Systematics of the genus *Aconogonon* (Polygonaceae–Persicarieae) in Himalaya and adjacent regions

Suk-Pyo Hong

(Department of Biology, Kyung Hee University, Seoul 130-701, Korea)

Abstract

The genus *Aconogonon* (Meisn.) Reichb. (Polygonaceae – Persicarieae) in Himalaya and adjacent regions is reviewed. The generic delimitation within the tribe Persicarieae Dum. is discussed. Selected morphological characters (including pollen morphology) of *Aconogonon* are briefly described. With respect to the sexual system, the possible evolution of dioecy via heterostyly within the genus *Aconogonon* is also discussed. A cladistic analysis, which is aimed primarily at elucidating interrelationships of the Himalayan species including five well-known species from other areas, is presented. The taxa are phytogeographically grouped. Twelve species with nine additional varieties are recognized and keys to the species are given. The synonyms for all taxa and their distributional data are enumerated.

Introduction

*Aconogonon* (Meisn.) Reichb. comprises approximately 25 species of mostly perennial herbs or subshrubs adapted to wet or dry habitats and occurs in the temperate forest region of the northern hemisphere, particularly in mountain areas where they reach the subalpine and alpine belts. It is mostly Asian (extending down to SE Asia, e.g. Malaya and Indonesia) with one species extending to SE Europe and three occurring in North America. The most important centre of diversity is in Himalaya and the adjacent areas, where close to half of the known taxa occur (Hong, 1991b, 1992 and unpublished data). This account is part of a global taxonomic revision of the genus. This paper reviews a taxonomy, including studies of morphology, palynology, sexual system, phylogeny and phytogeography of the twelve species of *Aconogonon* in Himalaya and adjacent regions.
Generic Delimitation

Aconogonon has mostly been treated either as a distinct genus or as a subgenus or section under either Polygonum L. s. lat. or Persicaria Mill. (Small, 1895; Haraldson, 1978; Ronse Decraene and Akeroyd, 1988). Generic status for Aconogonon has been accepted by, e.g. Hedberg (1946), Hara (1966), Haraldson (1978) and Wilson (1988). Many modern floras also adopt Aconogonon as a generic name. My results support the generic status of Aconogonon.

Aconogonon is characterized by its pollen morphology (Hedberg, 1946; Hong and Hedberg; 1990 and Fig. 1), distinctive inflorescence type, and by some anatomical features, e.g. in petiole, stem and seed testa (Haraldson; 1978). Ronse Decraene and Akeroyd (1988), although treating Aconogonon as a section of Persicaria, agreed that some floral microcharacters in Aconogonon also provide distinctions from the other sections in their widely circumscribed Persicaria (For comparisons with other genera in the tribe Persicarieae, see Hong 1992: 11, Tab. 1).

Selected morphological characters

Inflorescences. The flowers of the studied species are mostly arranged in terminal or subterminal, well-branched panicles. The most well-branched panicles are found in A. coriarium, A. alpinum, A. molle and A. lichiangense, where they usually carry numerous flowers. However, in some species (e.g. A. kuttense, A. rechingeri) the panicles are few-branched, short and terminal, carrying only a few flowers on each branch. Also within some of the species, such as A. campanulatum and A. tortuosum, there is a considerable variation from well-branched panicles to very reduces ones.

In A. hookeri and A. rhombiepalum the inflorescences are characteristically non-leafy, narrow terminal panicles, bearing short lateral branches which are somewhat horizontal or slightly drooping.

The most primitive type of inflorescence is probably that of A. ruminicfolium characterized by the short terminal and axillary panicles as in Reynoutria Houtt. and Fallopia sect. Pleuropterus (Trucz.) Haraldson. A. panguanum appears to be the only species in which the inflorescences are usually simple, loose spike-like racemes.

The evolutionary relationships among the different types of inflorescences in the genus is hypothesized in Fig. 2. Starting from the inflorescence type in Fig. 2A it is possible to derive the one in Fig. 2B by amplification, and the ones in Fig. 2C and D by reduction.

