew. *ex* Edgew & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 242. 1874, *non* Fenzl *ex* Torrey and A. Gray (1840). *A. glandulosa* (Benth. *ex* G. Don) F.N. Williams in Bull. Herb. Boiss. 5: 603. 1895 and J. Linn. Soc. Bot. 33: 431. 1898, *non* Jacq. (1798). *A. blinkworthii* J. McNeill in Notes R. Bot. Gard. Edinb. 24. 128. 1962. *Lepyrodiclis debilis* (Hook.*f. ex* Edgew. & Hook.*f.*) H. Ohba in Fl. E. Himal. 3: 31. 1975. *L. glandulosa* (Benth. *ex* G. Don) H. Ohba in Fl. E. Himal. 3: 32. 1975.

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim, Uttarakhand and West Bengal).

6. *Arenaria densissima Wall. *ex* Edgew. & Hook.*f.* in Hook. *f.*, Fl. Brit. India 1: 239. 1874. *Cherleria juniperina* D. Don, Prodr. Fl. Nepal. 214. 1825, *non Arenaria juniperina* Villars (1789) and Thuill (1799). *Dolophragma juniperinum* (D. Don) Fenzl in Ann. Wien. Mus. 1: 63. t. 71. 1836.

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim).

7. *Arenaria depauperata* (Edgew. *ex* Edgew & Hook. *f.*) H. Hara in J. Jap. Bot. 51: 129. 1976. *Stellaria depauperata* Edgew. *ex* Edgew and Hook.*f.* in Hook. *f.*, Fl. Brit. India 1: 234. 1874. *Arenaria tenella* Duthie *ex* F.N. Williams in J. Linn. Soc. Bot. 33: 356. 1890, *non* Kit (1814), Nutt (1838), Turcz. *ex* Steud. (1840) and Phil. *ex* Reiche (1895). *A. bhutanica* Majumdar and Babu in J. Arn. Arb. 50: 626. f. 1. 1969.

Distrib.: Bhutan. Nepal and India (Sikkim, Uttarakhand and West Bengal).

8. *Arenaria edgeworthiana* Majumdar in J. Ind. Bot. Soc. 44: 141. 1965. *A. monticola* Edgew. *ex* Edgew & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 238. 1874, *non* Buckley (1862).

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim).

9. *Arenaria ferruginea* Duthie *ex* F.N. Williams in J. Linn. Soc. Bot. 33: 410. 1898.

Distrib.: Endemic to India (Uttarakhand, so far known only from Kali and Dhauli valley of Kumaon Himalaya).

10. *Arenaria festucoides* Benth. in Royle, Illus. Bot. Himal. 81. t. 21. f. 3. 1834. *A. muralis* Edgew. *ex* J.F. Watson, Pl. Kumaon 1874, *non* Sieber *ex* Spreng. (1825).

Distrib.: Pakistan, Tibet and India (Jammu & Kashmir, Himachal Pradesh and Uttarakhand).

11. *Arenaria glanduligera* Edgew. *ex* Edgew and Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 240. 1874.

Distrib.: Bhutan, Nepal, Tibet and India (Arunachal Pradesh, Jammu & Kashmir, Sikkim and Uttarakhand).

12. *Arenaria griffithii* Boiss., Diagn. Fl. Orient. Nov. Ser. II. 1: 89. 1853.

Distrib.: Afghanistan, Pakistan, Tibet and India (Jammu & Kashmir).

13. *Arenaria kansuensis* Maxim. in Bull. Acad. Sci. St.-Petersb. 26: 428. 1880. *A. kumaonensis* Maxim., Fl. Tangut. 1: 86. 1889.

Distrib.: Bhutan, China, Nepal, Tibet and India (Uttarakhand).

14. *Arenaria littledalei* Hemsley in Bull. Misc. Inf. Kew 1896: 209. 1896. *Gooringia littledalei* (Hemsley) F.N. Williams in Bull. Herb. Boiss. 5: 530. 1897.

Distrib.: Tibet and India (Sikkim).

15. *Arenaria melandryiformis F.N. Williams in J. Linn. Soc. Bot. 38: 399. 1909.

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim).

