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Succulent endemic Crassulaceae from Argentina

including three new taxa

Abstract. The succulent endemic species of Crassulaceae in Argentina are reviewed and three new taxa are described. *Echeveria argentinensis* is a new species already collected 80 years ago in the Quebrada of Humahuaca at Jujuy between 2700 and 3600 m, determined primarily as *E. peruviana*. Hutchison recognized it as a new species 50 years ago and recorded this epithet in the herbarium sheets, but he never described it. Both species are close and belong to series Racemosae, they share having tuberous roots, but the new species has smaller rosettes and leaves than *E. peruviana*, a longer stem but smaller scapes and less flowers with erect or adpressed sepals and an opposite petal color pattern, red proximally and yellow distally. Populations from Salta are described as *E. argentinensis* var. *kieslingii.* They are smaller, lighter or glaucous in color, leaves are obovate and cuspidate when young, scapes are shorter with less but slightly larger flowers that have a constriction near the middle and are mostly yellow in color. They are distributed along the Quebrada del Toro between 2050 to 2350, in more exposed situations. Also from Salta, but further South, near the border with Tucumán, *E. saltensis* is described. It resembles *E. chiclensis* var. *cantaensis* from Perú, with narrow oblong to linear leaves, in this case with a very interesting multicolored raster on its surface, less tuberous roots, shorter sepals and longer but wider petals, more yellowish than the Peruvian species. This is perhaps the southernmost and lowest growing *Echeveria* in South America. An extended description of *Sedum jujuyense*, the only endemic *Sedum* of Argentina together with some photographs of it are also given.

Keywords: Crassulaceae, *Echeveria*, *Sedum*.

I. Genus *Echeveria*

1. *Echeveria argentinensis* Hutchison ex Pino, R. Kiesling, W. Ale & D. Marquiegui **sp. nov.** Fig. 1a

Introduction: This plant was discovered by British plant hunter Edward Kent Balls, (1892–1984) a horticulturalist who collected ornamental plants for private subscribers, specimens for museum herbaria and wild potatoes for agricultural research. In 1939 he started an expedition from Lima and Arequipa, Perú, via La Paz, Bolivia, reaching Jujuy, Argentina and there he collected this plant at Tilcara, a place where it is abundant. He then returned to Bolivia, crossed again Peru to explore Cusco and other provinces, Ecuador and finally Colombia, where he located *Echeveria ballsii* (Walther, 1958). His Argentinian plant was first determined at Kew to be *E. peruviana* Meyen. Paul Hutchison, who had already found the true *E.*

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1a. *Echeveria argentinensis* in habitat at Cerro Negro. (D.M.)

1b. Detail of the roots of *Echeveria argentinensis* from Humahuaca.

1c. Echeveria argentinensis ex situ from Tilcara. (W.A.)

peruviana near its type locality in 1964, examined herbarium specimens of this taxon and its closely related variety from Salta (see below), and coined the epithet "*E. argentinensis*" (*nomen herbariorum*), being totally sure it was a new, undescribed species. He never described it, though, and until now it has continued to be identified as *E. peruviana*. The recent publication of an update of this last species (Pino, 2019) enables us to compare both taxa and support the description of it as a new taxon.

Holotype: ARGENTINA: Prov. Jujuy, Dpto. Tilcara, Above Tilcara, growing on sunny rocks and among harsh, spiny shrubs and cacti. Steep, open hills with probably no lime in the rocks or soil. Flowers scarlet and orange, narrow mouthed bells to 0.5" long, on curved, upright stems to 10" tall. Basal rosettes rather untidy and irregular, of a dark, glossy green, many fanged, fleshy roots, 2900 m, Feb 09, 1939, *Balls E.K. 5960.* (K 000486303, determined by Hutchison as *E. argentinensis* n.n. in 1968).

Description: A succulent glabrous herb. **Roots** widely tuberous; **Main root** a taproot, (3–) 6–8 (–15) mm diam., abruptly tapering distally to 1–2 mm diam., 2.5–5 cm long. 1–4 **secondary tuberous roots**, 4–6 mm diam., 2–4 cm long, light cream to greenish white. **Fibrous roots** abundant around tuberous roots, 5–7 cm long × 0.2–0.5 mm diam., brown (Figs. 1b, c). **Stem** short, simple, erect, covered with dry leaves near rosette, 0.3–0.8 (-2.5) cm long, 0.2–1 cm diam., light cream. **Rosette** generally simple, 3.5–7.5(-10) cm diam. **Leaves** 8–14, narrow ovate to sublanceolate, wider when young (Fig. 1d), sessile, inserted erect or in 45°, 2–4 (-6) cm long, 0.5–0.8 cm wide at base, 0.8–1.2 cm wide at proximal third, 0.9–1.8 cm wide at middle, 0.6–1.2 cm wide at distal third, 3–4 mm thick, upper side slightly concave to subcanaliculate, light to dark green, margins slightly reddish at distal 2/3, lower side subcarinate, reddish at keel and near tip, apex acute to cuspidate or mucronate: mucro, when present, reddish, 1 × 1 mm; base whitish (Fig. 1e).

Flowering stem a lateral subterminal raceme, rachis 25–45 (–65) cm long, 3–4 mm diam. at base, slowly tapering to 1–2 mm diam. at apex dark red (Figs. 1f, g). **Peduncular bracts** 14–18, erect or inserted in a very acute angle, alone at proximal two thirds of stem, then one at the base of each pedicel, spaced 1.5–2 cm apart at base and 0–1 cm apart towards apex, very narrowly ovate or narrowly lanceolate, straight,

1d. Young plants of *Echeveria argentinensis* from Humahuaca.

1e. Detail of the leaves of *Echeveria argentinensis.*

1f. Start of anthesis of *Echeveria argentinensis* in habitat

1g. *Echeveria argentinensis* at Humahuaca with mature scape. (D.M.)

1h. Detail of the bracts of *Echeveria argentinensis.*

1i. From left to right: *Echeveria argentinensis* sepals (4), petals (4), gynoecium, sectioned flower showing gynoecium, bud, single flower, dry fruit. (W.A.)