Flowers. The flowers are mostly regular, open and more or less rotate, or rarely campanulate (A. campanulatum). The perianth is petaloid, creamy white in many species to dull greenish (A. ruminicfolium) or pinkish white (some specimens of A. campanulatum) in colour, and usually persistent; it encloses the achene at maturity (Fig. 3A). In A. molle
Fig. 1. SEM of pollen grains of Aconogonon and other four putatively related genera. A-B: 3—colpate with foveolate surface [Aconogonon molle (D. Don) Hara var. rude (Meisn.) Hara].—C: 6—colpate [Koenigia delicatula (Meisn.) Hara ssp. delicatula].—D: Echinate with microspinules in between [K. forrestii (Diels) Hedl.].—E-F: 6—colpate, with the granulated reticulate seksi (Persicaria wallichii Greuter and Burdet var. wallichii, P. sect. Rubrivena).—G: 3—colpate [P. runcinata (Buch.-Ham. ex D. Don) Masamune var. sinensis Hemsl., P. sect. Cephalophilon].—H: reticulate seksi without granulated muri [P. strigosa (R. Br.) Nakai, P. sect. Echinocaulon].—I: poryporate [P. senegalensis (Meisn.) Soják, P. sect. Persicaria].—J: 3—colporate with microreticulate surface (Reynoutria japonica Houtt.).—K: 3—colporate (Knorringia sibirica (Laxm.) Tzvel. var. sibirica; it was treated as an Aconogonon species.).—L: microreticulate with rugulose muri (K. sibirica ssp. thomsonii (Meisn.) S.—P. Hong).—A, C, J; D, F and E, K to same scale. Scale bars on A, E, G, I: 10μm; B, D, H, L: 2 μm.
Table 1. Characters used in the cladistic analysis of Aconogonon Himalaya and adjacent regions as well as a few well-known species from outside areas.

<table>
<thead>
<tr>
<th>Char. no.</th>
<th>Character</th>
<th>Character states</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Life cycle</td>
<td>perennial(0); annual(1)</td>
</tr>
<tr>
<td>2</td>
<td>Habit</td>
<td>± tall shrubs (usually ≥ 100 cm high)(O); herbaceous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(usually ≤ 100 cm high)(1)</td>
</tr>
<tr>
<td>3</td>
<td>Stem</td>
<td>simple of few-branched (O); well-branched (1)</td>
</tr>
<tr>
<td>4</td>
<td>Leaf base</td>
<td>cordate or ± truncate (O); cuneate to attenuate (1)</td>
</tr>
<tr>
<td>5</td>
<td>Leaf margin; long, curled hairs</td>
<td>absent (O); present (1)</td>
</tr>
<tr>
<td></td>
<td>(hairs ≥ 1.5mm long)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Guard cell size</td>
<td>usually ≤ 50μm long (O); usually ≥ 50μm (1)</td>
</tr>
<tr>
<td>7</td>
<td>Number of vascular bundles in petiole</td>
<td>≥ 10 (O); ≤ 10 (1)</td>
</tr>
<tr>
<td>8</td>
<td>Inflorescence position</td>
<td>terminal + axial (O); terminal only (1)</td>
</tr>
<tr>
<td>9</td>
<td>Inflorescence type</td>
<td>well-branched panicles (O); spike-like racemes (1)</td>
</tr>
<tr>
<td>10</td>
<td>Pedicel</td>
<td>articulate (O); non-articulate (1)</td>
</tr>
<tr>
<td>11</td>
<td>Pedicel length</td>
<td>usually ≥ 3 mm long (O); usually ≤ 3 mm long (1)</td>
</tr>
<tr>
<td>12</td>
<td>Ochracea</td>
<td>glabrous (O); pubescent (1)</td>
</tr>
<tr>
<td>13</td>
<td>Flower shape</td>
<td>open, non-campanulate (O); campanulate (1)</td>
</tr>
<tr>
<td>14</td>
<td>Flower sex</td>
<td>bisexual [or pseudo-hermaphrodite; ♀ or ♂ part poorly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>developed] (O); clearly dioecious (1)</td>
</tr>
<tr>
<td>15</td>
<td>Flower colour</td>
<td>green (O); whitish-yellow, red or pink (1)</td>
</tr>
<tr>
<td>16</td>
<td>Heterostyly</td>
<td>absent (O); present (1)</td>
</tr>
<tr>
<td>17</td>
<td>Tepal shape</td>
<td>ovate to spathulate (O); rhombic (1)</td>
</tr>
<tr>
<td>18</td>
<td>Tepal venation</td>
<td>dendrlicular (O); trifid (1); only 1 midvein (2)</td>
</tr>
<tr>
<td>19</td>
<td>Tepal in fruit</td>
<td>dry (O); becoming fleshy (1)</td>
</tr>
<tr>
<td>20</td>
<td>Tepal lobes</td>
<td>± unequal (O); subequal (1)</td>
</tr>
<tr>
<td>21</td>
<td>Tepal anticlinal walls of epidermal cells</td>
<td>undulate to sinuate (O); ± straight (1)</td>
</tr>
<tr>
<td>22</td>
<td>Glandular hairs on tapal</td>
<td>absent (O); present (1)</td>
</tr>
<tr>
<td>23</td>
<td>Stigma type</td>
<td>fimbriate (O); capitate (1)</td>
</tr>
<tr>
<td>24</td>
<td>Achene apex</td>
<td>without long beak (O); with long beak (1)</td>
</tr>
<tr>
<td>25</td>
<td>Achene base</td>
<td>not stipitate (O); stipitate (1)</td>
</tr>
<tr>
<td>26</td>
<td>Achene with membranous wings</td>
<td>present (O); absent (1)</td>
</tr>
<tr>
<td>27</td>
<td>Achene triquinous with three, hard wing-like structure (non-membranous)</td>
<td>present (O); present (1)</td>
</tr>
<tr>
<td>28</td>
<td>Achene covered by tapals</td>
<td>included/slightly exerted (O); 2/3 or 1/2 exerted (1)</td>
</tr>
<tr>
<td>29</td>
<td>Achene in fruiting stage</td>
<td>± nodding (O); not nodding (1)</td>
</tr>
<tr>
<td>30</td>
<td>Achene colour</td>
<td>blackish brown (O); light brown (1)</td>
</tr>
<tr>
<td>31</td>
<td>Pollen exine microspines</td>
<td>absent (O); present (1)</td>
</tr>
<tr>
<td>32</td>
<td>Pollen exine sculpturing pattern</td>
<td>micoreticulate (O); fo沃olate (1)</td>
</tr>
<tr>
<td>33</td>
<td>Pollen aperture number</td>
<td>three (O); six (1); twelve (2)</td>
</tr>
<tr>
<td>34</td>
<td>Pollen size</td>
<td>small to medium, usually &lt; 40 μm (O); large &gt; 40μm (1)</td>
</tr>
<tr>
<td>35</td>
<td>Non-glandular hair surface</td>
<td>striate (O); papilllose (1)</td>
</tr>
</tbody>
</table>