16. *Arenaria melandryoides* Edgew. *ex* Edgew. & Hook.*f.* in Hook. *f.* Fl. Brit. India 1: 241. 1874. *A. cerastiiformis* F.N. Williams in J. Linn. Soc. Bot. 38: 402. 1909.

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim).

17. *Arenaria neelgherrensis Wight and Arn., Prodr. Fl. Ind. Orient. 43. 1834.

Distrib.: Nepal, Pakistan and India (Himachal Pradesh, Jammu & Kashmir, Karnataka, Maharashtra (?), Punjab, Sikkim, Tamilnadu and Uttarakhand).

18. *Arenaria orbiculata* Royle *ex* Edgew. and Hook. *f.* in Hook.*f.*, Fl. Brit. India 1: 240. 1874.

Distrib.: Bhutan, Pakistan, Tibet and India (Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir and Uttarakhand).

19. *Arenaria oreophila* Hook.*f. ex* Edgew. & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 238. 1874.

Distrib.; Bhutan, Tibet and India (Sikkim).

20. *Arenaria polytrichoides* Edgew. *ex* Edgew. & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 237. 1874.

Distrib.: Bhutan, Nepal, Pakistan, Tibet and India (Himachal Pradesh, Jammu Kashmir and Sikkim).

21. *Arenaria pulvinata* Edgew. *ex* Edgew. & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 238. 1874. *A. polytrichoides* var. *perlaevis* F.N. Williams in J. Linn. Soc. Bot. 33: 405. 1898, *pp.*

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim).

22. *Arenaria serpyllifolia* L., Sp. Pl. 423. 1753. *A. wallichiana* Seringe in Wall., Cat. 19. n. 638. 1829, *nom. nud.*

Distrib.: America, Australia, Europe, Nepal, Pakistan, Temperate Asia, Tibet and India (Himachal Pradesh, Jammu Kashmir, Punjab, Rajasthan, Tamilnadu and Uttarakhand).

23. *Arenaria stracheyi* Edgew. *ex* Edgew. & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 240. 1874.

Distrib.: Bhutan, Pakistan, Tibet and India (Jammu and Kashmir and Sikkim).

24. *Arenaria thangoensis* W.W. Smith in Rec. Bot. Surv. India 4: 180. 1911.

Distrib.: Endemic to India (Sikkim).

* - Status changed in the present study.

Excluded / Doubtful taxa

Arenaria glanduligera Edgew. *ex* Edgew. & Hook. *f.* var. *micrantha* W.W. Smith in Rec. Bot. Surv. India 4: 179. 1911, *nom. nud.*

Arenaria festucoides Benth. var. *imbricata* Edgew. & Hook. *f.* in Hook. *f.*, Fl. Brit. India 1: 237. 1874.

Notes: In the Flora of British India this infraspecific taxon was included but locality was not clear. At present no herbarium specimens of this variety was found in Indian herbaria but if found in future, then an interesting infraspecific taxon will be added to Indian Flora because this variety having very short stems, leaves up to 1 cm long and peduncles very short as compared to variety proper.

Arenaria melandryoides Edgew. *ex* Edgew. & Hook. *f.* in Hook. *f.*, Fl. Brit. India 1: 241. 1874; F.N. Williams in J. Linn. Soc. Bot. 33: 374. 1898; Hara in Hara & Williams, Enum. Flow. Pl. Nepal 2: 52. 1979; N.C. Majumdar in Sharma *et al.*, Fl. India 2: 513. 1993. *A. cerastiiformis* F.N. Williams in J. Linn. Soc. Bot. 38: 402. 1909. var. *melandryoides*.

Perennial herbs, 5-14 cm tall, glandular-pubescent or purplish pilose; stems usually branched, laxly tufted, suberect; roots slender, fibrous. Leaves 5-15 x 2-5 mm, oblong-elliptic or oblong-lanceolate, in distant pairs, sessile, lax, thick and fleshy, 1-nerved, obtuse to subacute at apex, green or purplish. Flowers solitary, terminal, rarely axillary; pedicels 5-10 mm long, curved in flower and erect in fruit. Sepals 5-7 mm long, erect-recurved, usually obtuse at apex, rarely subacute, usually nerveless, pubescent, ciliate along margins. Petals 10-14 mm long, linear-oblong, rounded at apex, clawed at base, white to pale rose. Stamens 4-6 mm long; filaments subulate, slender, ciliolate. Styles 2-3. Capsules 6-9 mm long, ovoid, 4-6 valved, usually exceeding the sepals. Seeds orbicular-reniform, tuberculate, broadly winged.