1–2.5 cm long, 5–6 mm wide, 1 –1.5 mm thick, inner side flat to slightly concave, light to bright green, outer side convex or subcarinate, tips and 2/3 distal of margins and keel reddish, apex acuminate, base hyaline pink purplish (Fig. 1h). **Flowers** 9–15, appearing from January to beginning of March, at distal third of the scape, 1.2–1.5 cm long and 0.7–0.8 cm diam. **Pedicels** 0.6–1.5 cm long, curved upwards, 1–1.5 mm diam., dark red, with 1–2 small 3–4 mm long, 1–1.2 mm wide bractlets at the middle. **Calyx lobes** united at base, sepals erect at first then inserted at 45° and later at a right angle, incurved, unequal, oblong to ovate or triangular, acute, reddish at tips, dark green, inner side concave, outer side convex, 4–6 mm long, 2–3 mm wide. **Flower buds** wide ovoid, 0.6–0.7 cm long, 0.6–0.9 cm diam., salmon pink, redder at apex and keels. **Corolla** urceolate, subprismatical to narrow pyramidal, 0.7–0.8 cm thick near base, 0.4–0.5 cm thick near apex, 1.2–1.5 cm long, petals oblong, acute, 1.2–1.6 cm long, 3.5–5 mm wide, outer surface keeled, salmon red at proximal 2/3, orangish yellow at distal 1/3, apex slightly recurving and redder, inner surface orangish yellow, reddish at margins. **Stamens** 10, the 5 epipetalous 6–9 mm long, the antesepalous 9–11 mm long, filaments cream, 1–1.4 mm thick at base, gradually tapering to 0.2 mm. **Anthers** ovoid, yellow, 1.1–1.2 mm long and 0.7–0.8 mm wide. **Gynoecium** ovoid, 7–10 mm long, 4–6 mm thick. **Carpels** 5, cream yellow. **Styles** 3–4 mm long, parallel, almost touching each other, greenish yellow, greenish at the tip. Stigma reddish. **Nectaries** narrow reniform, greenish yellow 1.5–2.5 × 0.5–0.8 mm. **Fruit** a dehiscent capsule 1–1.2 cm long, 0.6–0.7 cm diam., brown.

Other localities: ARGENTINA: Prov. Jujuy, Dpto. Tilcara, Pedestrian road to Alfarcito (La Garganta del Diablo, gorge of the Huasamayo river), 2750 m, Mar 14, 1994, *M. Múlgura, N. Deginani, C. Taylor* & *P. Careno 1243.* (SI 176396) **Dept. Tumbaya**: West of San José del Chañi (El Angosto), El Moreno, 3350 m, cultivated at Huntington Botanical Gardens as HNT 54251 Aug 1987 (HNT). Route 79, road from El Moreno to Pueblo Viejo, 3610 m, S 23°55'03", W 65°49'21", Feb 12, 2007, *F.O. Zuloaga, L. Aagesen, S. Nomdedeu* & *D.Salariato 9291* (SI 77203). Same route from El Moreno to Pueblo Viejo, 3575 m, S 23°57'08", W 65°49'19", Feb 14, 2010, *F.O. Zuloaga., L. Aagesen F., Biganzoli, D. Salariato* & *C.A. Zanotti, 11785.* (SI 178406). **Dept. Valle Grande:** Without location, on very high cliffs of reddish sand, glaucous rosette, orangish flowers, Feb 26, 1940. *A. Burkart* & *N. Troncoso* (SI 11455). **Dept. Humahuaca**: La Soledad, *Venturi* 29/8860 (US). Celato Gorge, 3 km Northeast of Humahuaca, 2900 m. No collector. (UC). Cerro Negro, North of Humahuaca city, on rocks, half shaded. Sept 22, 1998. *R. Kiesling 8922* (SI 176395). Same place, after crossing bridge east of Humahuaca, road to the North and then to the East towards Coctaca, gorge at the North side of road, after about a 20 minute walk, vertical rocky walls, on hard rock, 3137 m, S 23° 10' 28.3", W 65° 19' 30.9", Dec 15, 2018, *G. Pino, M. Toffoli, W.Ale* & *D. Marquiegui 3019* (Fig. 1j).

Discussion: All authors before this publication have determined these plants to be *Echeveria peruviana,* and have even based their detailed descriptions of this species from Argentinian plants. (Walther 1972, Pilbeam 2008) Its closest species is indeed *E. peruviana* and both have tuberous roots, a feature of many Peruvian species belonging to Series Racemosae, a fact that complicates their culture ex-situ. However, the rosettes of *E. peruviana* can reach larger diameters, its leaves are more numerous, wider and longer, sometimes faceted and frequently keeled at the underside, with a more greyish or dark green color. *E. argentinensis* develops a longer but thinner stem than *E. peruviana*, perhaps due to their quest for light among the cracks of the rocks or the bromeliad cushions where they grow, while the latter grows in more exposed habitats but among mosses. Flowering scapes of *E. peruviana* are longer, thicker at the base, lighter in color, with more and slightly larger bracts, almost always adpressed to the stem. Its flowers are more numerous, more or less the same size, sepals are longer, grayish and they remain erect or adpressed to the corolla unlike *E. argentinensis*. Petals in *E. peruviana* have an opposite color pattern, lighter (pink or light cream) proximally and salmon to bright red distally **(See Table 1).** Among the different populations along the overall distribution of var. *argentinensis*, plants from Tilcara are somewhat larger than those found in Humahuaca. Flowers are slightly larger, sepals are more oblong than triangular, and petals and gynoecium are slightly longer but of exactly the same color, but they all fall within the normal variation for this species.

Distribution: To date, *E. argentinensis* var. *argentinensis* has been found only in the Northern range of the Cordillera Oriental of the Andes of Northwestern Argentina, mainly around the Quebrada of Humahuaca in Jujuy, growing on cracks of massive rocks almost always at considerably higher elevations than the other variety from Salta, between 2700 and 3600 m, always half-shaded or protected from exposure to strong sunlight.