it becomes thick and fleshy and dark-reddish in fruit (Fig. 3B), which is unusual in Aconogonon.

The perianth is mostly pentameryous throughout the genus, except in A. rumicifoliuhm, in
Fig. 2. Diagrammatic representation of inflorescence types in *Aconogonon* described in the text. – A: Short terminal axillary and terminal panicles (in *A. rumicifolium*). – B: Well-branched terminal panicle (in many species). – C: More or less non-leafy, narrow terminal panicle with short lateral branches (in *A. rhombitepalum* and *A. hookeri*). – D: Simple, loose spike-like racemes (in *A. pangianum*).

which it is occasionally hexameric. The tepals are subequal or unequal in size (the two outer ones smaller than the three inner ones) and usually glabrous, rarely sparsely pubescent (*A. tortuosum* var. *pubitepalum*), ovate to elliptic to spathulate, sometimes rhombic (*A. rhombitepalum*) in shape, usually rounded or blunt, rarely acute at the apex. The gynoecium is usually three-angular and develops into a trigonous achene. The flowers are homostylos in all species except *A. campanulatum* in which they are clearly heterostylos (distyly). There is only one style, which is normally 3-cleft.

**Achenes.** The colour of the achene is usually dark brown or sometimes light brown. The shape of the achene is usually ovate or sometimes ellipsoidal in outline. In *A. rhombitepalum* and *A. hookeri* the achenes are stipitate with stalks ca. 0.4 mm long (Fig. 3C), while in the other species they are usually sessile (Fig. 3D–E). In *A. campanulatum* the achene is
Fig. 3. The various types of achene in *Aconogonon*.—A: Achene enclosed by thin perianth (in many species).—B: Achene enclosed by thick, fleshy perianth (*A. molle*).—C: Achene with a long stalk (*A. hookeri*).—D: Achene with a sessile base (in many species).—E: Achene with a more or less long beak (*A. campanulatum*).

distinctly beaked, the beak being derived from the lower part of the style (Fig. 3E). In all the other species the achene has no or only a short beak (Fig. 3C-D).