Fls. and Frts.: July-October.

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim).

Arenaria melandryoides Edgew. *ex* Edgew. & Hook. *f.* var. *melandryiformis* (F.N. Williams) R. Kr. Singh and P.G. Diwakar, *comb. nov.* and *stat. nov.*

A. melandryiformis F.N. Williams in J. Linn. Soc. Bot. 38. 399. 1909; Hara in Hara and Williams, Enu. Flow. Pl. Nepal 2: 52. 1979; N.C. Majumdar in Sharma *et al.*, Fl. India 2: 513. 1993.

Fls. and Frts.: Same as typical variety.

Distrib.: Same as typical variety.

Notes: After a critical study of herbarium specimens at *CAL*, the authors found that *A. melandryoides* and *A. melandryiformis* are very similar and vary only in the size of pedicels and petals. So, *A. melandryiformis* is best treated as a variety of *A. melandryoides*.

1a. Pedicels 5-10 mm long; petals 10-14 mm long
... *A. melandryoides* var. *melandryoides*

1b. Pedicels 15-20 mm long; petals 7-10 mm long
... *A. melandryoides* var. *melandryiformis*

Arenaria serpyllifolia L., Sp. Pl. 423. 1753; Edgew. & Hook. *f.* in Hook. *f.*, Fl. Brit. India 1: 239. 1874; Hara in Hara and Williams, Enu. Flow. Pl. Nepal 2: 53. 1979; N.C. Majumdar in Sharma *et al.*, Fl. India 2: 515. 1993. *A. wallichiana* Seringe in Wall., Cat. 19. n. 638. 1829, *nom. nud.* var. *serpyllifolia*.

Annual herbs, 5-30 cm tall, diffuse; stems branched, usually from the base, decumbent or suberect, pubescent or puberulent. Leaves 3-7 x 2-4 mm, ovate-lanceolate, acute, subsessile, 1-3 nerved, sparsely scabrid-puberulent. Flowers few or many, in open, leafy-bracted cymes, axillary or terminal, 4-7 mm across; pedicels 4-10 mm long, slender, erect; bracts foliar. Sepals 2-4 mm long, ovate-lanceolate, acute at apex, scarious-margined, scabrid-puberulent, 3-5 nerved. Petals entire, narrowly obovate, usually shorter than the sepals. Styles 3. Capsules ovoid-conic, firm, as long as sepals, sometimes exceeding the sepals. Seeds 0.4-0.7 mm wide, plumpy reniform, tuberculate.

Fls. and Frts.: February-September.

Distrib.: Afghanistan, America, Australia, Europe, Nepal, Pakistan, Tibet, Temperate Asia and India (Jammu & Kashmir, Himachal Pradesh, Punjab, Rajasthan, Tamilnadu , Uttarakhand).

Arenaria serpyllifolia L. var. ***neelgherrensis*** (Wight and Arn.) R. Kr. Singh and P.G. Diwakar, *comb. nov. and stat. nov.*

A. neelgherrensis Wight and Arn., Prodr. Fl. Ind. or. 43. 1834 ('*neelgherrense*')' Edgew. & Hook. *f.* in Hook. *f.*, Fl. Brit. India 1: 239. 1874; Hara in Hara and

Williams, Enum. Flow. Pl. Nepal 2: 52. 1979; N.C. Majumdar in Sharma *et al.*, Fl. India 2: 513. 1993.

Fls. and Frts.: June-August.

Distrib.: Nepal, Pakistan and India (Himachal Pradesh, Jammu & Kashmir, Karnataka, Maharashtra (?), Punjab, Sikkim, Tamilnadu and Uttarakhand).

