Prometheum rechingeri, a new report from Iran

Received: 22.07.2017 / Accepted: 11.10.2017

Mohammad Amini Rad✉: Research Assistant Prof., Department of Botany, Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran (aminirad2000@yahoo.co.uk)

Urs Eggli: Researcher, Wissenschaftlicher Mitarbeiter, Sukkulenten-Sammlung Zürich/Grün Stadt Zürich, Mythenquai 88, CH-8002 Zürich, Switzerland

Abbas Gholipour: Associate Prof., Department of Biology, Payame Noor University, Tehran, Iran

Abstract

In the course of the study of collected specimens from West Azerbaijan province (NW Iran), *Prometheum rechingeri* (*Crassulaceae*) is reported for the first time from Iran. Based on recent phylogenetic and morphological studies in *Crassulaceae* family, genus *Prometheum* was considered as independent genus. So far, two species *viz. P. pilosum* (under *Sedum pilosum*), and *P. sempervivoides* (under *S. sempervivoides*) has been reported from Iran. These two species and the new report are specific to mountains regions and they mostly occur at elevation above 2000 m.s.l. in the northwest of Iran (West and East Azerbaijan provinces). A short discussion on the taxonomic history of the genus *Prometheum* and the relative species, description, distribution, illustration, ecology and a key for existing three Iranian species is provided.

Keywords: Alpine, *Crassulaceae*, diversity, floristic, *Rosularia*

Prometheum rechingeri، گزارشی جدید برای فلور ایران

دریافت: ۱۳۹۶/۰۴/۳۱ / پذیرش: ۱۳۹۶/۰۷/۱۹

محمد امینی‌راد✉: استادیار پژوهش، بخش تحقیقات گیاه‌شناسی، مؤسسه تحقیقات جنگل‌ها و مراتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران (aminirad2000@yahoo.co.uk)

اورس اگلی: محقق، زوریخ، سوییس

عباس قلی‌پور: دانشیار گروه زیست‌شناسی، دانشگاه پیام نور، تهران، ایران

خلاصه

تیره گل ناز (*Crassulaceae*)، دارای ۳۳ تا ۳۴ جنس و ۱۴۴۰ تا ۱۵۰۰ گونه در دنیا می‌باشد که اکثر گیاهان این تیره گوشتی می‌باشند (Eggli *et al*. 1995, Thiede & Eggli 2007). از این تعداد، شش جنس و ۳۴ گونه در ایران رویش دارند (Akhiani 2000, Joharchi & Akhani 2006). اخیرا، *Prometheum* (A. Berger) H. Ohba توسط اوهبا (Ohba 1978) با داشتن هشت گونه، به عنوان جنسی مستقل از *Sedum* L. در نظر گرفته شده است که شواهد مولکولی نیز این جدایی را تایید می‌کند. جنس مذکور عنصر ایرانو-تورانی است و در شمال یونان، ترکیه، ارمنستان، ناحیه قفقاز، شمال‌شرق عراق و شمال‌غرب ایران پراکنش دارند. از این جنس تا به حال، دو گونه *P. pilosum* (M. Bieb.) H. Ohba تحت نام *Sedum pilosum* M. Bieb. و *P. sempervivoides* (M. Bieb.) H. Ohba با نام *Sedum sempervivoides* M. Bieb. از ایران گزارش شده است. براساس سه نمونه جمع‌آوری شده از استان آذربایجان‌غربی، *Prometheum rechingeri* (C.-A. Jansson) 't Hart برای نخستین بار از ایران گزارش می‌شود. این دو گونه به همراه *P. rechingeri*، گیاهانی مختص نواحی مرتفع کوهستانی بوده و اغلب در ارتفاعات بالای ۲۰۰۰ متر از سطح دریا در شمال‌غرب کشور (استان‌های آذربایجان‌شرقی و غربی) پراکنش دارند. در این مقاله، توضیحاتی مختصر در مورد تاریخچه تاکسونومی این جنس و گونه‌های آن به همراه شرح مورفولوژیکی و تصاویر مربوط توضیح داده شده است. همچنین، کلید شناسایی برای سه گونه موجود از این جنس در ایران نیز تهیه و ارایه گردیده است.

