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## Contribution to the Phytogeography of Kashmir Himalaya I. *Ranunculaceae* and *Paeoniaceae*

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### Keywords

Floristic composition, Extant links, Endemism, *Ranunculaceae*, Kashmir Himalaya

### Abstract

JEE V., DHAR U. et KACHROO P.: Contribution to the Phytogeography of Kashmir Himalaya I. *Ranunculaceae* and *Paeoniaceae*. — Folia Geobot. Phytotax., Praha, 24: 387—402. — The affinities and endemism of Kashmir Himalaya *Ranunculaceae* and *Paeoniaceae* reveal some interesting distribution patterns in some taxa. Isoflor maps, revealing the affinities of *Aconitum*, *Aquilegia*, *Delphinium* and *Ranunculus*, are given. A high degree of endemism exists in the study area. About 41 % of the total taxa show restricted distribution which is discussed. The floristic relationships of the wides show close links with Central Asia than any other phytogeographical unit. The significance of altitudinal amplitude of some taxa vis-a-vis their distribution pattern is discussed.

### INTRODUCTION

Kashmir Himalaya is predominantly a high mountainous area and affords interesting scope for phytogeographic studies. It is situated between 33—36° N latitude and 72—90° E longitude; occupies an area of about 222.8 sq. km in which most of the land lies over 3,000 m (Fig. 1). The highest peak ascends to 5,500 m, thereby offering strong isolation which apart from being geographical also seems to be ecological as well (STOTT 1980).

The phytochorion (Kashmir Himalaya) considered in the present study is confined to the physical boundaries of Kashmir and Ladakh; however, it also includes the area of north Pakistan on account of its vegetational similarities (STEWART 1972). The area is surrounded by China in the east, Pakistan in the west, USSR — China in the north and the Indian Plains in the south.

Climatically, the area exhibits a great diversity ranging from subtropical-

-temperate and high alpine tundras to the cold arid conditions of Ladakh. Two high altitude passes separate the valley from these climatic extremes, namely the Zoji La Pass (3,400 m) situated in the northeast and the Pir Panjal Pass (3,200 m) in the southwest direction. The former checks the influence of cold dry conditions while the latter that of subtropical north Siwaliks. Perhaps the marked climatic diversity provides ample opportunities for speciation in this geographically young area.

No doubt, during the past two decades data on floristics and phytogeography has accumulated fast yet certain areas are underexplored. Ladakh Expedition Report (1982) sufficiently proves this point by putting on record 20 species new to Ladakh. Besides, many species have been added to the general flora of this area from time to time. Thus, on the one hand, new endemics are constantly being added while thorough systematic research and exploration keeps on reducing the endemic status of many other taxa. This insertion/elimination of endemics usually maintains a balance in almost every active phytochorion.

Although a fairly good account of the post glacial vegetational history of Kashmir is available (SAHNI 1963; WADIA 1975; PURI 1943, 1947; VISHNU-MITTRER 1963, 1964) yet the knowledge of the extinct flora is too limited to be of any major significance in assessing the nature and extent of endemism.

#### ENDEMISM IN KASHMIR HIMALAYA

The only detailed treatise on the extant endemics of the Indian subcontinent is that of CHATTERJEE (1939), who puts on record 61.5 % of the dicots as endemics. The highest concentration of endemics is encountered in the Himalaya (28.8 %) which is attributed to geographical isolation caused by the lofty mountains. TAKHTAJAN (1969) listed about 150 endemic genera in the Indian Floristic Region (which includes peninsular India upto the flanks of the Himalaya and to Sri Lanka); RAO (1972) recognised 164 endemic genera in the same region (including Burma and Ceylon) and NAYAR (1980) records 141 endemic genera exclusively within the boundaries of India in which 111 genera are monotypic. Of these monotypic genera, 68 are confined to the Himalaya (40 in the eastern, 11 in the western and 17 throughout the Himalaya). MANI (1978) believes that 3,000 dicot and 1,000 monocot species are endemic to the Himalayan region.

KANAI (1963, 1966) published an extensive review of the phytogeography of Japano-Himalayan elements and of the eastern Himalaya respectively. BANERJI (1963) analysed the flora of Nepal Himalaya which was later supplemented by DOBERMEZ (1972). HEDGE and WENDELBO (1972) recognised 23 endemic genera in the Afghanistan flora and specific endemism studied in 9 important families ranged from 23 % (*Brassicaceae*) to 100 % (*Ericaceae*). Later BRECKLE (1974) recorded 20.2 % endemic species from alpine and nival flora of the Hindukush mountains. BHARGAVA (1983) reports 54 endemic species in *Poaceae* of northwest Himalaya, many of which are endangered. Recently DHAR et al. (1987) in their comprehensive review on endemism in Kashmir Himalaya emphasised the conservation and preservation of many endangered taxa and their habitats.