2. *Echeveria argentinensis* Pino et al. var. ***kieslingii***, Pino, W. Ale & D. Marquiegui, **var. nov.**

Holotype: ARGENTINA: Prov. Salta, Dpto. Rosario de Lerma, Collected by José Piccardo S/N, Aug 16, 1958, Botanical Garden accession 55.795.4, prepared by P.C. Hutchison. UC 088100 (determined by Walther as *Echeveria peruviana* in 1958 and by Hutchison as *E. argentinensis nom. nud.* in 1968!). **Isotype:** José Piccardo, Aug 16, 1958, Botanical Garden accession 55.795.1, prepared by P.C. Hutchison. UC 088101 (determined by Walther as *E. peruviana in 1958* and by Hutchison as *E. argentinensis nom. nud.* in 1968!)

Introduction: Paul Hutchison had only observed living plants of this variety of *Echeveria argentinensis* from Salta that he prepared for herbarium. If he had observed complete living plants from Jujuy he may had noticed that there are slight but consistent differences between the populations of both provinces. Recently, thanks to photographs from both localities posted in internet by enthusiasts, these differences were pointed out and they clearly merit the description of another variety for this species (Fig. 2a).

Description: A succulent glabrous herb. **Roots** widely tuberous; **Main root** a taproot, 4–6 (-9) mm diam. gradually tapering, 3.5–9 cm long, very light grayish brown. 2–3 secondary tuberous roots, 2–3 mm diam., 1–3 cm long, fibrous roots scarce, around tuberous roots, 2–3 cm long × 0.5–1 mm diam., brown (Fig. 2b). **Stem** simple, erect, covered with dry leaves near rosette, 0.5–3.5 (-7) cm long, 0.7–1.4 cm diam., grayish brown (Fig. 2c). **Rosette** generally simple, 2.5–6 (–10) cm diam. (Fig. 2d). **Leaves** 10–16, wide obovate to oblong when young (Fig. 2e), narrow obovate to lanceolate in older plants, sessile, erect or inserted in 45°, 1.5–4 (– 5) cm long, 0.6–1 cm wide at base, 0.8–1.1 cm wide at proximal third, 1.1–1.6 cm wide at middle, 0.9–1.6 cm wide at distal third, 1.5–2.5 mm thick, upper side flat to slightly concave to subcanaliculate, light grayish green to glaucous, margins red at distal half, lower side subcarinate, reddish at keel and in distal third, apex obtuse to cuspidate, sometimes acute in central leaves and in old leaves, with a 1 × 0.5 mm mucro, sometimes recurved at distal third; base whitish (Fig. 2f).

Flowering stem a lateral subterminal raceme (Figs. 2g, h), rachis 25–35 cm long, 2–3 mm diam. at base, slowly tapering to 1–1.5 mm diam. at apex, dark red. **Peduncular bracts** 12–16, erect or inserted in a very acute angle, alone at proximal two thirds of stem, then one at the base of each pedicel, spaced 1–1.5 cm apart

2a. *Echeveria argentinensis* var. *kieslingii* growing in habitat at Chorrillos. (W.A)

at base and 0–1 cm apart towards apex, very narrowly ovate or narrowly lanceolate, straight, 1–1.8 cm long, 3–7 mm wide, 1–1.2 mm thick, inner side flat to slightly concave, light green-glaucous, outer side convex or subcarinate, tips and 2/3 distal of margins and keel reddish, apex acuminate and mucronate, base hyaline whitish (Fig. 2i). **Flowers** 6–12 (–20), appearing from January to late February, at distal third of the scape (Fig. 2j), 1.4–1.7 cm long and 0.8–0.9 cm diam. **Pedicels** 0.8–1.8 cm long, at 45° or curved upwards, 1–1.5 mm diam., pink, with 1 (–2) small 2–7 mm long, 1–1.5 mm wide bractlets at the middle. **Calyx lobes** united at base, sepals at first in 45º and later consistently in right angles, straight, unequal, oblong to ovate or rarely triangular, acute, reddish at tips, light green, both sides convex, 5–7 mm long, 3–3.5 mm wide. **Flower buds** wide ovoid, 0.7–0.8 cm long, 0.8–0.9 cm diam., yellow, sometimes orangish at base. **Corolla** urceolate, subprismatical, swollen at the level of gynoecium and slightly constricted above, pyramidal in mature and pollinated flowers, 0.8–0.9 cm thick near base, 0.1–0.4 mm thick near apex, 1.4–1.7 cm long, petals oblong, acute, 1.4–1.7 cm long, 3–4 mm wide, outer surface keeled,

2b. *Echeveria argentinensis* var. *kieslingii* ex-situ. (W.A.)

2c. Young plants of *Echeveria argentinensis* var. *kieslingii*. showing stems and roots.

2d. Rosette of *Echeveria argentinensis* var. *kieslingii* showing dry leaves attached at the end of stem.

2e. Detail of young *Echeveria argentinensis* var. *kieslingii* leaves before flowering.

2f. Detail of mature *Echeveria argentinensis* var. *kieslingii* leaves at the end of the growing season. (W.A.)

2g. Young *Echeveria argentinensis* var. *kieslingii* with scape at the beginning of anthesis.

2h. *Echeveria argentinensis* var. *kieslingii* scape showing flowers with pink blush and pyramidal dry flowers. (W.A)

orangish yellow to cream yellow at proximal 1/3, yellow at distal 2/3 or above constriction, apex recurving and reddish at the very tip, inner surface yellow. **Stamens** 10, the 5 epipetalous 6–9 mm long, the antesepalous 9–11 mm long, filaments cream, 0.8–1 mm thick at base, gradually tapering to 0.2 mm. **Anthers** ovoid, yellow, 1.1–1.2 mm long and 0.7–0.8 mm wide. **Gynoecium** ovoid, 7–10 mm long, 5–7 mm thick. Carpels 5, cream yellow. **Styles** 3–4 mm long, parallel, almost touching each other, greenish yellow, greenish at the tip. **Stigma** green. **Nectaries** narrow reniform, greenish yellow to transparent 1.5–2.5 × 0.5–0.8 mm. **Fruit** a dehiscent capsule 1–1.2 cm long, 0.6–0.7 (–1.3) cm diam., brown (Fig. 2k).