واژه‌های کلیدی: تنوع، تیره گل ناز، فلوریستیک، کوهسری، *Rosularia*

Introduction

The family *Crassulaceae*, embraces 1440–1500 species in 33–34 genera (Eggli *et al*. 1995, Thiede & Eggli 2007), and all its species are more or less succulent (mostly leaf succulents, a few stem or caudex also succulents). In Iran, it is represented by six genera [*Crassula* L., *Umbilicus* DC., *Sedum* L., *Sempervivum* L., *Pseudosedum* (Boiss.) A. Berger, and *Rosularia* (DC.) Stapf], and 34 species (Akhiani 2000, Jansson & Rechinger 1970, Joharchi & Akhani 2006). These authors treated *Rosularia* mostly in the wide sense of Eggli (1988). However, van Ham (1995) found *Rosularia* to be polyphyletic in his molecular study using chloroplast sequence data, and this was further corroborated by Mort *et al.* (2001). Accordingly, 't Hart (1995), 't Hart (1999), and 't Hart (2003a) placed the species of *Rosularia* sect. *Chrysanthae* Eggli in the genus *Prometheum* (A. Berger) H. Ohba, and those of *Rosularia* sect. *Sempervivella* (Stapf) C.-A. Jansson (not represented in Iran) in the genus *Sedum*. *Prometheum* includes eight species and has an Irano-Turanian distribution ('t Hart 2003a). It was originally proposed by Ohba (1978) on the base of *Sedum* sect. *Prometheum* A. Berger [type *Prometheum sempervivoides* (M. Bieb.) H. Ohba]. It shares some characteristics with *Rosularia* as well as with *Sedum* (esp. ser. *Cepaea*), but differs in inflorescence structure and cytology ('t Hart 2003a) (Table 1). *Rosularia* s.s. is represented in Iran with four species [*R. elymaitica* (Boiss. & Haussknecht) A. Berger, *R. modesta* (Bornm.) Parsa, *R. radicosa* (Boiss. & Hohen.) Eggli, *R. sempervivum* ssp. *kurdica* Eggli, *R. sempervivum* ssp. *persica* (Boiss.) Eggli, and *R. sempervivum* ssp. *sempervivum*] (Eggli 1988a, 't Hart 2003b). Both *Prometheum* and *Rosularia* belong to the "Leucosedum clade" (Mort *et al*. 2001) in tribe *Sedeae* of subfamily *Sempervivoideae* (Thiede & Eggli 2006) (*Sempervivoideae* equals the more widely used *Sedoideae* but has nomenclatural priority over that name).

Materials and Methods

Specimens of a dwarf rosette-forming *Crassulaceae* species were found amongst a collection of plants from the alpine zones of West Azerbaijan (NW Iran). Based on photographic records from the field and the herbarium specimens, the material was identified with the help of Jansson & Rechinger (1970)'s key and the descriptions given by Eggli (1988a), and 't Hart (2003a). Morphological characteristics and other information of the newly collected species such as distribution, habitat and a key for identification of the existing species in Iran were studied.

Results and Discussion

The material was identified as *Prometheum rechingeri* and the collections represent the first report of the taxon for Iran. Previously, *P. rechingeri* was only known from the eastern most of Turkey (C10/vil. Hakkari), and adjacent Iraq (Kordestan) (Eggli 1988a) on the basis of less than 10 collections (Eggli 1988b). All material studied by Eggli (1988a, b) were from altitudes between 2500 [erroneously given as 2900 in Eggli 1988a: 80), and 3800 m.s.l. One of the Iraqi collections (Rechinger 11883) was stated to be from metamorphic schists and serpentine rocks, and for one of the Turkish collections (Nábělek 282), black limestone rocks are mentioned. The plants here recorded as new record for Iran and have been found on pale grey limestone.

Table 1. Comparison of diagnostic characters of *Prometheum*, *Rosularia*, and *Sedum* (esp. ser. *Cepaea*)

Character	*Prometheum*	*Rosularia*	*Sedum*
Cytology ('t Hart & Eggli 1988)	x = 7(6)	x = 9	Variable, ser. *Cepaea* x = 11(10)
Habit	Rosette	Rosette	Variable, including rosette or dense forming
Caudex	Absent or slightly thickened taproot	Often present	Absent
Leaf margins	Glabrous or glandular-hairy, never ciliate	Glabrous, glandular-hairy or ciliate	Glabrous or glandular-hairy
Inflorescences	Cymose/corymbose	Paniculate	Variable: cymes or corymbose
Inflorescence Position	Terminal or lateral	Lateral, rarely terminal (e.g. *R. elymaitica*)	Variable
Petals	Basally connate for up to ½ of their length	Basally connate mostly for more than ½ of their length (rarely less)	Mostly free, or when connate not biennial or perennial rosette
Petal color	Whitish, greenish, yellowish, pink or red	Whitish, greenish, yellowish or pinkish	Whitish, greenish, yellowish but never red in taxa of the Irano-Turanian region