The detailed phytogeographic studies on west Himalayan flora are still fragmentary, however, some notable contributions include: MEUSEL (1971) and MEUSEL

and SCHUBERT (1971) on the colline, montane and subalpine vegetation of the western Himalaya followed by MANI (1978) on the high altitude flora of northwest Himalaya. DHAR and KACHROO (1982; 1983a, b) dealt this aspect critically with respect to the alpine-subalpine flora of Kashmir Himalaya (*Poaceae* excluded). HARTMANN (1966, 1968, 1972) contributed significantly to the floristic analysis and ecological peculiarities of the Karakorum flora. STEWART (1916), KACHROO et al. (1977) and HARTMANN (1984) investigated the flora of Ladakh while SEYBOLD and KULL (1985) confined their studies to the floristics and vegetation of Zaskar. HARTMANN (1983) also attempted synecological studies en route from Kashmir to Ladakh and more recently (HARTMANN 1987) he studied the community characteristics of xerophytic subalpine and alpine species in the southern and eastern part of Ladakh. Cytological studies have also been initiated to provide a better understanding of the biogeographical character of Kashmir Himalayan taxa (VIR JEE et al. 1983, 1984, 1985, 1987). The present attempt is, however, aimed at providing a family wise precise account of the extent of endemism and affinities of this phytochorion.

Table 1. Distribution of endemic taxa (*Ranunculaceae*) in Kashmir Himalaya

Local area	No. of endemic taxa
Kashmir	3
Ladakh	3
Kashmir—Ladakh	0
Kashmir—north Pakistan	8
Ladakh—north Pakistan	3
Kashmir—Ladakh—north Pakistan	3
Total	20

#### ENDEMISM IN *RANUNCULACEAE*

*Ranunculaceae* is practically confined to the north temperate hemisphere (GOOD 1964) whereas in India, it is mostly distributed in the Himalaya. In Kashmir Himalaya the family is represented by 98 taxa in 17 genera ranging from 350—5,500 m (Table 3). *Ranunculus* is the largest genus (28 taxa) followed by *Thalictrum* (12 taxa). Six genera are monospecific in the study area, namely, *Actaea*, *Caltha*, *Cimicifuga*, *Consolida*, *Pulsatilla* and *Trollius*. Of the 98 taxa, 20 are endemic (20.4 %) in which 13.25 % shows specific and 7.14 % infra-specific endemism. These endemic taxa further reveal the following distribution pattern (Table 1).

It is interesting to note that only three taxa are represented throughout the natural area while the remaining 17 lie confined to one or two localities (Figs. 1, 2). Of the 78 wide taxa, 20 (25.64 %) are distributed in the Himalaya including parts of east Afghanistan and Tibet. In general 40 taxa (40.71 %) of the total Kashmir Himalayan *Ranunculaceae* remain confined to the Himalaya (including Afghanistan

and Tibet) whereas the rest serve as wides beyond this range. In the 20 restricted taxa mentioned above the following local distribution pattern is discernable (Table 2). The extent of endemism in *Ranunculaceae* and *Paeoniaceae* of Kashmir Himalaya and the adjoining areas is given in Table 3. *Aconitum* shows maximum dominance in Central Asia (51 taxa) than Europe (14 taxa) but the reverse is true in so far as the endemic percentage is concerned (Table 3). However, it is note-

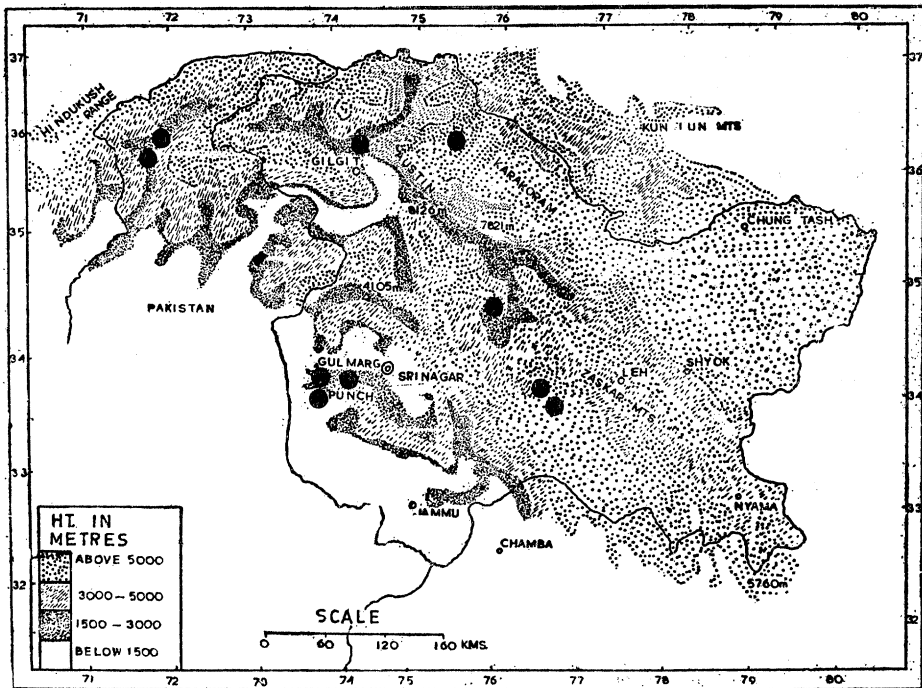


Fig. 1. Total known distribution of ● *Agulegia nivalis* FALC. ex JACKSON — a characteristic endemic species of the Kashmir Himalaya.