Other localities: ARGENTINA: Prov. Salta, Dpto. Rosario de Lerma, Route 51, road from Salta city to San Antonio de los Cobres, Puente de integración Argentino-Chilena, rocky walls, orange flowers with yellowish tips, 2190 m, S 24° 44', W 65° 44', Feb 02, 2002, *A.M. Cialdella, N.B.Deginani* & *L.M. Giussani 329*. (SI 175407). Same route, 110 Km SE of San Antonio de los Cobres, 48 km below Santa Rosa de Tastil, 10 Km below El Gólgota, Quebrada del Toro, at the Puente de integración Argentina-Chilena,

2i. Detail of *Echeveria argentinensis* var. *kieslingii* bracts.

2j. Detail of *Echeveria argentinensis* var. *kieslingii* scape with flowers in habitat. (W.A.)

steep schistose-rocky mountain-side on the orographic left-hand side, with dense cushions of Abromeitella (*Deuterocohnia brevifolia*), several epilithic *Tillandsia* sp. and numerous lichens. Locally common in rock fissures or at the margins of Abromeitella cushions. 2320 m, S 24° 44' 54.6", W 65° 44' 57.6", Dec 2, 1998, *B.E. Leuenberger, U. Eggli* & *E. Arroyo-Leuenberger 4618*. (B, JUA, ZSS). El Alisal, stemless plants, flowers lemon yellow, tinged pink near base, leaves glaucous green, red margined, Jul 1976, cultivated at Huntington Botanical Gardens as HNT 22833, received in 1968

2k. From left to right: sepals (5), petals (3), gynoecium, sectioned flower showing gynoecium, bud with blush and constriction, single flower, dry fruit of *Echeveria argentinensis* var. *kieslingii*. (W.A.)

from Marnier-Lapostolle, prepared by M. Kimnach. *S. Fechser s.n.* (HNT). El Alisal, yellow flowers, glaucous leaves, 1982, cultivated at Huntington Botanical Gardens as HNT 30089, received from Charles Uhl as I743FI, II/72. *S. Fechser s.n.* (HNT). Quebrada del Toro, Sep 13, 1985, cultivated at Huntington Botanical Gardens as HNT 54250, *Victor Turecek s.n.* (HNT). Tastil, Apr 18, 1986, cultivated at Huntington Botanical Gardens as HNT 56293, *S. Linden 86-14.* (HNT). Chorrillos train station, pedestrian walk to the North until railroad, then eastwards along railroad after passing small waterfall before double bridge, 2137 m, S 24° 45' 50.4", W 65° 44' 28.1", Dec 14, 2018, *G. Pino, W. Ale* & *D. Marquiegui 3016*.

Discussion: *Echeveria argentinensis* var. *kieslingii* differs from var. *argentinensis* mainly in size of the plants and rosettes (it is slightly smaller), it has more leaves that are somewhat lighter or more glaucous, young leaves are clearly oblong to wide obovate with obtuse to cuspidate apices instead of ovate with acute apices (Although adult leaves seem to be lanceolate and acute in both varieties), the scape is slightly shorter and narrower at the base, it has less bracts and flowers, that are somewhat larger in compensation, the base of the flower is swollen and rounded, there is a constriction at the middle of floral tube forming a waist, the apex is narrower with more recurved tips, sometimes giving a wide pyramidal shape to the mature flower; sepals are slightly larger, straighter and biconvex compared to the incurved, flatter sepals of var. *argentinensis* with concave adaxial side. Petal color is yellow with a slight blush in the middle or rarely pale orange at proximal third (Most of the plants have pure yellow flowers) and the gynoecium is somewhat more swollen, bulging in the flower base (Fig. 2l). In the Southern hemisphere, they bloom earlier and start fruiting by the end of February, while var. *argentinensis* can still be found in blossom at this time. They are

2l. Plant ex- situ of *Echeveria argentinensis* var. *kieslingii* with redder flowers at the base, typical constriction and pyramidal mature flowers. (W.A.)

found mostly at lower altitudes than the type variety, more exposed to the sun facing south and they are slightly easier in cultivation. **(See Table 1).**

Etymology and distribution: This variety epithet is dedicated to the life-long cactus and succulent researcher of Argentina, Roberto Kiesling, who has collected both varieties extensively. The Cordillera Oriental (Eastern Mountain Range) of the Andes of Northwestern Argentina is a mountain chain running from North to South, from the Northern border with Bolivia along the provinces of Jujuy and Salta reaching the North of the provinces of Tucumán and Catamarca, where it becomes considerably lower and is called "Sierras Pampeanas". It has the Puna at the west and the Sierras Subandinas to the East. This variety has been found only in the Midwest of this mountain range, at the so-called "Quebrada del Toro" somewhat Southwest of the city of Salta, along the Valley of Lerma, in a narrow strip between 2050 to 2350 m. Plants with pure yellow flowers show very distinctive features and those with orange hues blossom later and share some characters with variety *argentinensis* suggesting a possible hybridization.

3. *Echeveria saltensis* Pino, W.Ale & D. Marquiegui, **sp. nov.**

Holotype: ARGENTINA: Prov. Salta, Dpto. Guachipas, Alemanía, on slate outcrops associated to banks of *Deuterocohnia* sp. (*Blossfeldia liliputana* growing near), 1264 m, S 25° 39' 58.0", W 65° 36' 29.3" March 1, 2019, *W.Ale & D. Marquiegui 01/2019.* (MCNS 13545). **Material used for description:** Same place, on shaded rocky banks of the small river that drains northward into Río Las Conchas, about 4 Km South from the hamlet, Dec 13, 2018, *G. Pino, W. Ale & D. Marquiegui 3015.*

Introduction: This new species is a surprise brought up through social networks. It was published as *Echeveria peruviana* Meyen in https://m.facebook.com/sebasantecchia/posts/pcb.10155933712572508/?photo_id=183243047682 7264&mds=%2Fphotos%2Fviewer%2F%3Fphotoset_token%3Dpcb.10155933712572508%26photo%3D1 832430476827264%26profileid%3D683858429%26 source%3D48%26refid%3D18%26__tn__%3DEH-R%26cached_data%3Dfalse%26ftid%3D&mdp=1& mdf=1, however, it does not match neither this species nor *E. argentinensis*. It has been carefully documented by our coauthors Ale & Marquiegui and according to its features, it is a new, distinct taxon (Fig. 3a).