Prometheum rechingeri is closely related to the Turkish species *P. chrysanthum* (Boiss.) 't Hart, *P. aizoon* (Fenzl) 't Hart (which just extends to adjacent Armenia), and *P. serpentinica* (Werderm.) 't Hart- all have the same overall flower shape with yellowish color, and carpels that are shortly fused at their bases. *Prometheum rechingeri* differs from its close allies by comparatively shorter sepals.

Eggli (1988a) reports an overall general similarity of some collections of *P. rechingeri* with material of *Rosularia sempervivum* ssp. *kurdica*. The absence of a well-developed caudex, the glandular leaf margins and the basally shortly fused carpels are diagnostic features of this taxon, however, *R. sempervivum* ssp. *kurdica* usually has a well-developed caudex that passes into a thickened taproot, denticulate leaf margins, and completely free and usually more slender carpels. Eggli (1988a) speculatively invoked hybridization to explain the similarity of some collections, but no evidence was found to support this.

Jansson & Rechinger (1970) also listed *Rosularia globulariifolia* for Iran with a general distribution *viz.* "Anatolia, Syria, and Persia occidentalis". Eggli (1988a) found no evidence that the species is present in Iran, beside his specimens found in Cyprus, Lebanon, Syria, and Turkey (Eggli 1988b). The specimen mentioned by Jansson & Rechinger (1970) (Koelz 17559, "Persia: W: Lur.: Tidar, 1800 m") was also not located in Iran. According to Akhiani (2000), the report is erroneous which is based on a misidentification of *R. elymaitica*.

To accommodate the newly recorded species, an updated generic description of *Prometheum* is being provided below to reflect the diversity present in Iran along with a key to distinguish the three species:

Prometheum (A. Berger) H. Ohba, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 12(4): 168 (1978)

Syn.: *Sedum* sect. *Prometheum* A. Berger in Engl. et Prantl, Nat. Pflanzenfam. ed. 2. 18a: 459 (1930); *Rosularia* sect. *Chrysanthae* Eggli, Bradleya 6 Suppl. 32 (1988)

Biennial (very rarely annual) or perennial rosette plants, usually densly glandular-pubescent. Leaves spiral, sessile, succulent, flat to semiterete, oblong to obovate-spatulate. Inflorescence terminal or lateral, cymose or corymbose. Flowers shortly pedicellate, diurnal, 5-merous; sepals broadly sessile; petals connate for less than half of their length, yellow, white, cream, pink or red, stellately spreading to suberect with somewhat spreading tips. Stamens 10. Follicles stellately patent [*P. pilosum* (M. Bieb.) H. Ohba, *P. sempervivoides* (M. Bieb.) H. Ohba], or erect or spreading, with distinct or indistinct ventral lips.

Key to *Prometheum* species in Iran

1. Rosettes monocarpic; flowers pink or red ……..…….……..……. 2
- Rosettes polycarpic; flowers greenish-yellow …….……..…… 1. *P. rechingeri*
2. Flowers pink; rosettes upto 2 cm in diameter …….. 2. *P. pilosum*
- Flowers red; rosettes 3–5 cm in diameter …….. 3. *P. sempervivoides*

1. *P. rechingeri* (C.-A. Jansson) 't Hart, in 't Hart & Eggli (eds), Evo1. Syst. *Crassulaceae* 170 (1995)

Syn.: *Rosularia rechingeri* C.-A. Jansson (1966); *Umbilicus libanoticus* f. *minor* Nábělek (1923)