Table 2. Distribution of restricted taxa (*Ranunculaceae*) of the Kashmir Himalaya

Local range	No. of restricted taxa
Kashmir Himalaya — western Himalaya	12
Kashmir Himalaya — western and central Himalaya	4
Kashmir Himalaya — eastern Himalaya	4
Total	20

worthy that 58.82 % of the endemic Central Asian species of *Aconitum* are either new species or new combinations. In Kashmir Himalaya the endemic percentage is no less significant (50.00) while it reaches maximum in the eastern Himalaya (100 %). Genera like *Actaea*, *Ceratocephalus* and *Cimicifuga* are more or less widely distributed and hence not represented by endemics. Conversely *Consolida* and *Pulsatilla* reveal 100 % endemism in Kashmir Himalaya. The endemics in

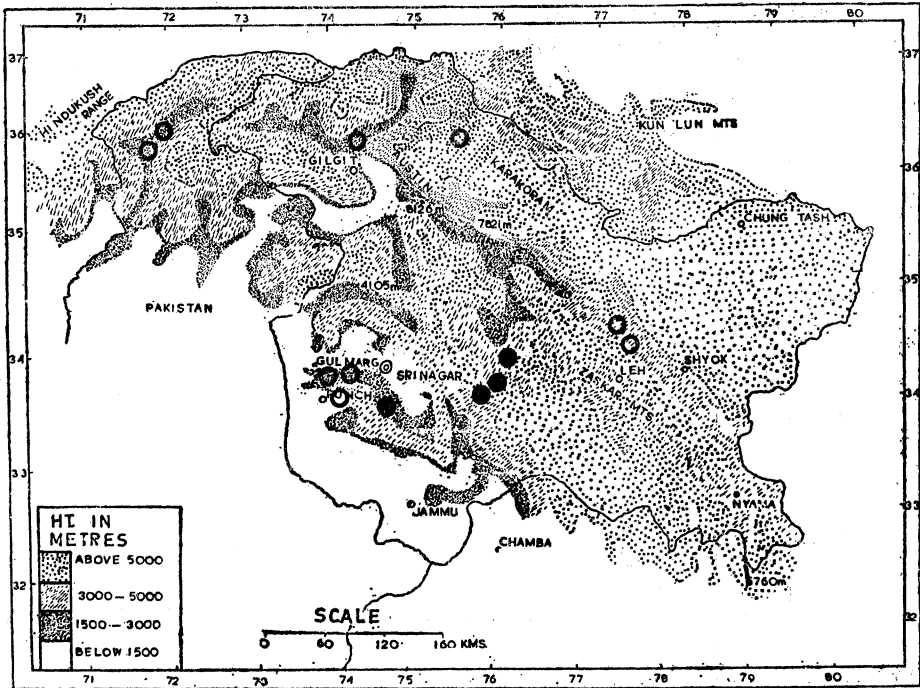


Fig. 2. Total known distribution of ● *Aconitum moschatum* STAFF and ○ *Anemone rupicola* CAMB. var. *glabriuscula* H. — endemic to the Kashmir Himalaya.

*Adonis* (25 %) and *Caltha* (14.28 %) are known only in Europe and Central Asia respectively. The maximum number of taxa of *Aquilegia* (29) in Europe corresponds to its maximum endemic percentage (72.41). The same is the case with *Anemone* in Central Asia, but the reverse for *Callianthemum*. The only species of *Delphinium* in eastern Himalaya is endemic, however, specific endemism of the genus is significant in Soviet Asia (61.72 %). In Kashmir Himalaya 25 % endemics exist in this genus. *Paraquilegia* — described relatively recently — has a maximum of five taxa in Afghanistan (40 % endemics). The genus is not known from southeast Asia and Europe. *Clematis*, despite being well represented in Central Asia, has insignificant endemics (5.55 %).

Table 3. Extent of endemism in Kashmir Himalaya and adjoining areas  
(I — total number of taxa; II — total percentage endemism)

S. No.	Name of the genus	Kashmir Himalaya		Pakistan		Afghanistan		Central Asia		Europe		Eastern Himalaya	
		I	II	I	II	I	II	I	II	I	II	I	II
1.	<i>Aconitum</i>	10	50	10	10	3	33.33	51	33.33	14	85.71	5	100
2.	<i>Actaea</i>	1	0	1	0	1	0	3	0	2	0	—	—
3.	<i>Adonis</i>	3	0	3	0	2	0	11	0	12	25	—	—
4.	<i>Anemone</i>	11	18.88	10	0	3	0	46	36.95	21	23.80	5	20
5.	<i>Aquilegia</i>	5	40	6	0	5	20	14	21.42	29	72.41	—	—
6.	<i>Callianthemum</i>	2	0	2	0	1	0	4	0	3	100	—	—
7.	<i>Callitha</i>	1	0	1	0	2	0	7	14.28	1	0	3	0
8.	<i>Ceratocephalus</i>	2	0	2	0	3	0	2	0	2	0	—	—
9.	<i>Cimicifuga</i>	1	0	1	0	—	—	5	0	1	0	1	0
10.	<i>Clematis</i>	8	0	10	0	9	0	18	5.55	12	8.33	7	14.28
11.	<i>Delphinium</i>	8	25	13	15.28	16	43.75	81	61.72	31	9.67	1	100
12.	<i>Paraquilegia</i>	3	0	3	0	5	40	4	0	—	—	—	—
13.	<i>Pulsatilla</i>	1	100	1	0	—	—	26	26.92	22	18.18	—	—
14.	<i>Ranunculus</i>	28	21.42	25	4	16	12.50	146	34.93	170	41.17	6	16.66
15.	<i>Thalictrum</i>	12	8.33	10	0	5	40	19	15.78	28	17.85	5	0
16.	<i>Consolida</i>	1	6	6	0	6	16.66	under		16	25	—	—
17.	<i>Trollius</i>	1	0	1	0	—	—	11	27.27	4	0	1	100
ENDEMISM IN PAEONIACEAE													
1.	<i>Paeonia</i>	1	0	1	0	—	—	15	46.68	17	23.52	—	—