Notes: On examination and study of herbarium specimens (CAL and BSI) and literature, the authors found that *A. serpyllifolia* and *A. neelgherrensis* are highly variable but closely allied and very similar and the plants material of the two have been mixed up in herbaria. The present study revealed that the mixed herbarium specimens of these taxa may be distinguished into two groups on the basis of leaves characters given in the key. Besides the leaves characters, authors could not trace any other constant morphological characters to separate *A. neelgherrensis* from *A. serpyllifolia* due to wide range of variability in both taxa. The morphological characters and differences given by Wight & Arn., 1834 (*l.c.*), Majumdar, 1993 (*l.c.*) and others could not be confirmed from the herbarium materials. Some of the herbarium specimens of *A. serpyllifolia* at BSI (Acc. No. 70504, 70503 from Missouri, North America) and CAL show the characters of *A. neelgherrensis* as given by Wight & Arn. and Majumdar. Edgew. & Hook. *f.* too in Flora of British India have stated that both the taxa are very similar. So, *A. neelgherrensis* is reduced to the varietal rank under *A. serpyllifolia.*

According to M.K. Kaul (1986), in Kashmir valley *A. serpyllifolia* L. is an occasional weed of lawns, muddy walls, house tops and cultivated fields. It is known to be a lime indicator. The seeds are produced in large quantities and germinate in late autumn (Nov.-Dec.) and may get disseminated by wind, irrigation water and through anthropogenic activities. Seed viability is also high, nearly 82%. Majumdar (1993) has given the distribution of *A. neelgherrensis* in Maharashtra based on Dalz. & Gibs., Bomb. Fl. 15. 1861. However the inclusion of this species in Dalz. & Gibs. is from Dharwad and Belgaum which are actually in Karnataka state. So, the report of this species from Maharashtra is erroneous.

1a. Leaves ovate-lanceolate, acute at apex, 3-7 x 2-4 mm, sparsely scabrid-puberulent

. . . *A. serpyllifolia* var. *serpyllifolia*

1b. Leaves obovate-elliptic, obtuse at apex, 6-15 x 3-6 mm, glabrous

. . . *A. serpyllifolia* var. *neelgherrensis*

Arenaria polytrichoides Edgew. *ex* Edgew. & Hook. *f.* in Hook.*f.*, Fl. Brit. India 1: 237. 1874; F.N. Williams in J. Linn. Soc. Bot. 33: 404. 1898, excl. var. *perlaevis*; Hara in Hara and Williams, Enum. Flow. Pl. Nepal 2: 53. 1979; N.C. Majumdar in Sharma *et al.*, Fl. India 2: 515. 1993. var. *polytrichoides*.

Herbs, densely tufted, forming hemispherical moss-like compact tufts of 4-12 cm high. Leaves 3-5 x 1 mm, linear-lanceolate, imbricate, sessile, nerveless, recurved, pungent, shiny, acuminate. Flowers minute, solitary, axillary or terminal, shortly pedicellate; bracts elliptic, mucronate, concave. Sepals 2-3 x 1.0-1.5 mm, elliptic-ovate, subacute at apex, indistinctly 3-nerved. Petals 4-5 x 1-2 mm, obovate. Styles 3. Capsules globose, shortly 6-valved, coriaceous. Seeds nearly smooth, black.

Fls. and Frts.: June-October.

Distrib.: Bhutan, Nepal, Pakistan, Tibet , India (Himachal Pradesh and Sikkim).

Arenaria polytrichoides Edgew. *ex* Edgew. & Hook. *f.* var. ***densissima*** (Wall. *ex* Edgew. & Hook.*f.*) R. Kr. Singh and P.G. Diwakar, *comb. nov.* and *stat. nov.*

Arenaria densissima Wall. *ex*. Edgew. & Hook.*f.* in Hook.*f.*, Fl. Brit. India 1: 239. 1874; Hara in Hara and Williams, Enum. Flow. Pl. Nepal 2: 52. 1979; N.C. Majumdar in Sharma *et al.*, Fl. India 2: 509. 1993. *Cherleria juniperina* D. Don, Prodr. Fl. Nep. 214. 1825, *non Arenaria juniperina* Villars, 1789 and Thuiller, 1799; *Dolophragma juniperinum* (D. Don) Fenzl in Ann. Mus. Wien. 1: 63. t. 71. 1836.

Fls. and Frts.: Same as variety proper.

Distrib.: Bhutan, Nepal, Tibet and India (Sikkim).