Perennial herbs, up to 10 cm high when in flower stage, without caudex; main root a somewhat thickened taproot; rosette hemispherical, 1–2.5(–3) cm in diameter, usually with several offsets on thin stems to 5 mm length, forming compact small cushions. Leaves 6–16 × 2–4.5 mm, succulent, yellow-green, oblong to spatulate, apex rounded, surface laxly to densely glandular-hairy or almost glabrous, margins with some glandular hairs. Inflorescence lateral, cymose, with 1–14 flowers, 1–4 cm long, in the upper half glandular-hairy, neither viscid nor aromatic. Flowers 5-merous, (6–)8–10(–15) mm long, pedicel 1–8 mm long, funnel-shaped to almost tubular, outer parts glandular-hairy; sepals 2.5–3 mm long, greenish-yellow, densely glandular-hairy; petals 7–10 mm long, connate for c. 1/3 of their length, with recurved aristate tip, (pale) yellow, midvein purple, on the outer face and midvein glandular-hairy; stamens 10, shorter than the petals, somewhat unequal in length, basally adnate to the petals for 1/3–1/2 of their length; nectar scales oblong or square, c. 0.5 mm long; carpels c. 4 × 1 mm, slender, glandular-hairy, shortly fused at the base; style obliquely curved (Figs 1 & 2).

Specimens examined: Iran: West Azerbaijan, Khoy, Avrin mountain, 2905–3118 m, 19 July 2011, Amini Rad & Torabi, 56808 (IRAN); Zar Abad, Dibak, Mamish Khan mountain, 2800–3100 m, 9 July 2015, Amini Rad & Bahramishad, 72999 (IRAN); Khoy, Qotur, Balalan (Ghani Ziarat), 2975 m, 5 July 2010, Amini Rad & Torabi, 56809 (IRAN). Iraq: distr. Erbil; mons Helgurd ad confines Persiae, in declivibus occidentalis summi montis c. 3000–3800 m, n 36 40 e 44 50, 10–14 Aug. 1957, Rechinger 11883 (W). Turkey: Hakkari, Sat Dağ (above Yüksekova), 2900 m, 28 Aug. 1967, Duncan & Tait 90 (E).

Geographical distribution: E Turkey (C10 Hakkari), N Iraq (Kurdistan) and NW Iran (West Azerbaijan), high-alpine mountains, 2500–3800 m (Fig. 3).

