



A Taxonomic Revision of Genus *Polygonum* L. *sensu lato* (Polygonaceae) for Flora of Iran

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Authors' contributions

This work was carried out in collaboration between both authors. Author SH designed the study and wrote the draft of the manuscript. Author SPG managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The genus *Polygonum* L. *sensu lato* is revised based on articles, herbarium documents and field observations. In this article, a brief revision of this genus in Iran is presented. It was first described by Rechinger and Schiman-Czeika [1] for flora Iranica and has included up to 53 species. The last revision of this genus has been made by Mozaffarian [2], and the genus *Polygonum* L. *sensu lato* is divided into 3 genera (*Polygonum* L. *sensu stricto*, *Bistorta* Adans. and *Persicaria* Mill.). But in present study, according to our field observations and herbarium materials, the genus *Polygonum* L. *sensu lato* has to be separated into 5 different genera including *Aconogonon* (Meisn.) Rchb., *Bistorta* (L.) Scop., *Fallopia* Adans., *Persicaria* (L.) Mill., and *Polygonum* L. *sensu stricto*. The number of species for *Polygonum* L. *sensu lato* has been reduced to 25 species. For these 5 genera, new identification keys have been created.

Keywords: *Aconogonon*; *Bistorta*; *Fallopia*; *Flora of Iran*; *Persicaria*; *Polygonum*.

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1. INTRODUCTION

Polygonum L. *sensu lato* comprises annual and perennial weedy plants with a complex taxonomic situation [3]. The last arrangement of genus *Polygonum* L. *sensu lato* has been made in Iran by Mozaffarian [2], which included 45 species. According to revision by Mozaffarian [2], *Polygonum* L. *sensu lato* is separated to 3 genera including *Bistorta* Adans., *Persicaria* Mill., and *Polygonum* L. *sensu stricto*. This separation is done based on their inflorescence character. All the species with not branched stems and generally basal leaves, and terminal spike-like inflorescence have been transferred to the genus *Bistorta* Adans. Also, species with generally branched stems, cauline leaves, and terminal or axillary spike-like inflorescence have to be members of the genus *Persicaria* Mill. The aim of this article is to revise the taxonomy of the

genus *Polygonum* L. *sensu lato* for flora of Iran.

2. MATERIALS AND METHODS

During our investigations, new specimens were collected from fields and rangelands in different regions of Iran (East and West Azerbaijan, Karaj, Gilan, Kermanshah, and Hamadan provinces). Plant species collected were catalogued and pressed for later identification by flora Iranica [1] and Turkey [4]. Also for determination and separation of these species based on anatomical and morphological characters, we reviewed papers and herbarium materials of Vienna herbarium (Naturhistorisches Museum Wien Botanische Abteilung), herbarium of Agricultural faculty of Tehran and Tabriz University, and herbarium of Research Institute and Natural Resources.

3. RESULTS

Dichotomous key for detection of 4 genera from the genus *Polygonum* L. *sensu lato*.

- | | |
|--|------------|
| 1- Outer perianth segments winged or keeled | 2 |
| 1- Outer perianth segments not winged or keeled | 3 |
| 2- Flower base stalk-like; outer perianth segments winged (keeled in <i>Fallopia convolvulus</i>); leaf blade base sagittate, hastate, cordate, truncate, or ovate; ochrea papery, not 2-lobed distally | Fallopia |
| 2- Flower base not stalk-like; outer perianth segments keeled; leaf blade base tapered (ovate); ochrea generally translucent, 2-lobed distally | Polygonum |
| 3- Leaves generally basal; inflorescence terminal, spike-like; stems not branched | Bistorta |
| 3- Leaves cauline; inflorescence terminal, axillary, spike-like or not; stems generally branched | 4 |
| 4- Ochrea generally translucent, glabrous, 2-lobed, fibrous in age | Polygonum |
| 4- Ochrea opaque, glabrous to scabrous, not 2-lobed | 5 |
| 5- Inflorescence raceme- or panicle-like; perianth segments fused $\pm 1/4$; stamens 8 | Aconogonon |
| 5- Inflorescence \pm head-, spike-, or panicle-like; perianth segments fused $1/4-2/3$; stamens 5-8 | Persicaria |

Aconogonon:

Aconogonon alpinum
Syn.: *Polygonum alpinum*

Bistorta:

Bistorta major
Syn.: *Polygonum bistorta*

Dichotomous key for detection of *Fallopia* species:

- | | |
|---|--------------------------|
| 1- Perennial herby plants; inflorescence a lax panicle; Cultivated plants in Iran | <i>F. baldschuanicum</i> |
| 1- Annuals herby plants; inflorescence racemose or spicate; occur as weedy plants | 2 |

- 2- Fruiting pedicels 1- 3 mm, shorter than perianth segments; Nut finely granular *F. convolvulus*
 2- Fruiting pedicels 5- 8 mm, as long as or longer than perianth segments; Nut smooth and glossy *F. dumetorum*

Dichotomous key for detection of *Polygonum* species:

- 1- Perennial herby plants 2
 1- Annuals herby plants 16
 2- Stems long and virgate, up to 20-70 cm, with a hard woody stock 3
 2- Stems short, often prostrate, up to 20 cm, with or without a hard woody stock 6
 3- Basal and lower cauline leaves lanceolate or oblong- ovate, nerved, with cartilaginous- crenulate margins *P. iranicum*
 3- Basal and lower cauline leaves lanceolate or narrowly linear, non-cartilaginous margins 4
 4- Stem often prostrate; Nut somewhat longer than broad *P. hyrcanicum*
 4- Stem often erect or ascending; Nut up to 2 times longer than broad 5
 5- Stems branched below the inflorescence; Leaves revolute, linear- lanceolate, more than 5 mm broad; lower ones 30 (-50) × 3 mm; Pedicels as long as perianth segments *P. luzuloides*
 5- Stems unbranched below the inflorescence; Leaves usually flat, narrowly linear- lanceolate, less than 5 mm broad; lower ones until 30 × 2 mm; Pedicels very short *P. setosum*
 6- Flower bearing branches prostrate, rarely ascendant, herbaceous, only at base with hard woody stocks 7
 6- Flower bearing branches long conspicuous; with broad leaves or leaflets in flowering time and often deciduous 9
 7- Stem and branches are tick at base *P. alpestre*
 7- Stem and branches are woody or cushion at base 8
 8- Stem and branches are woody at base; leaves small, up to 10 mm long; flower bearing branches are prostrate *P. serpyllaceum*
 8- Stem and branches are cushion at base; flower bearing branches not longer than leaves; flowers included by leaves, leaves cylindrical *P. botuliforme*
 9- Flower bearing branches are leafy; ochrea long and conspicuous 10
 9- Flower bearing branches are leafless; ochrea short 13
 10- Branches spiny *P. spinosum*
 10- Branches non spiny 11
 11- Leaves shorter than ochrea or only lower ones less and more longer *P. paronychioides*
 11- Leaves longer than ochrea 12
 12- The entire plant (except ochrea) papillose; leaves linear; flowers always single *P. afghanicum*
 12- The entire plant papillose or glabrous; leaves ovate- lanceolate; flowers often in group of 3 *P. thymifolium*
 13- Internodes abbreviated, less and more up to 5 (- 10) mm; branches short and indurated *P. salicornioides*
 13- Internodes often longer, branches often long and herbaceous 14
 14- Branches erect and long *P. aridum*
 14- Branches short 15
 15- Branches thick; leaves ovate; flowers single *P. khaje-Jamali*
 15- Branches thin; leaves ovate- lanceolate; flowers single or binary *P. dumosum*
 16- Inflorescence branches leafless 17
 16- Inflorescence branches leafy 20
 17- Nut 4- 5 mm long *P. kitaebelianum*
 17- Nut less than 3 mm long 18
 18- Leaves quickly deciduous; flowers close *P. argyrocoleon*
 18- Leaves persistent in flower; flowers loose and distant 19
 19- Stems short, 10- 20 cm; flowers small *P. olivascens*

19- Stems long, 25- 80 cm; flowers slightly large and loose	<i>P. patulum</i>
20- Stems short, less than 7 cm long; prostrate; leaves setiformis (bristle like)	<i>P. molliaeforme</i>
20- Combination of characters not as above	21
21- Plants heterophyllus; erect, ascending, or decumbent; leaves variable (in size)	<i>P. aviculare</i>
21- Plants isophyllus; mostly prostrate; leaves not variable (similar each other)	22
22- Branches long; leaves similar and elliptic	<i>P. arenastrum</i>
22- Combination of characters not as above	23
23- Flowers 4- 6, pedicellate, close; pedicels 3-4 times longer than perianth segments	<i>P. corrigioloides</i>
23- Flowers 1- 3, sessile or nearly sessile, loose	24
24- Flowers borne in clusters 1-2 in axils of upper leaves; perianth segments subcampanulate, lobed in the upper middle	<i>P. polycnemoides</i>
24- Flowers borne in clusters 1-3 in axils of upper leaves; perianth segments tubular, lobed in the lower third	<i>P. rottboellioides</i>