3a. Detail of *Echeveria saltensis* scape with flowers in habitat. (W.A.)

Description: A succulent glabrous herb. **Roots** narrowly tuberous; Main root a taproot, 6–8 mm diam., gradually tapering distally to 2 mm diam., 5–15 cm long. 2–4 **secondary tuberous roots**, 4–6 mm diam. tapering to 2 mm diam, 4–6 cm long, grayish brown. **Fibrous roots** scarce, around tuberous roots, 4–6 cm long × 0.2–0.5 mm diam., whitish (Fig. 3b). **Stem** short, simple, very rarely branched in old plants (Fig. 3c), erect when young, then curved or decumbent, 2.5–7 cm long, (0.5–) 1–1.8 (–3) cm diam., greenish gray to light olive green near rosette, with circular leaf scars and sometimes dry leaves near rosette. **Rosette** generally simple at the end of stem, 8–18 cm diam. **Leaves** 10–22, very narrow obovate to very narrow oblong, wider obovate when young, sessile, horizontal or at 45°, 3.5–9 cm long, 0.7–1.3 cm wide at base, 0.6–2.1 cm wide at proximal third, 0.7–2.2 cm wide at middle, 0.6–2.2 cm wide at distal third, 2–5 mm thick, upper side flat to concave or canaliculate, shiny in some plants, (Fig. 3d) more frequently dull reddish green to brown, surface pattern formed by minute green, red, black and white longitudinal rows of discontinuous dots (Fig. 3e), margins light green or light red, lower side subcarinate, same pattern but lighter or redder in color, apex acute or mucronate, when present, mucro light green, 0.5 × 1 mm, base light olive green (Fig. 3f).

Flowering stem a lateral subterminal raceme, rachis 25–45 (–60) cm long, 8–10 mm diam. at base, slowly tapering to 3–4 mm diam. at apex, light green at base, then pinkish towards apex (Fig. 3g). **Peduncular bracts** 14–22, inserted at 45°, alone at proximal half of stem, then one at the base of each pedicel, spaced 1–1.5 cm apart at base and 0.5–1 cm apart towards apex, oblong to very narrowly ovate, slightly recurved, 2–4 cm long, 5–10 mm wide, 1.5–2 mm thick, inner side flat to slightly concave or canaliculated, same color and pattern as leaves, outer side convex to subcarinate, same color, acute, apices obtuse to acute, light green, base green (Fig. 3h). **Flowers** 10–23, appearing from January to February, at distal third of the scape, 1.3–1.5 cm long and 0.8–0.9 cm diam. (Fig. 3i). **Pedicels** 0.5–1.2 cm long, horizontal or slightly curved upwards, 1.2–1.4 mm diam., pink to dark red, with 1 small 3–4 mm long, 1.2–1.4 mm wide bractlet at the middle. **Calyx lobes** united at base, sepals horizontal, tips slightly incurved, unequal, oblong to ovate or triangular, acute, light green, inner

3b. Young plant of *Echeveria saltensis* showing root system.

3c. Old plant of *Echeveria saltensis* with multiple branches. (W.A.)

3d. Young rosette of *Echeveria saltensis* with shiny leaves.

3e. Detail of the multicolored surface of *Echeveria saltensis* leaves.

side flat to concave, outer side convex, 5–6 mm long, 2–3 mm wide (Fig. 3j). **Flower buds** wide ovoid, 1–1.2 cm long, 0.8–0.9 cm diam., salmon pink, yellowish at apex. **Corolla** urceolate to subprismatical, 0.8–0.9 cm thick near base, 0.4–0.5 mm thick near apex, 1.3–1.5 cm long, petals oblong, acute, 1.3–1.5 cm long, 4–5 mm wide, outer surface keeled, salmon red at proximal third or 2/3, yellowish at distal 2/3 or third, apex slightly recurving and red at the very tip, inner surface yellow. **Stamens** 10, the 5 epipetalous 6–7 mm long, the antesepalous 9–10 mm long, filaments cream, 0.8–1 mm thick at base, gradually tapering to 0.2 mm. **Anthers** ovoid, yellow, 1–1.2 mm long and 0.6–0.7 mm wide. **Gynoecium** ovoid, 8–9 mm long, 5–6 mm thick. **Carpels** 5, cream yellow. **Styles** 3–4 mm long, parallel, almost touching each other, greenish yellow,

3f. Detail of *Echeveria saltensis* leaf size and shape.

3g. *Echeveria saltensis* in situ with a developing scape.

3h. Detail of *Echeveria saltensis* bracts.

3i. *Echeveria saltensis* ex situ showing scapes and flowers. (W.A.)

greenish at the tip. **Stigma** whitish. **Nectaries** reniform, greenish white, 2–2.2 × 0.9–1.1 mm. **Fruit** a dehiscent capsule 0.9–1.1 cm long, 0.7–0.8 cm diam., brown (Fig. 3k).

