

The Crassulaceae of Cusco Peru

part I: subfamily Echeverioideae

Abstract. Six taxa of *Echeveria* (Crassulaceae) were found around the Sacred Valley in the Department of Cusco, Perú. (1) *Echeveria cuscoensis*, is a new, widespread species from the upper basin of the Sacred Valley (Vilcanota River) and is described from the ruins of P'isaq due to its abundance there. It has faceted rhomboid leaves, concave or canaliculate above, with obscurely incurved margins. (2) *Echeveria decumbens* is a small species with narrow green yellowish leaves and trailing horizontal inflorescences, it was described from plants cultivated in the Huntington Botanic Gardens collected by Baker in the 80's between Calca and Amparaes, but has never been found in habitat again. (3) *Echeveria decumbens* var. *urubambensis* is a new variety of this species with dark green leaves and fewer but larger flowers, growing westward from the locality of the type variety. (4) *Echeveria laresensis* is a new species close to *E. decumbens* but larger and with light glaucous leaves. In the lower basin of the Sacred Valley (Urubamba River) we found two species of *Echeveria*: (5) *Echeveria ochoae*, the largest of all new species, growing only at Pisqak'uchu, at the beginning of the Inca Trail towards Machu Picchu, with conspicuous stems and large obovate or spatulate glaucous leaves, and (6) *Echeveria westii* from Ollantaytambo, a small, few-flowered, purplish leaved species, discovered by Hutchison and described by Walther in the 50's, locally hard to find in this place. Some other new localities are mentioned.

Keywords: Crassulaceae, *Echeveria*.

1. *Echeveria cuscoensis* Pino, Galiano & Núñez sp. nova

Holotype: PERU: Dept. Cusco, Prov. Calca, Dist. Pisac, Ruins of P'isaq, on cliffs of mountain facing the ruins crossing Kitamayo stream, 3460 m, S13°24'30", W71°50'45", Nov 15, 2014, G. Pino, W.H. Galiano, P. Núñez V. 2716 (USM 295252) (Fig. 1a).

A succulent glabrous, solitary or proliferous herb eventually forming loose light clusters. **Roots** 4–10 or more, fascicular and fibrous, 3–5 cm long, 1.5–2.5 mm diam., light gray. **Stem** procumbent, usually unobserved, subterranean or hidden among mosses, rarely aerial in exposed sites, 0.4–2.5 cm diam., light green to brownish, branching only from the base, decumbent up to 60 (–90) cm long in very old plants (Fig. 1b). **Rosettes** usually one at the end of stem, up to 6 in very old plants, (4–) 6–8 (–15) cm diam. (Fig. 1c). **Leaves** 18–32, sessile, rhomboid obovate to sub-spatulate, slightly incurved at tip, 2–5 cm long,



1a. *Echeveria cuscoensis* growing at Kitamayo gorge in P'isaq. (B.K.)

0.6–0.9 cm wide at base, 0.9–1.5 cm wide 1 cm from apex, 1.1–1.7 (–2.5) cm wide at middle, 6–9 mm thick, (Fig. 1d) upper side concave to canaliculate, faceted 1–2 mm near margins, light olive green in the shade,

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1b. *Echeveria cuscoensis* ex situ from P'isaq showing flower buds. (G.P.)

purplish green when exposed, more reddish or purplish in outer leaves or in dry exposed plants, **central nerve** frequently prominent, with lighter stripes corresponding to central nerve and facet angles, **margins** lighter in color, obscurely curved inwards, lower side keeled or convex, light green to reddish where exposed, redder at keel, apex acute to obtuse, rarely cuspidate, with an acute slightly recurved hyaline mucro 1 mm long at apex, base hyaline (Fig. 1e).

Flowering stem an oblique or horizontal raceme, rarely 2, **rachis** 8–20 (–28) cm long, 3–4 mm diam. at base, 2–3 mm diam. at apex, light green to pink at proximal third, bright red at distal half or third (Fig. 1f). **Peduncular bracts** 7–12, appearing from the proximal third or half, spaced evenly 1–2 cm apart, narrowly ovate to lanceolate, straight to slightly recurved or incurved, tips acute, 1.3–2.3 cm long, 0.3–1 cm wide, 2–3 mm thick, upper side concave to flat or convex, middle nerve sometimes conspicuously lighter and prominent, lower side convex, olive green, reddish at tip and margins, base hyaline. **Flowers** 3–6, appearing from October to November, present only on the distal fourth or fifth of the raceme, 1.4–1.6 cm long and 0.6–0.7 cm in diam. **Pedicels** oblique, 1–2 cm long, 1.3–1.5 mm diam., red, with 0–1 lanceolate or narrowly ovate bracteoles near calyx, when present 3–4 mm long and 0.5–1 mm wide, olive green. **Calyx** lobes united at base, sepals unequal, narrowly ovate acute, spreading in 45°, upper side slightly recurving, 7–11 mm long, 2–3.5 mm wide, olive green. **Corolla** urceolate, sub-pentagonal, 7–8 mm thick near base, 5–6 mm thick near apex, 1.4–1.6 cm long, petals linear lanceolate, acuminate, 1.5–1.6 cm long, 3–4 mm wide, outer surface keeled, yellowish on apical half and red orange on basal half, apex uncinately recurving, inner surface yellow on distal half, orange in basal half.