Dichotomous key for detection of *Persicaria* species:

1- Inflorescence dense and oblong; flowers contiguous	2
1- Inflorescence lax and linear; flowers not contiguous	7
2- Ochrea long and fimbriate (up to 20 mm); flowers generally greenish-white	<i>P. barbata</i>
2- Ochrea shortly ciliate (up to 3 mm) or not ciliate	3
3- Ochrea not ciliate	<i>P. glabra</i>
3- Ochrea shortly ciliate	4
4- Plants usually more than 1 m high; Leaves ovate or ovate- cordate, acuminate, median cauline leaves more than 40 mm broad, less and more petioled	<i>P. orientalis</i>
4- Plants usually gracilis; Leaves lanceolate up to 40 mm broad; shortly or non petioled	5
5- Perennial; Leaves truncate or cordate at base	<i>P. amphibia</i>
5- Annual; Leaves attenuate or cuneate at base	6
6- Ochrea tubular; ciliate (more than 1 mm long)	<i>P. maculosa</i>
6- Ochrea patent, glabrous, ciliate (less than 1 mm long)	<i>P. lapathifolia</i>
7- Perennial	<i>P. salicifolia</i>
7- Annual	8
8- Perianth segments glandular (yellowish or brownish glands)	<i>P. Hydropiper</i>
8- Perianth segments eglandular	9
9- Perianth segments more than 3 mm long; leaves lanceolate up to 7 mm broad	<i>P. mitis</i>
9- Perianth segments less than 2.5 mm long; leaves lanceolate- linear, less than 5 mm broad	<i>P. minus</i>

4. DISCUSSION

According to revision by Mozaffarian [2], *Polygonum* L. *sensu lato* is separated into 3 genera including *Bistorta* Adans., *Persicaria* Mill., and *Polygonum* L. *sensu stricto* for flora of Iran. And According to revision by Ter-Voskanyan [5], this genus is divided into *Aconogonon* (Meisn.) *Reichenb.*, *Bistorta* (L.) Scop., *Fallopia* Adans., *Persicaria* Mill., *Polygonum* L. s. s., which include 16 species, instead of 20, mentioned in 2nd volume of Flora of Armenia. In this article and in order by other available resources such as different floras and literatures [6,4,7,2,8,-12,5], the genus *Polygonum* L. has been divided into 5 genera including *Aconogonon* (Meisn.) Rchb. with one species (*Aconogonon alpinum* instead

of *Polygonum alpinum*), *Bistorta* (L.) Scop. with one species (*Bistorta major* instead of *Polygonum bistorta*), *Fallopia* Adans. with 3 species (*Fallopia baldschuanicum*, *F. convolvulus*, and *F. dumetorum* instead of *Polygonum baldschuanicum*, *P. convolvulus*, and *P. dumetorum*, respectively), *Persicaria* (L.) Mill. with 10 species (*Persicaria barbata*, *P. glabra*, *P. orientalis*, *P. amphibia*, *P. maculosa*, *P. lapathifolia*, *P. salicifolia*, *P. Hydropiper*, *P. mitis*, *P. minus* instead of *Polygonum barbata*, *P. glabra*, *P. orientalis*, *P. amphibia*, *P. maculosa*, *P. lapathifolia*, *P. salicifolia*, *P. Hydropiper*, *P. mitis*, *P. minus*, respectively), and *Polygonum* L. *sensu stricto* with 25 species (*Polygonum iranicum*, *P. hyrcanicum*, *P. luzuloides*, *P. setosum*, *P. alpestre*, *P.*

serpyllaceum, *P. botuliforme*, *P. spinosum*, *P. paronychioides*, *P. afghanicum*, *P. thymifolium*, *P. salicornioides*, *P. aridum*, *P. khaje-Jamali*, *P. dumosum*, *P. kitaebelianum*, *P. argyrocoleon*, *P. olivascens*, *P. patulum*, *P. molliaeforme*, *P. aviculare*, *P. arenastrum*, *P. corrigioloides*, *P. polycnemoides*, and *P. rottboellioides*) for flora of Iran.

5. CONCLUSION

The genus *Polygonum* L. *sensu lato* has to be separated into 5 different genera including *Aconogonon* (Meisn.) Rchb., *Bistorta* (L.) Scop., *Fallopia* Adans., *Persicaria* (L.) Mill., and *Polygonum* L.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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