Notes: After critical study of herbarium specimens at CAL and BSI, the authors found that *A. polytrichoides* and *A. densissima* are closely allied, very similar and inseparable. So, here new combination and status has been proposed for *A. densissima* as a variety of *A. polytrichoides*. Hara (1979) too has the same view.

In BSI, Pune one specimen from Sikkim Himalaya, 1400 ft., collected by G.A. Gammie dated 18-06-1892 (field no. 132, Acc. No. 6416) was identified as *A. polytrichoides* but after critical study both

A. polytrichoides and *A. densissima* were found on the same sheet. Left side of the sheet having another cushion is identified as *A. densissima* and right side having one cushion as *A. polytrichoides* but no intermediate form was found. It means that, at the time of collection both the taxa were collected and pasted on the same sheet.

1a. Leaves 3-5 x 1 mm, linear-lanceolate; petals obovate

. . . *A. polytrichoides* var. *polytrichoides*

1b. Leaves 6-9 x 1.5-2.5 mm, ovate-lanceolate; petals linear-spathulate

. . . *A. polytrichoides* var. *densissima*

Endemic and Endangered Taxa

Arenaria curvifolia Majumdar in Blumea 26: 446. f. 1(a-h). 1980.

Herbs, perennial, decumbent or ascending, 20-60 cm tall, usually branching at upper nodes; stems cylindrical, minutely pubescent. Leaves 20-70 x 1-4 mm, subulate, linear or linear-lanceolate, acuminate, scabro-puberulent. Flowers few, in terminal cymes; pedicels 2-4.5 cm long, minutely scabro-puberulent; bracts 3-6 mm long, foliaceous, acuminate. Sepals 5, 7-12 mm long, ovate-lanceolate, glabrous, acuminate, 1-veined. Petals 5, 5-8 mm long, oblong, obtuse at apex. Styles 3. Capsules 4-6 mm long, obovate, 6-valved. Seeds 3-4 mm long, ovate-oblong, brown, rough.

Habitat: Grows on rocky slopes at 3340-3650 m with *Arenaria depauperata* (Edgew. *ex* Edgew. & Hook. *f.*) H. Hara, *Primula* spp. and other herbaceous species.

Fls. and Frts.: July-September.

Distrib.: Endemic to Uttarakhand (Kauri Pass, Garhwal Himalaya).

Illus.: Majumdar (1980), *l.c.*; Majumdar in Sharma *et al.*, Fl. India 2: 508. f. 101 (a-h). 1993.

Notes: This taxon is rediscovered in the year 2006 by D.S. Rawat and C.S. Rana of G.P. Pant University of Agriculture and Technology after a gap of 121 years from the type locality. Grazing seems to be a treat factor because this area are subjected to heavy grazing during summer and post monsoon season, that is why the fruit and seeds are not get enough time for maturity. Thus both *in situ* and *ex situ* conservation are required for the production of seeds and the seeds should be dispersed in the natural habitat. So far no economic or medicinal value is known for this species but from ecological point of view the survival of this species in its natural environment is very necessary.

Arenaria ferruginea Duthie *ex* F.N. Williams in J. Linn. Soc. Bot. 33: 410. 1898.

Herbs, annual or perennial, 8-30 cm tall, laxly caespitose with slender branches; stems cylindrical, branched all over, pubescent, angular below. Leaves 4-12 x 1-2 mm, linear-subulate, acuminate, rigid, glabrous or minutely pubescent. Flowers few at branch ends; pedicels 0.5-1.5 cm long, scabro-pubescent; bracts similar to leaves but smaller. Sepals 5, 5-7 mm long, lanceolate, thick, acuminate, 1-nerved, broadly scarious margined. Petals 5, 3-4 mm long, ovate-lanceolate, acute, clawed. Style 3. Capsules 3-4 mm long, 6-valved, ovoid. Seeds few, flat, cream yellow.

Habitat: Grows amidst rocks in the valleys at 2100-3000 m with *Silense kumaonensis* F.N. Williams and other herbaceous species.

Fls. and Frts.: July-September.

Distrib.: Endemic to Uttarakhand (Kali and Dhauli valley, Kumaon Himalaya).

Illus.: Nayar and Sastry, Red data books of Indian plants 1: 112. 1987.