Discussion: This new species is phenologically very similar to *Echeveria chiclensis* from Perú, with which it could easily be mistaken (Fig. 3l), especially with its recently described variety *cantaensis* (Pino, 2002, 2018). Rosettes and leaves are approximately the same size and shape, narrow linear oblong, especially in mature plants, however, *E. saltensis* surface pattern of coloration is a raster of closely spaced minute stripes of multicolored dots making some plants range from olive green to reddish and even purplish. This color variation and pattern is not seen in *E. chiclensis*. While *E. saltensis* develops aerial stems that bend searching support on the rocks or trunks where they grow, and even branch freely in very old plants, in *E. chiclensis* these stems are erect, very short or when present, hidden or buried among moss. The roots of this species are definitely tuberous, but they are the

3j. *Echeveria saltensis* flowers in habitat. (W.A.)

narrowest and longest of all Argentinian species, and definitely not as thick as the tuberous roots of *E. chiclensis*, corresponding to the lusher habitats where they grow**.** Scapes are similar in size and number of bracts, but flowers are more abundant and slightly larger in *E. saltensis*, with longer pedicels, similar sepals in right angle but slightly shorter, longer and wider petals with a more consistent yellowish distal 2/3 on the outer surface and slightly thicker carpels **(See Table 1).**

Distribution: To date, there is only one locality known for this unusual *Echeveria*, far south in the Province of Salta, quite close to its border with the province of Tucumán. This location belongs also to the Cordillera Oriental of Argentina, but it lies deep into its lowest valleys, specifically the Santa María-Guachipas River system, with a subtropical climate. This is perhaps the southernmost (almost 26° south) and lowest (1200 m) growing *Echeveria* in South America.

II. Genus ***Sedum***

4. *Sedum jujuyense* Zardini, 1971. *Bol. Soc. Argent. Bot.* 14 (1–2): 95–106.

Holotype: ARGENTINA: Prov. Jujuy, Dept. Manuel Belgrano. Yala gorge, Dec 6, 1969, *A.L. Cabrera* & *R. Kiesling 20222*. (LP, holotype, K, isotype).

Introduction: In 1969 our coauthor Roberto Kiesling discovered this species near Jujuy. Even though

3k. Details of *Echeveria saltensis* flowers, from left to right: sepals (5), petals (3), gynoecium, sectioned flower showing gynoecium, bud, single flower, dry fruit. (W.A.)

3l. Cluster of plants of *Echeveria saltensis* in habitat, resembling *E. chiclensis* var. *cantaensis* from Peru. (D.M.)

he was to become the Argentinian expert in cacti and other succulents, his mentor, the renowned botanist Ángel Lulio Cabrera assigned Elsa Matilde Zardini to describe this species, as she was then in charge of Rosaceae for Argentina. After that, very few localities have been found for this plant and no pictures have been published so we decided to include it in this treatment. A detailed description is presented (Fig. 4a).

Description: A succulent glabrous herb growing on rocks, forming loose mats up to 10–15 cm diam., basally branching, 2–10 cm tall in the vegetative state (Fig. 4b), 8–18 (–22) cm tall in the reproductive state. **Basal stem** decumbent, 1–5 cm long, 1.5–1.8 mm diam., gray brownish, with fibrous roots 0.5–2

Table I Comparison of the main features of the species of *Echeveria* from Argentina and the Peruvian species *E. peruviana* and *E. chiclensis* var. *cantaensis*

	Echeveria argentinensis var. *argentinensis*	*Echeveria argentinensis* var. *kieslingii*	*Echeveria peruviana*	*Echeveria saltensis*	*Echeveria chiclensis* var. *cantaensis*
Roots, number	Wide tuberous 2–5.	Wide tuberous, 1–4	Wide tuberous, 3–5	Narrowly tuberous, 3–5	Wide tuberous, 2–6
Color	Light cream to greenish white.	Very light grayish brown.	Cream yellowish.	Grayish brown.	Light gray-whitish
Stem	Erect. 0.3–0.8 (-2.5) cm long, 0.2–1 cm diam., light cream	Erect. 0.5–3.5 (-7) cm long, 0.7–1.4 cm diam. cm diam., grayish brown.	Very short, hidden among mosses, 1–3 cm diam., cream yellowish.	Aerial, erect or decumbent, sometimes branched. 2.5–7 cm long, (0.5-) 1–1.8 (-3) cm diam.	Subterranean, 2–8 cm long, 1–2 cm diam, only in old plants.
Rosette diameter	3.5–7.5 cm	2.5–6 cm	5–18 cm	8–18 cm	12–20 cm
Leaf number	8–14.	10–16.	12–20.	10–22.	10–14.
Leaf shape	Narrow ovate when young, narrow ovate to sublanceolate in older plants.	Wide obovate to oblong when young, narrow obovate to lanceolate in older plants	Wide obovate when young, narrowly obovate in older plants.	Obovate when young, very narrow obovate to narrow oblong in older plants.	Narrow ovate to lanceolate when young, linear oblong to very narrow obovate in older plants.
Leaf length	2–4 (–6) cm.	1.5–4 (–5) cm.	2–6 (–8) cm.	3.5–9 cm.	6–13 cm.
Leaf width	0.5–1.6 cm.	0.6–1.6 cm.	0.7–2.5 cm.	0.7 –2.2 cm.	0.6–2 cm.
Leaf color	Light to dark green, margins slightly reddish at distal 2/3.	Light green to glaucous, margins red at distal half.	Grayish olive green to gray glaucous with a purplish hue.	Dull reddish green to brown, surface raster of multicolored rows of dots.	Light glossy green, reddish in very exposed plants
Scape	25–45 (–65) cm long, 3–4 mm diam. at base.	25–35 cm long, 2–3 mm diam. at base.	25–38 (–78) cm long, 5–8 mm diam. at base.	25 – 45 cm, 8–10 mm diam. at base.	25–60 cm, 7–10 mm diam. at base.
Bracts	14–18, erect or inserted in a very acute angle	12–16, erect or inserted in a very acute angle	10–20, erect.	14–22, inserted in 45º.	18–22, ascending or at 45º,
Flower number and period	9–15, appearing from January to March.	6–12, appearing from January to late February.	9–21 (-30), appearing from February to May.	10–23, appearing from January to February.	6–12, appearing from October to May.
Flower length and diam.	1.2–1.5 cm long, 0.7–0.8 cm diam.	1.4–1.7 cm long, 0.8–0.9 cm diam., swollen at the level of gynoecium and slightly constricted above.	1.4–1.6 cm long, 0.8–0.9 cm diam.	1.3–1.5 cm long, 0.8–0.9 cm diam.	1.2–1.3 cm long, 0.8–1.2 cm diam.
Pedicels	0.6–1.5 cm long.	0.8–1.8 cm long.	0.4–1.5 cm long.	0.5–1.2 cm long.	0.15–0.5 cm long.
Sepals	Erect at first then in 45°, later in right angle, 4–6 mm long, 2–3 mm wide.	At first in 45° and later in right angle, 5–7 mm long, 3–3.5 mm wide	Erect, adpressed to the calyx, 6–9 mm long, 2–2.5 mm wide.	In obtuse to right angle, 5–6 mm long, 2–3 mm wide.	In obtuse to right angle, 5–10 mm long, 2.5–4 mm wide.
Petal size	1.2–1.6 cm long, 3.5–5 mm wide.	1.4–1.7 cm long, 3–4 mm wide.	1.3–1.7 cm long, 3–4 mm wide.	1.3–1.5 cm long, 4–5 mm wide.	1.2–1.4 cm long, 2–4 mm wide.
Petal outer surface	Salmon red at proximal 2/3, orangish yellow at distal 1/3, apex redder.	Orangish yellow to cream yellow at proximal 1/3, yellow at distal 2/3 or above constriction, apex reddish at the very tip.	Cream yellow at proximal half with reddish stripes, salmon red at distal half and keel, apex darker red.	Salmon red at proximal third or 2/3, yellowish at distal 2/3 or third, apex red at the very tip.	Evenly reddish, orange to yellowish, apex sometimes yellowish.
Petal inner surface	Orangish yellow, reddish at margins.	Yellow.	Cream or yellow at proximal half, red at distal half.	Yellow.	Yellow.
Gynoecium	7–10 mm long, 4–6 mm thick.	7–10 mm long, 5–7 mm thick	7–10 mm long, 4–6 mm thick	8–9 mm long, 5–6 mm thick	8–9 mm long, 4–5 mm thick