**Palynology**

Most species of *Aconogonon* have 3-colpate pollen grains, except *A. campanulatum* and *A. pangianum*, which have 6-colpate (very rarely 4-colpate) and 12-porate pollen grains, respectively (For the detailed pollen description, see Hong 1992: 36 and tab. 4 therein).

The pollen grains of *Aconogonon* are usually characterized by a foveolate exine surface with scattered microspinules, and most of them are 3-colpate. In Polygonaceae a similar exine ornamentation can be found in *Bistorta* Mill. species and one species in *Muehlenbeckia* Meisn., *M. cunninghamii* F. Mueller (cf. Nowicke and Skvarla, 1977). However, the pollen grains of these two groups differ markedly from those of *Aconogonon* by being 3-colporate.

The genus *Aconogonon* appears to follow a pollen evolutionary model called 'successiformy', i.e. 3-colpate-pericolpate-periporate, which was proposed by Van Campo (1976; also cf. Hong and Hedberg, 1990).
Fig. 4. The possible evolutionary pathway of the sexual systems in the genus *Aconogonon*.—A: Bisexual flower (in many species).—B: Heterostyly (*A. campanulatum*).—C: Dioecious flowers (*A. hookeri*).

**Sexual systems**

The species of *Aconogonon* studied are mostly hermaphroditic and homostylos, but at least one species is heterostylos (*A. campanulatum*), and one (*A. hookeri*) is clearly dioecious.

Bawa (1980) described the possible evolutionary pathways leading to dioecy, from heterostylos hermaphroditism or via gynodioecy and monoecy. On the basis of Bawa’s (op. cit.) hypothesis, the evolutionary pathway to dioecy in *Aconogonon* may be presumed to go from hermaphroditism and homostyly via heterostyly (Fig. 4). However, this possibility is not supported by the infrageneric variation pattern of pollen morphology (Hong, 1991a).

**Phylogeny**

A cladistic analysis has been carried out to illustrate character evolution in *Aconogonon* as well as to establish a preliminary hypothesis of the phylogeny. The analysis is aimed primarily at elucidating interrelationships of the Himalayan species, but five well-known species from other areas (three from North America, two from the Far East) are also included. The ingroup, *Aconogonon*, is considered to be monophyletic and the species share a number of synapomorphies, i.e. a trifid tepal venation (secondarily midveined in one species), a capitate stigma, pollen exine foveolate with scattered microspinules and colpate
Table 2. Data matrix for the cladistic analysis of *Aconogonon* in Himalaya and adjacent regions.

O = plesiomorphic, 1 (2) = apomorphic, − = polymorphic. Character numbers are explained in Table 1.

<table>
<thead>
<tr>
<th>Species</th>
<th>Character number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>OUTGROUP</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. rimulicifolium</em></td>
<td>0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. rhombifolium</em></td>
<td>0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. hookeri</em></td>
<td>0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. curiarium</em></td>
<td>0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
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<tr>
<td><em>A. alpinum</em></td>
<td>0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. molle</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. rechingeri</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. tortuosum</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. kuttenense</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. lehiniense</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
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<tr>
<td><em>A. campanulatum</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. pangianum</em></td>
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</tr>
<tr>
<td><em>A. hulsenianum</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
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<tr>
<td><em>A. phytolacifolium</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. davisciae</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. woyrichii</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td><em>A. tripterocarpum</em></td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
</tbody>
</table>

or rarely porate apertures. These features are absent from related genera such as *Reynoutria*, which has a dendriform tepal venation, a fimbriate stigma, pollen exine microreticulate without scattered microspinules and colporate apertures. The East Asian genus *Reynoutria* was utilized as an outgroup for polarizing the characters. The two genera share close similarities of stem and petiole anatomy (cf. Haraldson, 1978) as well as gross morphological similarities (cf. Gross, 1913), e.g. usually well branched panicles, pollachanthic with perennating rhizomes and fast-growing annual shoots.

The character states are given in Table 1. Thirty-five characters, with little or no infraspecific variation, were selected for the analysis. Among those, there are only twenty-two informative characters, however. Thirteen characters are ingroup synapomorphies (23, 31 and 32) and autoapomorphies (1, 5, 6, 13, 16, 17, 19, 24, 27, and 34) for the species. These uninformative characters were excluded from the computer analysis but added to the cladogram. There are only two multistate characters, one of them (character 33) was treated as additive, the other (18) as non-additive. The data matrix is given in Table 2.