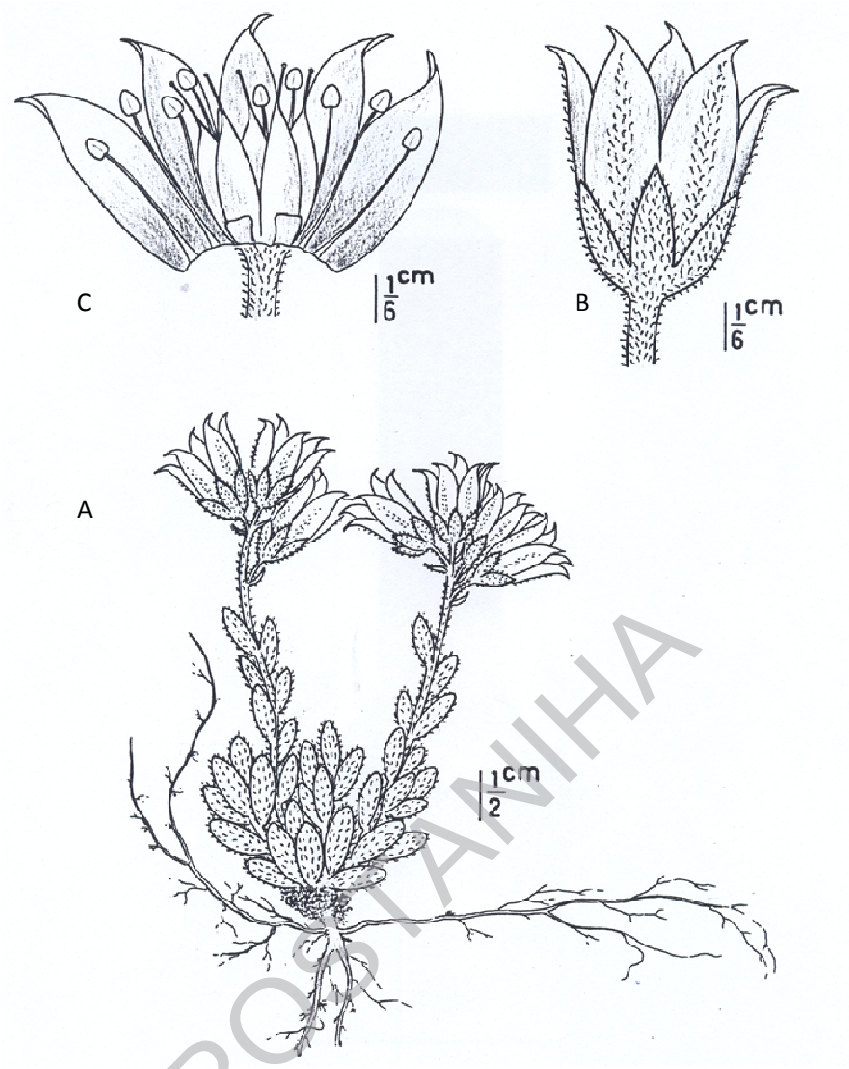

Fig. 1. *Prometheum rechingeri* (IRAN 56808): A. Plant habit, B. Flower, C. Petals, stamens and nectar scales.

Fig. 2. *Prometheum rechingeri*: Plant habit in natural habitat.

2. *P. pilosum* (M. Bieb.) H. Ohba, J. Fac. Univ. Tokyo, Sect. 3, Bot. 12(4): 169 (1978)

Syn.: *Sedum pilosum* M. Bieb. (1808); *Rosularia pilosa* (M. Bieb.) Borissova (1939); *Pseudorosularia pilosa* (M. Bieb.) Gurgenidze (1978) (incorrect name, Art. 11.4); incl. *Cotyledon pubescens* C.A. Meyer (1831) (nom. illeg., Art. 52.l); *Umbilicus pubescens* (C.A. Meyer) Ledebour (1843) (nom. illeg., Art. 52.1); incl. *Sedum regelii* hort. ex Borissova (1939) (nom. inval., Art. 34.1c)

The species with pink flowers is distinguished from other two species and is reported from Turkey (NE Anatolia), Georgia, Armenia, Caucasus, and North of Iran (Fig. 4).

Specimens examined: Iran: East Azerbaijan, Kaleybar, Paygham, Marzroud, Gharadagh (Mt.), 2700–2890 m, 9 July 2014, Amini Rad 70602 (IRAN); Kaleybar, Paygham, Barzandigh, 2100–2700 m, 6 July 2015, Amini Rad & Bahramishad 70607 (IRAN); Kaleybar, Ghaleh Babak, 2170–2300 m, 12 July 2016, Amini Rad & Bahramishad 71326 (IRAN); same locality, 1700–2100 m, Termeh, Mussavi & Habibi 60290 (IRAN); Ahar to Horand, Majid Abad, Kandeh, Halilu, Chaman Gol (Mt.), 2400–2943 m, Amini Rad & Bahramishad 71334 (IRAN); Arasbaran protected area, 2400–2700 m, 15 July 1977; Assadi & Sardabi 24302 (TARI); same locality, 2100 m, 1975, Savabi (TARI); Arasbaran protected area, Saigram-Dagh, ca. 1300 m, 14 July 1977, Assadi & Sardabi 24224 (TARI); Arasbaran protected area, Doghroon & Kalan mountain, Kalan guard station toward Savalan Naveh, 2200–2550 m, 12 July 1991, Jamzad *et al*. 70358 (TARI); Arasbaran protected area, between Kalaleh and Mahmoudabad, 2000–2500 m, 9 July 1995, Assadi 73925 (TARI); Arasbaran protected area, Forests above Kalaleh aulia, 1200 m, 5 June 1998, Hamzeh'ee & Asri 81443 (TARI); Arasbaran protected area, elavations of Shojaabad-Kaleibar, 2250 m, 17 July 1996, Hamzee'ee & Asri 81450 (TARI); Arasbaran protected area, Doghrun and Kalan mountains, 2300 m, 14 July 1977, Assadi & Sardabi 24136 (TARI). West Azerbaijan, Zar Abad, Dibak, Mamish Khan (Mt.), 2800–3100 m, 9 July 2015, Amini Rad & Bahramishad 70608 (IRAN); between Maku and Khoy, Arab-Dizechi, 2150 m, 29 June 1978, Assadi & Mozaffarian 30276 (TARI).