4a. *Sedum jujuyense* in habitat at Volcán.

4b. *Sedum jujuyense* ex-situ in the vegetative state.

cm long, 0.2–0.3 mm diam., cream to light grayish brown. **Primary branches** 4–8, born every 0.3–1.5 cm, decumbent or curved upwards, rooting along the sides, 1.4–1.7 mm diam. at base, 5–10 cm long, shiny brown (Fig. 4c), **Secondary branches** many, vegetative shoots erect, 1–6 cm long, stem 0.8–1 mm diam., **flowering shoots** 5–18 cm long, erect or decumbent, stem 1.4–1.7 mm diam. at base, gradually tapering to 0.6–0.8, reddish green at base, light green towards apex (Fig. 4d). **Leaves** succulent, spirally attached, densely imbricate on young shoots, spaced 15–2 mm towards tip, sessile, oblong, 5–10 mm long, 1.5–2.2 mm wide, 0.8–1.2 mm thick, apex obtuse to rounded, upper side flat to slightly convex in the dry season, both sides convex in the rainy season, dull green with minute black and white spots, margins entire and rounded, section elliptic, base hyaline reddish (Fig. 4e).

Inflorescence terminal, with 1–2 distal short cincinnoid branches 1–4 cm long, rachis 0.6–0.8 mm diam., light green, each branch bearing 1–3 (–6) flowers. **Flowers** 2–6 (–11) per inflorescence, appearing from December to January, sessile. **Flower buds** 4–5 mm × 2.5–3.5 mm, pure white, bracteoles similar to leaves, 3–5 mm long, 0.6–1 mm wide. Sepals unequal, oblong, slightly incurving, inner side flat to concave, outer side convex, 3–5 mm long, 0.8–1.2 mm wide, color similar to leaves. **Petals** oblong, acute-deltoid at tip, adnate at the base, folded outwards at the distal fourth, 4–6 mm long, 2–2.5 mm wide, induplicate, outer surface white, with a greenish white keel, inner surface pure white, margins entire (Fig. 4f). **Stamens** 10, the 5 epipetalous 2.5–3.5 mm long, the antesepalous 4–5.5 mm long, filaments pure white, 0.2–0.3 mm wide. **Anthers** globular, yellow, 0.6–0.8 mm diam. **Gynoecium** wide ovoid, 1.8–2.2 long × 1.5–1.8 mm diam., **Carpels** 5, light green. **Styles** 1 mm long, light green. **Nectary** scales lemon yellow, trapezoid, 0.8–0.9 mm long, 0.5–0.6 mm wide (Fig. 4g). **Fruit** pentalocular, dehiscent, reddish brown, 5 × 5.5 mm.

4c. Young *Sedum jujuyense* showing vegetative shoot.

4d. Flowering shoot of *Sedum jujuyense*.

4e. Detail of the leaves of *Sedum jujuyense*.

4f. From left to right: *Sedum jujuyense* sepals (4), flower with bractlet, sectioned flower showing gynoecium, petals (2), dry fruit.

Other localities: ARGENTINA: Prov. Jujuy, Dept. Manuel Belgrano: Lozano to Tiraxi, small side valley off route to Tiraxi. Scrub forest with open areas. Dry cliff face. 1450 m. Nov 11, 1978, *S.A. Renvoice, M. Wilmot-Dear* & *R. Kiesling 3432*. (K, SI). Yala, side valley from main Humahuaca valley. Damp, shaded cliff face. 1400 m. Nov 13, 1978, *S.A. Renvoice, M. Wilmot-Dear* & *R. Kiesling 3456*. (K, SI) Yala Gorge, Nov 11, 1978, *A.L. Cabrera, S. Botta. C. Ezcurra. A.M. Ragonese* & *M. Vásquez 29765* (SI). Jaire Gorge, epiphytic, Nov 16, 1978, *A.L. Cabrera, S. Botta. C. Ezcurra. A.M. Ragonese* & *M. Vásquez 29939* (SI). Same locality, epiphytic, Apr 18, 1989, *R. Kiesling 7025* (SI 39320) **Dept. Tumbaya:** Volcán, Volcán Lagoon on the way to Lozano, 2340 m, S 23°56', W 65°28', Feb 2, 1998, *O. Morrone, N. Deginani, A. Cialdella* & *L. Giussani 2394*, (SI 064827) Volcán, on rocky slopes facing south to the dry lagoon, 2074 m, S 23° 55' 20.6", W 65° 28' 16.6", Dec 15, 2018, *G. Pino, M. Toffoli, W.Ale* & *D. Marquiegui 3018*. **Prov. Salta, Dpto. Rosario de Lerma**, Quebrada del Toro, *R. Kiesling s/n* (Observed).