The analysis produced ninety-five equally parsimonious trees, 51 steps long with a consistency index 50 and a retention index 66. However, the strict consensus tree was not fully resolved basally, except two stable groups composed by (1) *A. rhombifolium* and *A. hookeri* (2) *A. campanulatum* and *A. pangianum*. The next attempt was analyses using the successive approximations character weighting by implementing the "xsteps w" routine in
Fig. 5. One of the 13 equally parsimonious trees found after successive weighting of the data matrix in Table 2. Solid bars represent apomorphies; open bars represent apomorphic characters which appear as reversals later; double lines denote parallelisms; crosses represent reversals; a stippled long bar represents the well-known species from other areas. The numbers refer to the characters given in Table 1. The nodes marked with letters are discussed in the text (After Hong, 1992).

Hennig 86, which was suggested by Carpenter (1988) on the basis of the concept of "cladistic reliability" without making prior decisions on weighting (Farris, 1969). Weights are calculated from the best fits, as the product of the character consistency and character retention indices, then scaled to lie in the range 0–10. After applying this method, the analysis reduced the number of trees down to thirteen. One of the thirteen trees is shown in Fig. 5. Interestingly, as can be seen in the cladogram, the present study group (in node A) is monophyletic and characterized by two synapomorphies (characters 11, 15), excluding *A. rumicifolium* which comes out at the base. The species from the other areas are the sister group of the Himalayan species.
Node B is well supported by two characters (characters 8, 26), but character 26 is weakened by its occurrence as parallelisms in *A. ruminicfolium*, *A. phytolaccifolium* (Meisn. ex Small) Rydb. and *A. davisiae* (Brewer ex A. Gray) Soják.

Node C is supported by only one synapomorphy, viz. character 25 (stipitate achene), which is, however, considered a strong character. *A. rhombipectalum* is characterized by an autapomorphy (17), but also by the homoplastic character 30.

Node D is well supported by two synapomorphies (3, 20), but character 20 is somewhat weakened by its occurrence as a parallelism in node J.

*A. molle* is well distinguished by a synapomorphy (25) as well as one homoplastic character (21) as a parallelism. The result of the present analysis also suggest that *A. molle* has originated from its sister species, *A. alpinum*. *A. rechingeri* is well distinguished by an autapomorphy (5) as well as three homoplastic characters (7, 28, 30, see also under node H and in *A. kutchiense*).

Node F is weakly supported by a homoplastic character 21 which is also found in node K and in *A. molle*, but *A. lichiangense* is well characterized by two autapomorphies (6, 34).

One stable group is formed by *A. campanulatum* and *A. panguianum*, and they constitute a well supported clade with three synapomorphies (22, 33 state 1 and 35) at node G. It is also worth noticing that those two species are characterized by several autapomorphies, viz. characters 13, 16, 24 in *A. campanulatum*, characters 1, 18 state 2, 33 state 2 as well as three homoplastic characters 7, 9 and 28 (all parallelisms) in *A. panguianum*.

Node H is weakly supported by two homoplastic characters (28, 30), which are supposed to have evolved three times, viz. in *A. rechingeri* (both characters), in *A. panguianum* (character 28) and in *A. rhombipectalum* (for character 30), respectively.

Node I (see also under node E) is weakly supported by the homoplastic character 29.

**Phytogeography**

On the basis of the present study, the centre of diversity of the genus *Aconogonon* is presumed to be in Himalaya and adjacent regions, where there are many endemic species. Most species of *Aconogonon* grow on rocky slopes, in damp places, on open alpine meadows or near streams. In the Western Himalaya they sometimes also grow on fairly dry slopes (especially *A. tortuosum* var. *tibetanum*). They are mostly alpine or subalpine species and occur at altitudes between 1000 and 5800 m.

The distributions of the 12 species of *Aconogonon* found in Himalaya and adjacent areas have been arranged in phytogeographical groups mainly on the basis of the regions proposed by Takhtajan (1986), and partly adopted from Hara (1966). Most species are confined to either the Eastern Asiatic region or the Irano-Turanian region, except two species (*A. alpinum* and *A. molle*), which occur in more than two regions (The more detailed discussion on phytogeography, see Hong, 1992).
The Eastern Asiatic group. Six species belong to this group, *Aconogonon rhombitepalum*, *A. hookeri*, *A. tortuosum*, *A. lichiangense*, *A. campanulatum* and *A. pangianum*.