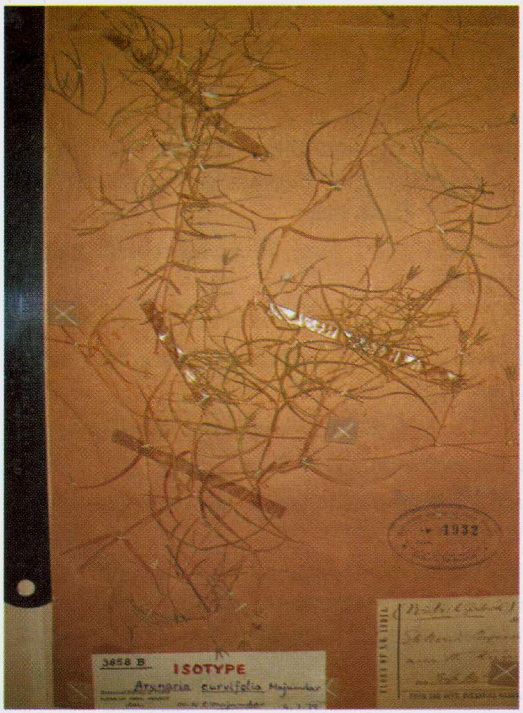
Notes: This species has not been collected after 1886 (J.F. Duthie), may be due to heavy grazing or other ecological cause but the type locality and near by areas should be thoroughly explored for locating the species for suitable conservation measures. So far no economic or medicinal value is known for this species.

Arenaria thangoensis W.W. Smith in Rec. Bot. Surv. India 4: 180. 1911.

Herbs, annual, 2-3 cm high, delicate, viscid-pubescent; stems having a line of whitish to brownish hairs. Leaves 3-4 mm long, broadly lanceolate, margins ciliate, 1-nerved. Flowers few in cymes; pedicels 3-4 mm long, divaricate, hairy. Sepals 5, 1.5-3 mm long, broadly lanceolate, hairy. Petals absent. Stamens 5, 1-1.5 mm long,. Ovary up to 1 mm long, ovoid. Styles 2. Capsules 2.5-3 mm long, 4-valved. Seeds few, sub-globose.

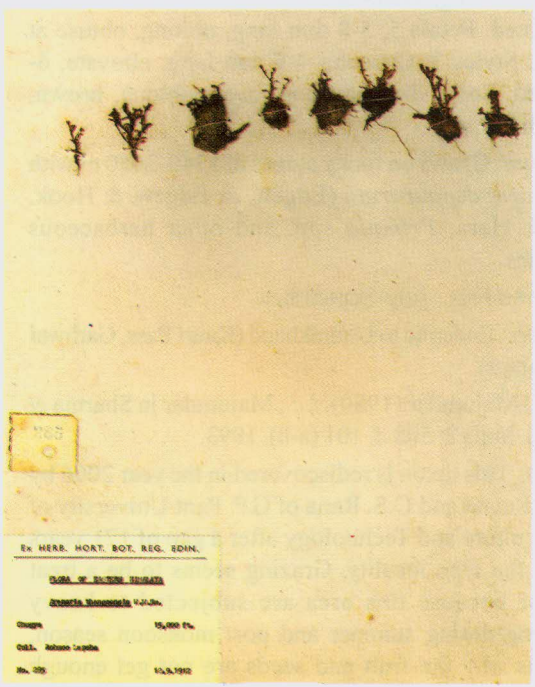
Habitat: Grows in alpine region of Sikkim Himalaya with *Primula* spp., *Rhododendron* spp. and others *Arenaria* spp.

1a. *Arenaria curvifolia* Majumdar (Endemic and Endangered).