Discussion: This is the only *Sedum* endemic to Argentina. European *Sedum acre* L. and *Sedum thartii* L.P. Hébert (Arana et al. 2014) have been introduced and naturalized in the southern provinces and in Córdoba respectively. *Sedum jujuyense* is a true South American *Sedum* very close in appearance to the Peruvian *Sedum berillonanum* Raymond-Hamet from Ayacucho and Cusco (Pino, 2017) and to *Sedum incarum* (Ball) Pino (Pino, 2006) from Lima. The main differences with them is the shape of the leaves, which is flat linear or narrow oblong with a very rounded apex, instead of ovoid with a subacute tip, of more or less the same size in *S. incarum*, and smaller in *S. berillonanum*.

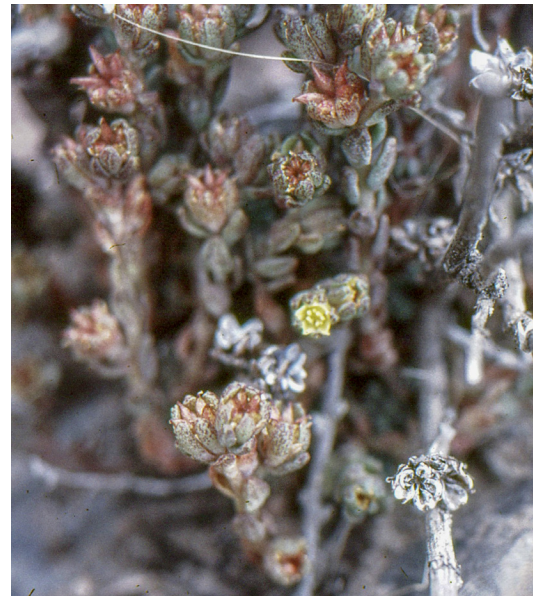
Distribution: To date, this *Sedum* has been reported to be endemic to the province of Jujuy in two of its departments, all around Yala, in altitudes of 1000 to 2400 m. R. Kiesling has also observed it in province Salta at the Quebrada del Toro, growing near *E. argentinensis* var. *kieslingii*, although no collection was made.

5. *Sedum cymatopetalum* Fröderström. 1936. *Acta Horti Gothoburgensis* 1935, 10(4) app. 83 p. 619–628, pl. 41.

Holotype: Bolivia. Dept. Potosí, Prov. Linces, between Cuchu Ingenio and Lajatambo, 3570–4000 m, 1934 *C. Hammarlund 439* (S).

Localities in ARGENTINA: Prov. Catamarca, Dept. Andalgalá. Cuesta de las Chilcas, on route to Aconquija, 1515 m, S 27° 38' 14", W 66° 10' 20", Mar 31, 2012, *J. Urdampilleta, F. Chiarini* & *N. Moreno 701*. (CORD 51981) **Prov. Jujuy, Dept. Tumbaya**: El Angosto de San José del Chañi, 3350 m, *A. Cabrera, J. Frangi, A. Frangi, R. Kiesling* & *E. Zardini 22467*, Nov. 26 1972 (K). **Prov. La Rioja, Dept. Famatina.** Sierra de Famatina, Medina cave, among rocks, 3100 m, Apr. 1, 1969, *A. Krapovickas* 5204. (CORD). Los Cajoncitos, 2974 m, S 28° 57' 19", W 67° 40' 53", Feb 2, 2011, *G. Barboza, J. Cantero, F. Chiarini, C. Núñez* & *E. Filippa 2742*. (CORD 30340). **Prov. San Juan, Dept. Angaco,** Sierra de Pie de Palo, 2200–3000 m, Feb 15, 1984, *R. Kiesling 4436*, (SI) (Fig. 5a), **Dept. Zonda,** Estancia Maradona, Sierra del Tontal, behind Puesto Pinto, 2400-2500 m, Feb 9, 1986, *R. Kiesling, N. Bacigalupo* & *E. Gómez 6090* (SI) **Dept. Sarmiento**, Gorge of las Flechas. (Observed). **Dept. Caucete**, Mogote Corralitos, 3162 m, Feb 9, 1991, *E. Haene 1079* (SI). **Prov. San Luis, Dept. Capital.** Quebrada de los Cóndores, facing SE, 45° slope, rock crevices, 980 m, Jan 14, 1971, *D. Anderson 1950* (CORD 444464). According to Hunziker (1966) and Zardini (1971) it is present also in provinces **Córdoba, Mendoza, Salta** and **Tucumán** in altitudes of 1000–4200 m. Kiesling (1994) is responsible of its many collections in San Juan. Information about this taxon and detailed photos can be viewed at the Darwinion

4g. Detail of gynoecium and androecium of *Sedum jujuyense*.



5a. *Sedum cymatopetalum* in bloom at Pie de Palo (R.K.)

Institute web page at: http://www2.darwin.edu.ar/Proyectos/FloraArgentina/DetalleEspecie.asp?forma=&variedad=&subespecie=&especie=cymatopetalum&genero=Sedum&espcod=25024.

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Note: In Pino et al. 2019, *Cact. Succ. J. (Los Angeles)* 91 (2), p. 117, protologue of *Sedum ignescens* Pino & Montesinos, at the end of the paragraph we wrote: "(HUSA 11900, HSP)". We meant to say: "(HUSA 11900, Holotype; HSP, Isotype), meaning that D. Montesinos 1064 had two specimens, the holotype is deposited at the Herbarium Areqvipense of University San Agustín, and the other, at Herbario del Sur del Perú, is the isotype.

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