The Irano-Turanian Group. Four species belong to this group, *Aconogonon ruminicfolium*, *A. coriarium*, *A. rechingeri* and *A. kuttiense*. They are all endemic to the Irano-Turanian region.

Widespread species. Two Himalayan species of *Aconogonon* (*A. alpinum*, *A. molle*) range very widely outside the limits of the area being considered here.

**Taxonomy**

*Aconogonon* (Meisn.) Reichenbach

*Polygonum* * Polygonum* Linnaeus, Sp. Pl. 1: 362. 1753, pro parte.
*Ampelygonum* Lindley, Bot. Reg. 8: 63. 1838, pro parte.

Nomenclatural note. Reichenbach (1837), when raising *Polygonum* sect. *Aconogonon* to generic rank, changed the name to "Aconogonum". Sometimes *Aconogonum* has been regarded as a new name created by Reichenbach, but already in 'Flora Germanica' (1830–32) he used this latinized spelling for Meisner's section. According to ICBN Art. 73 the original spelling of a name or epithet is to be retained, except for the correction of typographic or orthographic errors. Therefore, the correct spelling of the genus is 'Aconogonum'.

Key to the species of *Aconogonon* in Himalaya and adjacent regions

1. Flowers campanulate, heterostylos; achenes beaked .......... 11. *A. campanulatum*
   — Flowers open and±rotate, homostylos; achenes not beaked ....... 2
2. Most leaves basal; plants consistently dioecious .......... 3. *A. hookeri*
   — All or most leaves cauline; plants hermaphrodite .. 3
3. Tepals rhombic, acute at the apex; achenes stipitate, stalk ca. 0.4 mm long .......... 2. *A. rhombitepalum*
4. Tepals with distinct midvein, always with numerous peltate glands; annual herbs .................................................................12. A. pangianum
— Tepals with 35 veins arising from the base and 1-3 lateral veins, without or rarely with a few peltate glands; perennial herbs or subshrubs ........................................5
5. Inflorescence normally a terminal panicle only .........................................................6
— Inflorescence a terminal panicle often supported by axillary branches .......................8
6. Fruits baccate, enclosed by thick reddish black fleshy tepals; habit usually creeping to suberect ..............................................................................6. A. molle
— Fruits not baccate, enclosed by normal thin, non-fleshy tepals; habit usually erect ....7
7. Inflorescences usually with numerous dense flower clusters; pedicel not articulate; style 0.4-0.6 mm long; leaves ovate to obovate-lanceolate, broadly cuneate or rounded at the base .................................................................4. A. coriarium
— Inflorescences not with numerous dense flower clusters; pedicel articulate; style ca. 0.2 mm long; leaves lanceolate to narrowly lanceolate, attenuate at the base ........................................5. A. alpinum
8. Stem simple, mostly herbaceous at the base; leaf base usually rounded to truncate or cordate, texture rather fleshy; flowers ± greenish, nodding in fruit ................................1. A. rumicifolium
— Stem usually branched, rarely ± simple with a few lateral branches, often ± woody at the base; leaf base shortly attenuate or ± cuneate, texture not fleshy; flowers usually creamy white, not nodding in fruit ........................................9
9. Leaves with greyish or dull whitish woolly tomentum below ......................................10
— Leaves without woolly tomentum below ...................................................................11
10. Plants 60-150 (-180) cm tall; leaves normally oblong-lanceolate, 6.0-12.5 cm long; inflorescence a thyrsoid panicle, 5-15 cm long and carrying numerous flowers from nearly every node; tepals 3.8-5.5 (-6.1) mm long ..................................................10. A. lichiangense
— Plants ca. 15-45 cm tall; leaves narrowly elliptic-lanceolate, 1.1-3.0 cm long; inflorescence with short raceme-like panicles, 12 cm long; tepals 2.6-3.6 mm long ......9. A. kuttiense

11. Leaf margin glabrous or with a few long, curled hairs, revolute; achenes 5.2-5.8 mm long, mostly with half or two-thirds exserted beyond the tepals; inflorescences 0.8-1.2 cm long ..................................................................7. A. rechingeri
— Leaf margin ciliate or scabrous, rarely glabrous without long, curled hairs, not revolute; achenes (2.5-) 3.0-4.3 mm long, mostly included or slightly exserted beyond the tepals; inflorescences 0.8-7.0 cm long ................................................................8. A. tortuosum

(1a). *A. ruminifolium* var. *ruminifolium*


**Distribution.** *A. ruminifolium* var. *ruminifolium* occurs in the C.I.S., NW India (mostly in Himachal Pradesh, Kashmir, Punjab, Uttar Pradesh), through the northern parts of Pakistan to the central Nepal; 1200-4800 m.