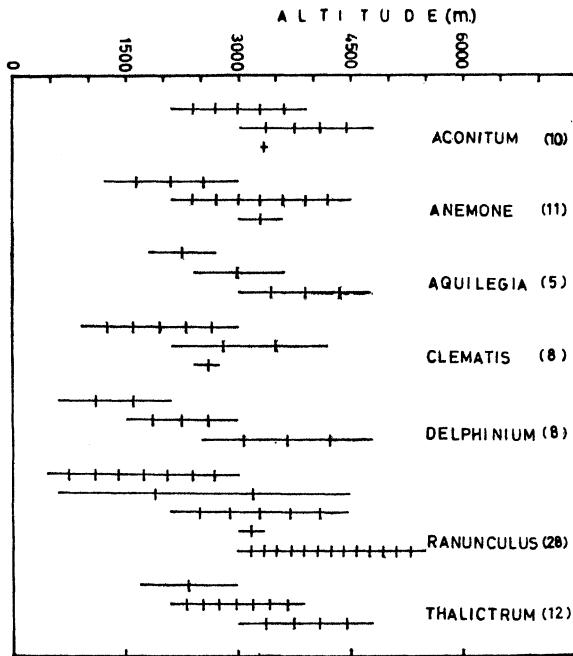


Fig. 3. Horizontal bars showing altitudinal ranges of seven major genera of *Ranunculaceae* in the Kashmir Himalaya. The number of vertical bars indicate total species within a specific range. The numerals in parentheses denote the total number of species.

#### AFFINITIES IN *RANUNCULACEAE*

The interesting features of affinities revealed by Kashmir Himalayan *Ranunculaceae* are given in Fig. 4. *Aconitum* shares 80 % wides with Pakistan; 40 % with USSR and 20 % each with Afghanistan and Europe. No doubt 60 % of the wides extend up to China but none beyond this area (Fig. 5). *Actaea*, *Caltha*, *Cimicifuga*, *Adonis* and *Ceratocephalus* range widely in all the adjoining phytogeographic units; however, the representatives of the latter two genera are not known from the Sino-Japanese region. In *Anemone* the affinities are more marked with West-Central Asia (71.42 %) than with Sino-Himalaya (42.85 %) while only 14.28 % taxa are common with the remaining phytochoria. Amongst restricted genera, *Consolida* and *Pulsatilla* lie confined to the study area; *Trollius* extends up to the west Himalaya while *Aquilegia* — up to western and central Himalaya (Fig. 6). Of the two species in *Callianthemum*, *C. alatavicum* FREYN is distributed in west-central Asia while *C. pimpinelloides* (D. DON ex ROYLE) H. et T. shows a Sino-Japanese link. *Clematis* leans more heavily towards the Sino-Japanese region (71.42 %) and beyond the western limits of Afghanistan, the relationship tends to decline (28.56—14.28 %). The wides in *Delphinium* manifest an almost similar decreasing trend in their extensions (100—16.66 %) in all neighbouring regions

(Fig. 7). *Paraquilegia* displays 100 % affinities with west-central Asia and parts of Sino-Japanese Region (China). *Ranunculus* and *Thalictrum* reveal almost similar extensions with the adjoining parts of the study area; however, the former shows stronger links with Central Asia (Fig. 8) and the latter with China (83.33 %).

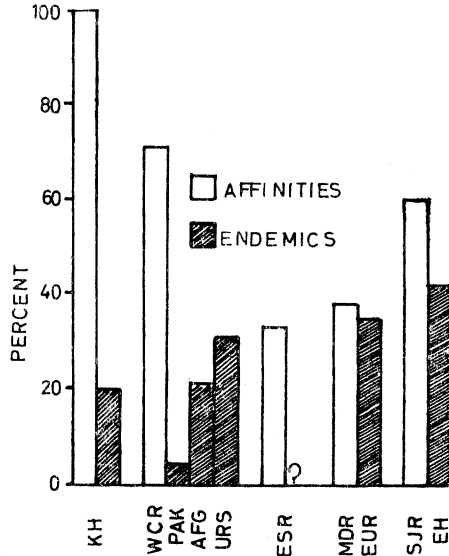


Fig. 4. Affinities of Kashmir Himalayan *Ranunculaceae* with neighbouring phytogeographic regions and the extent of endemism in political units. (KH — Kashmir Himalaya; WCR — West-Central Asian Region; PAK — Pakistan; AFG — Afghanistan; URS — USSR; ESR — Euro-Siberian Region; MDR — Mediterranean Region; EUR — Europe; SJR — Sino-Japanese Region; EH — Eastern Himalaya.)