3. *P. sempervivoides* (Fischer ex M. Bieb.) H. Ohba, J. Fac. Univ. Tokyo, Sect. 3, Bot. 12(4): 169 (1978)

Syn.: *Sedum sempervivoides* Fischer ex M. Bieb. (1819); *Rosularia sempervivoides* (Fischer ex M. Bieb.) Borissova (1939); *Pseudorosularia sempervivoides* (Fischer ex M. Bieb.) Gurgenidze (1978) (incorrect name, Art. 11.4); incl. *Sedum sempervivum* De Candolle (1828); incl. *Sedum divaricatum* Schlechtendal ex Ledebour (1843) (nom. illeg., Art. 53.1); incl. *Sedum kurdistanicum* Fröderström (1939).

The species is distinguished with fiery-red flowers from other species belonging to this genus. It is reported from Turkey (Anatolia), Georgia, Armenia, Caucasus, and North of Iran (Fig. 5).

Specimens examined: Iran: East Azerbaijan, Marand, Payam, Kuhe Mishodagh, 1710–1970 m, 26 June 1985, Termeh, Mussavi & Tehrani 60918 (IRAN); pass between Kaleibar and Ahar, 2200 m, 10 July 1994, Assadi 73966 (TARI); Salavat Goli daragh village, Goli daragh mountain, 1500–1850 m, 24 June 1980, Mozaffarian & Nowrozi 35063 (TARI); Arasbaran protected area, 1975, Savabi (TARI); West Azerbaijan, ca. 70 km W. of Khoy, mountain above the village Razi, 2000–2250 m, 26 July 1990, Assadi & Olfat 68920 (TARI).

Acknowledgements

The authors would like to thank Mr. Mehranfard for drawing the illustration.

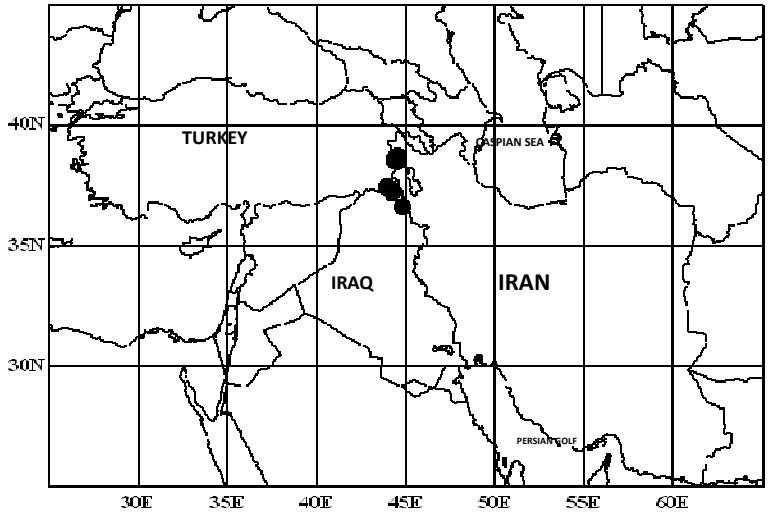

Fig. 3. Distribution map of *Prometheum rechingeri*.

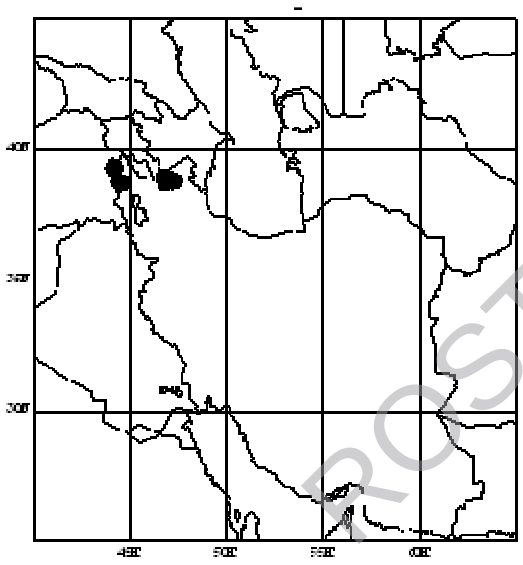

Fig. 4. Distribution map of *Prometheum pilosum* in Iran.