**Distribution.** *A. ruminifolium* var. *glaberrimum* is known from NE Afghanistan, N Pakistan, and NW India: 2900-4100 m.


**Distribution.** *A. rhombitepalum* occurs in Upper Burma and the Yunnan province of China: 3350-3960 m.


**Distribution.** *Aconogonon hookeri* occurs from Sikkim in N India through Bhutan to SW Kansu, Szechwan, Tibet, Tsinghai, Yunnan in China: 3600-5800 m.

4. *Aconogonon coriarium* (Grigorjev) Sojk, Preslia 46: 151. 1974A.


Distribution. A. coriarium occurs in S Kazakhstan, Kirghiz, Tadzhikistan (Pamir area), Uzbekistan, and Turkmenistan, Afghanistan, and in a few localities in N Pakistan and Kashmir: 1400-3500 m.

5. Aconogonon alpinum (Allioni) Schur, Fl. Transsilv. 64. 1853.

(5a). A. alpinum (All.) Schur var. alpinum


Polygonum diffusum Pallas ex Sprengel, Syst. Veget. 255. 1825.—Type: Not traced (Probably in B-WILLD.?).

Distribution. In the study area A. alpinum var. alpinum occurs in NW India and in the northern parts of Pakistan?. It is also known in the C.I.S. (Caucasia, Siberia, Turkestan), some parts of the Middle East (e.g. N Iran, Sinai, Turkey, etc.), and W, C & S Europe: 2100-3400 m.


Distribution. Aconogonon alpinum var. stewartii is distributed from Kashmir in NW India to Swart and Gilgit areas in Pakistan: 2100-3050 m.

—Polygonum molle D. Don, Prodr. Fl. Nep. 72. 1825y (Feb.). Type: Nepal, 1821, Wallich 1685/1 (BM! lectotype, G!, K!, NY! isolectotypes, both are selected by Hong, 1992).

(6a). A. molle var. molle

Coccocolba toinea Buch.-Hamilton ex D. Don, Prodr. Fl. Nep. 74. 1825. —Type: Nepal, without precise locality, not dated, Hamilton s.n. (possibly in BM, not traced).

Polygonum polyanthos de Bruyn in Miquel, Pl. Jungh. 3: 304. 1854. Type: Indonesia,
Java, not dated, Jungh s.n. (L lectotype, selected by Hong 1992).

**Distribution.** *A. molle* var. *molle* W occurs from NE India (Assam, Sikkim), Nepal, Bhutan and SW China through the Indo–Malayan Peninsula to Indonesia. There are also a few collections from Sri Lanka and one collection from Madras in SE India: 1200–3650 m.


**Distribution.** *A. molle* var. *rude* occurs from Nepal, Bhutan, SW China (especially in Kwangsi, Tibet, Yunnan) and NE India (Assam, Sikkim) to N Thailand; there are also a few collections from C India: 900–3650 m.


*Polygonum paniculatum* Blume, Bijd. Fl. Nederland. Ind. 1: 533. 1825 (Dec.)–1826 (Mar.), pro parte.—Type: Indonesia, Mt. Gede, not dated, Zollinger 1690 (L lectotype, selected by Hong, 1992).

**Distribution.** *A. molle* var. *frondosum* occurs from SW China (Kwangsi, Kweichow, Yunnan), C. Burma, Sikkim and Nepal, to NW India, and also in SW Asia, e.g. Malaya and Indonesia: 135–3950 m.


**Distribution.** *A. molle* var. *griffithii* is known from a few localities in Bhutan and Assam. No information is available about the altitude.
   — Type: Afghanistan, Ghazni Province, Ghoutch Kol, NNE Sang-i Masha, ca. 33° 40'N, 67° 25'E, 2. VII. 1962, Rechinger 17643 (W! holotype, G!, LD! isotypes).
   **Distribution.** A. rechingeri is known only from NE Afghanistan: ca. 3300 m.


(8a). *A. tortuosum* (D. Don) Hara var. *tortuosum*

*Polygonum tortuosum* var. *spicatum* Hook. f., Fl. Br. Ind. 5: 52. 1886 (as ‘*spicata’*).— Type: India, Kashmir, Ladak Road, Dras, 240–2750 m, 24. IX. 1848, Thomson s.n. (K lectotype, selected by Hong, 1992).