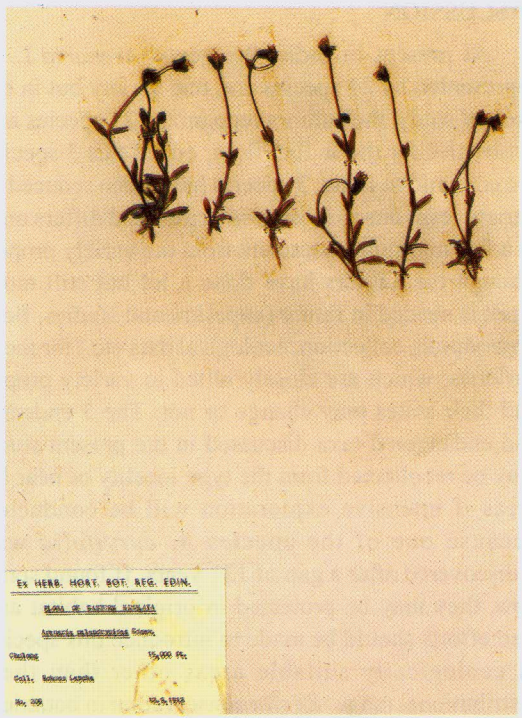


1b. *A. curvifolia* Majumdar (Isotype, BSI).

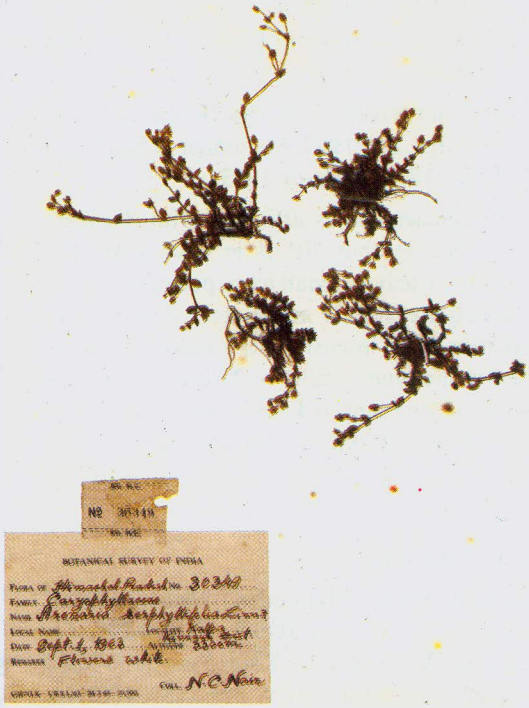
2. *A ferruginea* Duthie *ex* F.N. William (Endemic and Endangered).



3. *A. thangoenis* W.W. Smith (Endemic and Endangered).

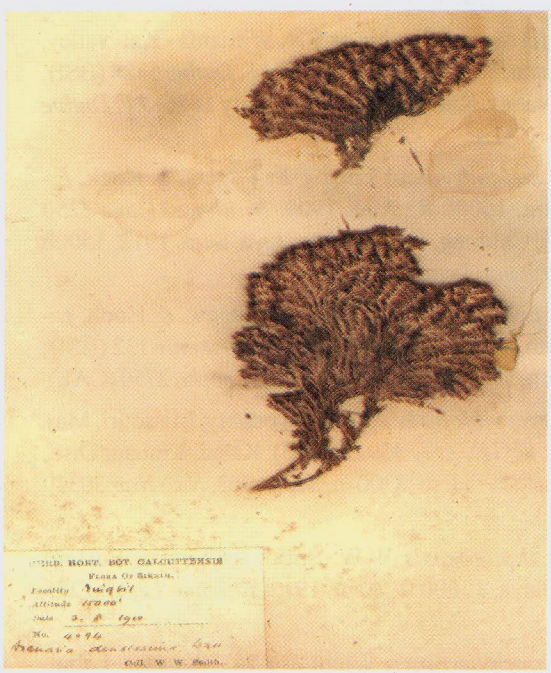


4. *A. melandryoides* Edgew. *ex* Edgew. & Hook.f.



5. *A. serpyllliolia* L.

6. *A. serpyllifolia* L. var. *neelgherrensis* (Wight & Arn.) R.Kr. Singh and P.G. Diwakar.



7. *A. polytrichoides* Edgew. *ex* Edgew. & Hook.f. var *densissima* (Wall. *ex* Edgew. & Hook.f.) R.K. Singh & P.G. Diwakar.

Fls. and Frts.: July-August.

Distrib.: Endemic to Sikkim (Thango, 4200 m and Chugya, 4500 m).

Illus.: Nayar and Sastry, Red data Books of Indian Plants 1: 114. figs. a-h. 1987; Majumdar in Sharma *et al.*, Fl. India 2: 518. f. 103 (a-e). 1993.