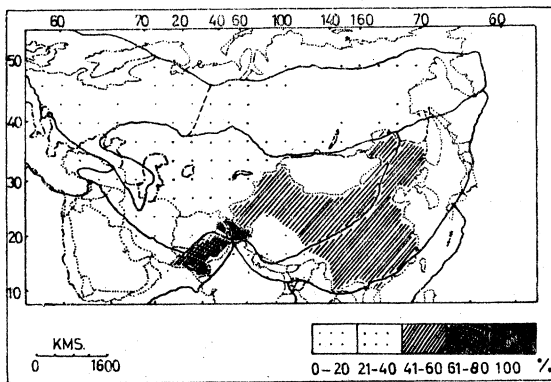


Fig. 5. Affinities of Kashmir Himalayan taxa of *Aconitum* with adjoining areas.

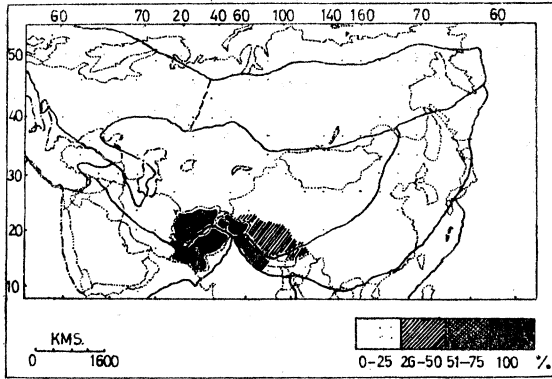


Fig. 6. Affinities of Kashmir Himalayan taxa of *Aquilegia*.

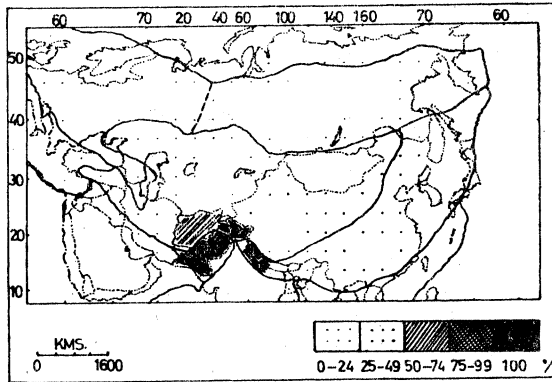


Fig. 7. Affinities of Kashmir Himalayan taxa of *Delphinium*.

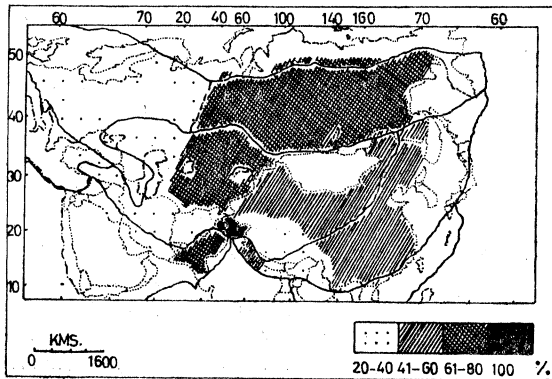


Fig. 8. Affinities of Kashmir Himalayan taxa of *Ranunculus*.

ENDEMISM AND AFFINITIES IN *PAEONIACEAE*

The genus *Paeonia* is monotypic in the western Himalaya and is represented by 15 and 17 taxa in Soviet Asia and Europe respectively. The endemic percentage is maximum in Central Asia (46.66 %) followed by Europe (23.52 %); whereas in the Kashmir Himalaya the lone species is a broad range endemic.

## DISCUSSION

The study of endemism is not only useful in assessing the origin and antiquity of a taxon but also plays an important role in realising the status of the past vegetational history. POLUNIN (1960) believed that relic endemics are useful in indicating antiquity, isolation and the diversification of habitats, while GOOD (1964) held that endemics may be more useful in the recognition of different floristic units. ANSARI (1984) stressed the occurrence of restricted taxa in a biological community in view of their sensitivity to even minor habitat differences. The geological and geographical changes are, however, also essential for better understanding of the nature of endemics in a particular region. The changes brought about by the Pleistocene glaciation have largely affected the distribution pattern of many taxa in the Kashmir Himalaya.

*Ranunculaceae* shows dominance in the U.S.S.R. (502 taxa) followed by Europe (418 taxa). The family is almost equally represented in the western Himalaya (77–105 taxa) while in the eastern Himalaya, the representation is very feeble (37 taxa). A comparative account of the number of taxa in various genera of Kashmir Himalaya vis-a-vis their areas of major preponderance implies: *Aconitum* (10 : 51); *Actaea* (1 : 3); *Adonis* (3 : 12); *Anemone* (11 : 46); *Aquilegia* (5 : 29); *Callianthemum* (2 : 4); *Caltha* (1 : 7); *Ceratocephalus* (2 : 3); *Cimicifuga* (1 : 5); *Clematis* (8 : 18); *Consolida* (1 : 16); *Delphinium* (8 : 81); *Paraquilegia* (3 : 5); *Pulsatilla* (1 : 26); *Ranunculus* (28 : 170); *Thalictrum* (12 : 28); and *Trollius* (1 : 11). Afghanistan represents the area of dominance for two genera (*Ceratocephalus* and *Paraquilegia*); Europe for 4 (*Adonis*, *Aquilegia*, *Thalictrum* and *Consolida*) while USSR for the remaining 11 genera of the study area.