   **Distribution.** *A. tortuosum* var. *tortuosum* occurs in NW India, N Pakistan, Nepal, Sikkim in NE India, Bhutan, Tibet and one locality from Yunnan in China: 3350–5000 m.


*Polygonum peregrinatoris* O. Paulsen in Ostenfeld and Paulsen, List Fl. Pl. Inner Asia. 8. 1922.— Type: China, SW Tibet, height above the source of Tsangpo, 5015 m, 18. VII. 1907, Hedin s.n. (C! holotype).
   **Distribution.** *Aconogonon tortuosum* var. *tibetanum* occurs mostly in N Pakistan, NW India, and Tibet (mostly close to the border of NW India) in Chianai: 3000–4850 m.

   **Distribution.** *Aconogonon tortuosum* var. *pubitepalum* is narrowly restricted to the Mt. Everest region (Solu Khumbu district) in E Nepal: 3350–4000 m.

VII VIII. 1895, Littledale s.n. (K! holotype).

**Distribution.** *A. tortuosum* var. *glabrofolium* occurs only in SE Tibet: 3800—4750 m.

—Type: NW India, Uttar Pradesh, Kutti, village site, 4950—5000 m, 22. IX. 1968, Dutta 277 [CAL! holotype (photo seen). CAL! isotype].

**Distribution.** *Aconogonon kultiense* is known from two restricted areas, Kutti Valley in Uttar Pradesh and Kyerang Pass in Himalchal Pradesh in NW India: 3350—5000 m.

—*Polygonum lichiangense* W. W. Smith, Notes Roy. Bot. Gard. Edinb. 8: 197. 1914.—Type: China, Yunnan province, the eastern flank of the Lichiang Range, 27° 41’N, VIII. 1910, Forrest 6296 (E lectotype, BM, K, P isolecototypes, both are selected by Hong, 1992).

**Distribution.** *Aconogonon lichiangense* is restricted to N Yunnan and SW Szechwan provinces in SW China: 2800—4000 m.

—*Polygonum campanulatum* Hook. f., Fl. Br. Ind. 5: 51. 1886.—*Polygonum campanulatum* var. *fulvidum* Hook. f., Fl. Br. Ind. 5: 52. 1886. (as ‘*fulvida’*). —Type: India, Sikkim, Bkola, 11000’, 6. XI. 1849, Hooker ‘*Polygonum 69*’ (K lectotype, GH isolecototype, both are selected by Hong, 1992).

(11a). *A. campanulatum* var. *campanulatum*


**Distribution.** *Aconogonon campanulatum* var. *campanulatum* occurs more or less sympatrically with var. *oblongum*, but in a much wider range from Nepal, NE India (mainly Assam, Sikkim, W Bengal), Bhutan, to SW China (SE Tibet, Yunnan, W Szechwan, NW Kweichow), and also in some localities in Upper Burma: 1300—4100 m.


*Polygonum rumpicfolium* var. *oblongum* Meisner, in DC. Prodr. 14: 138. 1856.—Type: India, Jhuni, S of Pindari glacier, 80° 03’E, V. 1848, Strachey and Winterbottom 35 (K lectotype, GH isolecototype, both are selected by Hong, 1992).
Polygonum campanulatum var. membranifolium Hook. f., Fl. Br. Ind. 5: 52. 1886 (as 'membranifolia').—India, Sikkim, above Lanchong toward Tunkra, VIII. 1849, Hooker s. n. (K lectotype, K isolectotype, both are selected by Hong 1992).

Polygonum campanulatum var. longipes Hook. f., Fl. Br. Ind. 5: 52. 1886.—Type: Nepal, Tambur River, XI. 1823?, Hooker 'Polygonum 71' (K lectotype, K isolectotype, both are selected by Hong, 1992).

Distribution. A. campanulatum var. oblongum occurs in Nepal, NE India (Sikkim), Bhutan, Upper Burma and Yunnan in SW China; 150–3900 m.

—Type: India, Arunachal Pradesh, Subansiri distr., Pange, 19. IV. 1980, Pal 77734 [CAL! holotype (photo seen), CAL!, ASSAM! isotypes].

Distribution. Aconogonon pangianum is known from Assam and Arunachal Pradesh in NE India, and there is one collection from N Burma: 240–3500 m.

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Literature Cited