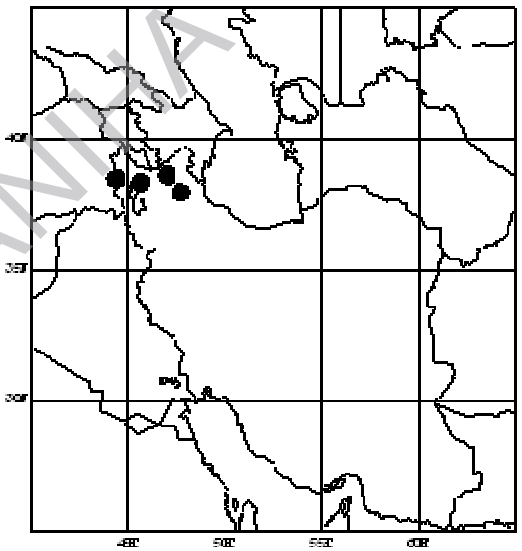

Fig. 5. Distribution map of *Prometheum sempervivoides* in Iran.

References

Akhiani, Kh. 2000. *Crassulaceae*. *In*: Assadi, M., Khatamsaz, M. & Maassoumi, A.A. (eds). Flora of Iran, No. 32. Research Institute of Forests and Rangelands. 72 pp. (In Persian).

Eggli, U. 1988a. A monographic study of the genus *Rosularia* (*Crassulaceae*). Bradleya 6 (Suppl.): 120 pp.

Eggli, U. 1988b. A monographic study of the genus *Rosularia* (*Crassulaceae*). Appendices. List of specimens examined. Collectors' index. Zürich: Institut für Systematische Botanik der Universität Zürich.

Eggli, U., 't Hart, H. & Nyffeler, R. 1995. Toward a consensus classification of the *Crassulaceae*. Pp. 173–192. *In*: 't Hart, H. & Eggli, U. (eds). Evolution and systematics of the *Crassulaceae*. Leiden (NL): Backhuys Publishers.

't Hart, H. 1995. Infrafamilial and generic classification of the *Crassulaceae*. Pp. 159–172. *In*: 't Hart, H. & Eggli, U. (eds). Evolution and systematics of

the *Crassulaceae*. Leiden (NL): Backhuys Publishers.

't Hart, H. 1999. Twee nieuwe combinaties in *Prometheum* H. Ohba. Succulenta (Netherlands) 78(5): 231–238.

't Hart, H. 2003a. *Prometheum*. Pp. 204–207. *In*: Eggli, U. (ed.), Illustrated Handbook of Succulent Plants. *Crassulaceae*, Berlin / Heidelberg: Springer-Verlag.

't Hart, H. 2003b. *Rosularia*. Pp. 227–233. *In*: Eggli, U. (ed.). Illustrated Handbook of Succulent Plants. *Crassulaceae*, Berlin / Heidelberg: Springer-Verlag.

't Hart, H. & Eggli, U. 1988. Cytotaxonomic studies in *Rosularia* (*Crassulaceae*). Botanica Helvetica 98(2): 223–234.

Jansson, C.A. & Rechinger, K.H. 1970. *Crassulaceae*. *In*: Rechinger, K.H. (ed.). Flora Iranica 72. Akademische Druck- und Verlagsanstalt. Graz.

Joharchi, M.R. & Akhani, H. 2006. Notes on the flora of Iran 6: Eight new plant records from Iran collected from Khorassan and Golestan provinces (NE Iran). Rostaniha 7 (Suppl. 2): 131–142.

Mort, M.E., Soltis, D.E., Soltis, P.S., Francisco-Ortega, J. & Santos-Guerra, A. 2001. Phylogenetic relationships and evolution of *Crassulaceae* inferred from matK sequence data. American Journal of Botany 88(1): 76–91.

Ohba, H. 1978. Generic and infrageneric classification of the Old World *Sedoideae* (*Crassulaceae*). Journal of the Faculty of Science: University of Tokyo, Section 3, Botany 12(4): 139–198.

Thiede, J. & Eggli, U. 2007. *Crassulaceae*. Pp. 83–118. *In*: Kubitzki, K. (ed.). The Families and Genera of Vascular Plants, Vol. 9. Berlin / Heidelberg (DE): Springer [NB: dated 2007, published 14 Dec. 2006].

van Ham, R.C.H.J. 1995. Phylogenetic relationships in the *Crassulaceae* inferred from chloroplast DNA variation. Pp. 16–29. *In*: 't Hart, H. & Eggli, U. (eds). Evolution and systematics of the *Crassulaceae*. Leiden (NL): Backhuys Publishers.