Being a young mountain system, the Kashmir Himalaya, as expected, harbours a relatively lower concentration of taxa. However, it is noting that *Ranunculus*, although it is a well adapted genus with a varied altitudinal range (450–5,500 m) shows meagre representation (28 taxa; 16 % of the maximum area of occurrence) as against other weedy genera — *Ceratocephalus* (66 %); *Adonis* (25 %) and *Anemone* (25 %), etc. Further the monotypic nature of *Consolida*, *Pulsatilla* and *Trollius* perhaps indicates their recent arrival or an unfavourable environment for their speciation. Among the other genera of the neighbouring areas, *Paroxygraphis* is distributed in the eastern Himalaya; *Hegemone*, *Enemion*, *Semiaquilegia*, *Trauvetteria* and *Leptopyrum*, in the USSR and *Helleborus*, *Hepatica*, *Myosurus*, *Eranthis* and *Nigella*, in the USSR and Europe (the latter two genera are also present in Afghanistan). Further, *Coptis*, *Batrachium*, *Ficaria*, *Oxygraphis* and *Helerpestes* represent valid genera in the USSR but are covered under *Ranunculus* in Europe and Kashmir Himalaya. Similarly *Atragene* considered valid in the USSR, is reported as a synonym of *Clematis* in Europe and Kashmir Himalaya.

Table 4. Species appendix alongwith altitudinal range and geographical distribution of the taxa of *Ranunculaceae* in Kashmir (SR = Short range endemics; BR = Broad range endemics; WCR = Western and Central Asian Region; ESR = Euro-Siberian Region; MDR = Mediterranean Region; SJR = Sino-Japanese Region)

Taxa	Alt. Range (m)	Endemism		WCR	ESR	MDR	SJR
		SR	BR				
<i>Aconitum chasmanthum</i> STAFF et HOLMES	2,100—3,900	—	—	+	+	+	—
<i>A. deinorrhizum</i> HOLMES ex STAFF	3,400	+	—	—	—	—	—
<i>A. heterophyllum</i> WALL. ex ROYLE	2,280—3,600	—	+	—	—	—	—
<i>A. kashmiricum</i> STAFF ex COVENTRY	2,400—3,300	+	—	—	—	—	—
<i>A. laeve</i> ROYLE	2,400—4,000	—	—	—	—	—	+
<i>A. moschatum</i> STAFF	3,300—3,900	+	—	—	—	—	—
<i>A. rotundifolium</i> KAR. et KIR.	3,000—4,800	—	—	+	—	—	+
<i>A. soongaricum</i> STAFF	3,000—3,300	—	—	+	—	—	+
<i>A. violaceum</i> STAFF	3,000—4,500	+	—	—	—	—	—
<i>A. violaceum</i> var. <i>robustum</i> STAFF	2,700—3,900	+	—	—	—	—	—
<i>Actaea spicata</i> L.	2,100—3,300	—	—	+	+	+	+
<i>Adonis aestivalis</i> L.	300—1,800	—	—	+	+	+	—
<i>A. chrysocephalus</i> H. et T.	2,700—3,900	—	—	+	—	—	—
<i>A. squarrosa</i> STEVEN	2,200—2,600	—	—	+	+	+	—
<i>Anemone biflora</i> DC.	1,200—1,800	—	—	+	—	—	—
<i>A. falconeri</i> T. T.	1,500—2,400	—	—	+	—	—	—
<i>A. narcissiflora</i> L.	3,000—3,600	—	—	+	+	+	—
<i>A. obtusiloba</i> D. DON	2,100—4,500	—	—	+	—	—	+
<i>A. obtusiloba</i> var. <i>potentilloides</i> (CAMP.) LAUENER	3,350—4,270	—	—	+	—	—	+
<i>A. polyanthos</i> D. DON	2,700—3,900	—	—	+	—	—	—
<i>A. rivularis</i> BUCH.-HAM.	2,100—3,600	—	—	+	—	—	+
<i>A. rupicola</i> CAMP. var. <i>glabruscula</i> H. et T.	2,700—4,500	+	—	—	—	—	—
<i>A. rupicola</i> var. <i>sericea</i> H. et T.	2,700—4,500	+	—	—	—	—	—
<i>A. tetrasepala</i> ROYLE	2,400—3,600	—	+	—	—	—	—
<i>A. vitifolia</i> HAM.	1,500—3,000	—	+	—	—	—	—
<i>Aquilegia fragrans</i> BENTH.	2,400—3,600	—	—	—	—	—	—
<i>A. moorcroftiana</i> WALL. ex ROYLE	3,000—4,800	—	+	—	—	—	—
<i>A. nivais</i> FALC. ex JACKSON	3,300—4,200	+	—	—	—	—	—
<i>A. pubiflora</i> WALL. ex ROYLE	3,000—4,200	—	—	—	—	—	—
<i>A. pubiflora</i> var. <i>mussoorientsis</i> ROYLE	1,800—2,700	+	—	—	—	—	—
<i>Callianthemum alatavicum</i> FREYN	2,400—3,300	—	—	+	—	—	—

Table 4 (Cont.)