Notes: The species shows affinities with *Arenaria littledalei* Hemsley, but differs in having broadly lanceolate ciliate leaves, small hairy pedicels, 5 hairy broad lanceolate sepals and petals absent. Not collected after 1912, intensive exploration should be conducted in the type locality and near by areas for rediscovery of the plant. If found some how, it may be protected in original habitat and may be also introduced in botanic gardens as a measure of *ex situ* conservation.

Specimens Examined

1. *Arenaria curvifolia* Majumdar - Near the Kuari pass, British Garhwal, 11-12000 ft., Sept. 1885, *J.F. Duthie* 3858B (BSI) [Isotype]; Kauri pass, 3400-3600 m, Aug. 2006, *D.S. Rawat* and *C.S. Rana* 18904 (CAL).

2. *Arenaria densissima* Wall. *ex* Edgew. & Hook. *f.* - Sikkim, 15000 ft., Oct. 1910, *W.W. Smith* 4094 (CAL).

3. *A. ferruginea* Duthie *ex* F.N. Williams - Kali valley, Kumaun, 7-8000 ft., July 1886, *J.F. Duthie* 5388 (BSI); Kali valley, Kumaun, 7-8000 ft., July 1886, *J.F. Duthie* 5388 (CAL).

4. *A. melandryoides* Edgew. *ex* Edgew. & Hook. *f.* - Sikkim, 15000 ft., Aug. 1909, *Smith* and *Cave* 2250 (BSI); Chulong, Eastern Himalaya, Sept. 1912, 15000 ft., *Rohmoo Lepcha* 205 (CAL).

5. *A. polytrichoides* Edgew. *ex* Edgew. & Hook. *f.* - Sikkim, 14000 ft., June 1892, *G.A. Gammie* 132 (BSI); Sikkim, 15000 ft., Sept.-Oct. 1904, *Lepcha* 2750 (CAL).

6. *A. serpyllifolia* L. - Madison county, Missouri, May 1969, *W.G.D. Arey* 3392A (BSI); Kalpa, Kinnaur Dist., Himachal Pradesh, 3300 m, Sept. 1963, *N.C. Nair* 30349 (CAL).

7. *A. thangoensis* W.W. Smith - Chugya, Eastern Himalaya, 15000 ft., Sept. 1912, *Rohmoo Lepcha* 285 (CAL).

8. *A. neelgherrensis* Wight & Arn. - Koksar, Lahul, 3200 m, July 1973, *U.C. Bhattacharya* 51731 (CAL).

DISCUSSION

At present in India, the genus *Arenaria* L. is represented by 24 species and one variety but in the present study, the authors recognized 21 species and 4 varieties for the Indian flora, out of this 3 species are endemic to India. 3 species have been reduced to variety level due to close similarities and differs only in a few marginal characters from the variety proper. Though the authors have done a lot but still more work is needed in future (experimental studies, field observation, collection, ecological data etc.) for these varieties, which are closely allied to variety proper and their states may change or not. The 3 endemic and endangered taxa discussed in the present study may be recollected from the type locality or near by areas if intensive exploration will be conducted because one of the species *A. curvifolia* was rediscovered after a gap of 121 years. If found some how, they may be protected in original habitat and also efforts should be made to introduce this species in ecologically suitable areas other than their distributional range. *Ex situ* conservation in botanical gardens having similar ecological conditions should be tried by propagation through seeds and micro propagation techniques. Grazing seems to be a treat factor for these three endemic species. However, the exact treat factor should be found out after critical field and ecological studies.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Botanical Survey of India, Kolkata for providing the facilities. Thanks are also due to Dr. S. Karthikeyan, Retd. Deputy Director, BSI, Pune for his help and valuable suggestions.

REFERENCES

Williams, F.N. (1898). A revision of the genus Arenaria. *J. Linn. Soc. Bot.* **33:** 326-437.

Majumdar, N.C. (1993). Caryophyllaceae. In: Sharma, B.D. and Balakrishnan, N.P. (eds.), *Flora of India.* **2:** 502-595. BSI, Calcutta.

Kaul, M.K. (1986). *Weed Flora of Kashmir Valley.* Scientific Publishers, Jodhpur.

Hara, H. and Williams, L.H.J. (1979). *An Enumeration of the Flowering Plants of Nepal* 2: 51-53. British Museum London.