Taxa	Alt. Range (m)	Endemism				WCR	ESR	MDR	SJR
		SR	BR	BR	SR				
<i>C. pimpinelloides</i> (D. DON ex ROYLE) H. et T.	2,400-3,900	-	-	-	-	-	-	-	+
<i>Calcha palustris</i> L. var. <i>alba</i> (JACQ. ex CAMB.) H. et T.	2,400-3,900	-	-	-	+	+	+	+	+
<i>Ceratocephalus falcatus</i> (L.) PERS.	350-3,000	-	-	-	+	+	+	+	-
<i>C. testiculatus</i> (CRANTZ) ROTH	2,100-2,300	-	-	-	+	+	+	+	-
<i>Cimicifuga foetida</i> L.	2,100-3,600	-	-	-	+	+	+	+	+
<i>Clematis alpina</i> (L.) MILLER subsp. <i>sibirica</i> (L.) O. KTZE	2,900-3,900	-	-	-	-	-	+	+	-
<i>C. buchaniana</i> DC.	1,200-3,000	-	-	-	-	-	-	-	+
<i>C. connata</i> DC.	1,500-2,700	-	-	-	-	-	-	-	+
<i>C. grata</i> WALL.	900-2,400	-	-	-	-	-	-	-	+
<i>C. graveolens</i> LINDL.	900-2,700	-	-	-	-	-	-	-	+
<i>C. montana</i> BUCH.-HAM.	1,800-2,700	-	-	-	-	-	-	-	+
<i>C. orientalis</i> L.	2,100-4,200	-	-	-	+	+	+	+	-
<i>C. soongarica</i> BUNGE	2,400-2,800	-	-	-	+	+	-	-	-
<i>Consolida schlagintweitii</i> (HUTH) MUNZ.	2,300-2,500	+	-	-	-	-	-	-	-
<i>Delphinium brunonianum</i> ROYLE	3,300-4,800	-	-	-	+	+	-	-	+
<i>D. cashmerianum</i> ROYLE	2,700-4,800	-	-	-	-	-	-	-	+
<i>D. denudatum</i> WALL. ex H. et T.	1,500-2,700	-	-	-	-	-	-	-	+
<i>D. dotatense</i> (P. BRUHL) MUNZ.	600-1,500	-	-	-	+	+	-	-	-
<i>D. pyramidale</i> ROYLE	2,100-3,000	+	-	-	-	-	-	-	-
<i>D. roylei</i> MUNZ.	1,800-2,700	+	-	-	-	-	-	-	-
<i>D. uncinatum</i> H. et T.	600-2,100	-	-	-	+	+	-	-	-
<i>D. vestitum</i> WALL. ex ROYLE	2,500-3,600	-	-	-	+	+	-	-	-
<i>Paraquilegia anemonoides</i> (WILLD.) ULBR.	2,700-4,050	-	-	-	+	+	-	-	+
<i>P. grandiflora</i> (FISCH.) DRUM et HUTCH.	3,900-5,100	-	-	-	+	+	-	-	+
<i>P. kareliniana</i> (DRUM) NEVSKI	2,400-3,300	-	-	-	-	-	-	-	+
<i>Pulsatilla wallichiana</i> (ROYLE) ULBR.	3,000-3,900	+	-	-	-	-	-	-	-
<i>Ranunculus aquatilis</i> L. var. <i>caespitosus</i> (THUILL.) DC.	1,700-2,200	+	-	-	-	-	-	-	-
<i>R. arvensis</i> L.	450-2,400	-	-	-	+	+	+	+	-
<i>R. aucheri</i> BOISS.	3,300	-	-	-	-	-	-	-	-
<i>R. brotherusii</i> FREYN	3,300-5,400	-	-	-	+	+	-	-	+
<i>R. chaerophyllos</i> L.	3,000-4,950	-	-	-	+	+	-	-	+
<i>R. diffusus</i> DC.	600-3,000	-	-	-	-	-	-	-	+

Table 4 (Cont.)

Taxa	Alt. Range (m)	Endemism SR	BR	WCR	ESR	MDR	SJR
<i>R. flavidus</i> (HAND.-MAZZ.) R. R. S.	2,900-3,500	-	-	-	-	-	+
<i>R. hirtellus</i> ROYLE	2,100-4,500	-	-	-	-	-	+
<i>R. hyperboreus</i> ROTHB. var. <i>multifidus</i> H. et T.	3,000-5,100	+	-	-	-	-	+
<i>R. hyperboreus</i> var. <i>natans</i> (C. A. MEY.) REGEL	3,000-5,100	-	-	+	-	-	+
<i>R. involucratum</i> MAXIM.	3,000-3,400	+	-	-	-	-	+
<i>R. kamchaticum</i> DC.	3,900-5,500	-	-	+	-	+	+
<i>R. laetus</i> WALL. ex H. et T.	1,200-2,700	-	-	+	-	+	+
<i>R. lingua</i> L.	1,500-2,100	-	-	+	+	+	+
<i>R. lobatus</i> JACQ. ex CAMB.	3,600-5,250	-	+	-	-	-	-
<i>R. minorcanus</i> DRUM.	3,000-4,200	+	-	-	-	-	-
<i>R. muricatus</i> L.	450-2,100	-	-	+	+	+	-
<i>R. patifolius</i> DUN.	3,000-3,900	-	+	-	-	-	-
<i>R. peltatus</i> SCHRENK ssp. <i>sphaerospermus</i> (BOISS. et BLANCHE) MEIKLE	600-4,500	-	-	+	+	+	-
<i>R. polypectatus</i> ROYLE	3,600-4,500	-	+	-	-	-	-
<i>R. pulchellus</i> C. A. MEY.	3,000-5,400	-	-	+	-	-	+
<i>R. rionii</i> LAGGER	2,200-3,400	-	-	+	+	+	-
<i>R. rubrocalyx</i> REGEL ex KOMAROV	2,100-4,500	-	-	+	-	-	-
<i>R. rufosepatus</i> FRANCH.	3,300-4,500	-	-	+	-	-	-
<i>R. sarmentosus</i> ADAMS.	2,400-4,500	-	-	+	+	+	+
<i>R. sceleratus</i> L.	600-1,800	-	-	+	+	+	+
<i>R. trichophyllus</i> CHAIX subsp. <i>trichophyllus</i>	600-4,200	-	-	+	+	+	+
<i>R. tricuspis</i> MAXIM.	3,600-4,800	+	-	-	-	-	-
<i>Thalictrum alpinum</i> L. var. <i>microphyllum</i> (ROYLE) HAND.-MAZZ.	3,600-4,800	+	-	-	-	-	-
<i>T. cheidoni</i> DC.	2,400-3,600	-	-	-	-	-	+
<i>T. cultiratum</i> WALL.	2,400-3,600	-	-	-	-	-	+
<i>T. elegans</i> WALL. ex ROYLE	3,000-3,900	-	+	-	-	-	+
<i>T. falconeri</i> LECOYER	2,400-3,400	-	+	-	-	-	+
<i>T. minus</i> L.	2,100-3,600	-	-	+	+	+	+
<i>T. minus</i> subsp. <i>majus</i> (CRANTZ) ROUY et FOUC.	2,100-3,600	-	-	+	+	+	+
<i>T. pedunculatum</i> EDGEW.	1,700-3,000	-	+	-	-	-	-
<i>T. platycarpum</i> H. et T.	3,000-3,900	-	-	-	-	-	+
<i>T. rutaefolium</i> H. et T.	3,000-4,200	-	+	-	-	-	+
<i>T. secundum</i> EDGEW.	2,100-3,900	-	+	-	-	-	-
<i>T. vaginatum</i> ROYLE	2,400-3,900	-	-	-	-	+	+
<i>Trollius acaulis</i> LINDL.	3,000-3,900	-	+	-	-	-	-

and of *Naravelia* in the eastern Himalaya. *Garidella* is monotypic in Europe but included under *Nigella* in the USSR. Most of these genera are mono- or bitypic and do not display any significant endemism. The overall degree of endemism in the Kashmir Himalaya and adjoining areas reads: 20.40 % (Kashmir Himalaya); 3.80 % (Pakistan); 20.77 % (Afghanistan); 31.47 % (USSR); 34.92 % (Europe) and 37.83 % (Eastern Himalaya).

The family, essentially quite old and diverse, envisages many phytogeographic peculiarities within the study area. These considerations are usually discernible at both intra and intergeneric levels with the result that no positive correlation is ordinarily conceivable. In some genera — *Aconitum* (2,100–4,800 m); *Aquilegia* (1,800–4,800 m); *Delphinium* (600–4,800 m), etc. altitudinal amplitude appears to have direct bearing on the distribution pattern of their constituent taxa irrespective of their occurrence in different ecological zones. Thus one might logically attribute the endemic status of taxa like *Aconitum deinorrhizum* (3,400 m); *A. kashmiricum* (2,400–3,300 m); *A. moschatum* (3,300–3,900 m); *Aquilegia nivalis* (3,300–4,200 m); *Delphinium pyramidale* (2,100–3,000 m); *D. roylei* (1,800–2,700 m); *Consolida schlagintweitii* (2,300–2,500 m); *Pulsatilla wallichiana* (3,300–3,900 m); and *Trollius acaulis* (3,000–3,900 m), etc. to their narrow altitudinal range which offers them limited scope of diversification. Conversely *Actaea* (2,100–3,300 m); *Adonis* (300–3,900 m); *Caltha* (2,400–3,900 m); *Ceratocephalus* (350–3,000 m); *Cimicifuga* (2,100–3,600 m); *Clematis* (900–4,200 m) and *Paraquilegia* (2,400–5,100 m) owing to their wide ecological range are characterised by greater adaptability and tolerance and are, therefore, widespread in distribution. Perhaps this may also be responsible for their significant representation in the study area vis-a-vis neighbouring floristic units. In addition, habitat specificity also appears to be a characteristic feature of many typical endemics and such a correlation becomes apparant even at the interspecific level within a genus. Thus, for example, *Aconitum laeve* (2,400–4,000 m) grows on diverse habitats and is widely distributed whereas *A. kashmiricum* (2,400–3,300 m) is a peculiar plant of alpine tundra and hence an endemic.

To sum up, it could be safely said that owing to the remarkable degree of phytogeographic peculiarity in the family, no single factor can be considered as decisive in determining the “potential area” occupied by a particular taxon. The degree of endemism is quite considerable, having evolved in the course of time following speciation in an invading flora. The extant links reveal more pronounced affinities with West-Central Asia than with the Sino-Japanese and other neighbouring phytogeographic units.

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