1c. Rosettes of *Echeveria cuscoensis* from P'isaq. (G.P.)



1d. General aspect of the leaves of *Echeveria cuscoensis* from P'isaq. (G.P.)



1e. Detail of the facets of the leaves of *Echeveria cuscoensis* (G.P.)

Stamens 10, the 5 epipetalous 7–8 mm long, the antepetalous 10–11 mm long, filaments cream, 0.6 mm thick at base, gradually tapering to 0.3 mm. **Anthers** quadrate, yellow, 1.2–1.6 mm long and 0.9–1 mm wide. **Gynoecium** turbinate, 10–12 mm long, 4–5 mm thick. **Carpels** 5, cream. Styles 3–4 mm long, parallel,



1g. From left to right: Bracts (3), sepals (3), sectioned flower showing gynoecium, petals (2), complete flower with peduncular bracts. (G.P.)



1f. Plant ex situ showing flowering stem (G.P.)



1h. Dry fruit. (G.P.)

almost touching each other, greenish, stigma white. **Nectaries** quadrate, pinkish white 1×1.6 mm (Fig. 1g). **Fruit** a dehiscent capsule 1–1.2 cm long, 1–1.5 cm diam. (spreading dry sepals), reddish brown (Fig. 1h).

Other localities: PERU. Dept. Cusco, Prov. Calca, Dist. Pisac, Ruins of P'isaq, 3234 m, S $13^{\circ}24'51''$, W $71^{\circ}50'35''$, August 10, 2002, *Robert Maijer* 225. Rocky cliffs about 1 km outside of the modern town of P'isaq, 3000 m, S $13^{\circ}24'28''$, W $71^{\circ}50'01''$, May 19, 2008, *Ben Kamm* 08519.2. Ruins of P'isaq, heading down the main watershed from the Inca baths, between the mountain the main ruins are on and the mountain with all the tombs, hanging from rock cliffs, within the Kitamayo gorge, 3300 m, S $13^{\circ}24'32''$, W $71^{\circ}50'43''$, May 19, 2008, *Ben Kamm* 08519.10,



1i. *Echeveria cuscoensis* growing in P'isaq at very exposed site. (B.K.)

P'isaq ruins, on rocky cliffs on the north side of the upper Kitamayo Gorge, 3480 m, S 13°24'22", W 71°50'44" Apr 26, 2009, *Ben Kamm 09426.1*. Vertical rock face above the tombs overlooking the Kitamayo Gorge, on the mountain in back of the main ruins of P'isaq, (Small, reddish plants) 3575 m, S 13°24'22" W 071°50'44", May 18, 2008, *Ben Kamm 08518.5*. Ruins of P'isaq, lower section Acchapata, on borders on terraces, 2975 m, Oct 24, 2016, *G. Pino, J. Ochoa 2783* (USM). Dist. Calca, Between Sacred Valley and Calca, 3100 m, Feb 18, 1958, *C. Vargas 012113* (CUZ 4795). Prov. Urubamba, Dist. Huayllabamba, Near Huayllabamba, trail from Estate Huayocari to the woodland near Yanacocha Lagoon and the stream, forest of *Cytherexylum*, *Polylepis*, *Ginoxys*, *Barnadesia*, 3780 m, S 13°21' W 072°03', Jul 5, 1988, *P. Núñez 9262* (CUZ 4797). Huaycollo, On the road between Hacienda Huayocari and town of Huayllabamba, gorge with a stream draining from Yanaqocha Lagoon, 2868 m, Oct 24, 2016, *G. Pino, J. Ochoa 2784*. (USM 295259) Trail from Yanacocha to Quellococha lagoon, *W. Galiano s/n*. Dist. Chinchero, without locality.

This plant was probably discovered by Julio César Vargas Calderón, the most well-known botanist and pteridologist from Cusco in 1958 at an uncertain point between the Vilcanota River (Willkamayu = Sacred River) and Calca. His herbarium sheet consists of only some flowers, but these match the size of the inflorescence of this new species and is determined on the Herbarium sheet as *Echeveria peruviana* Meyen. The poor knowledge of *E. peruviana* has led to many botanists to determine its presence

everywhere in Peru and even in the neighboring countries.

Many years later, in 2002, the expert Dutch succulent cultivator Robert Maijer found this species during his exploration of P'isaq ruins, but we were not able to determine it because of its lack of inflorescences. However, leaves were too broad to match *E. decumbens*, and much larger and of a lighter color than *E. westii*, the two already described species from the area.

The colonial town of P'isaq at 2950 m is nestled in the Vilcanota Valley at the base of the mountains next to the river. On the steep ridge rising above the town there is a majestic Inca citadel at over 3400 m. This site is claimed by some to

be laid out against the mountainside in the shape of a condor (Elorrieta Salazar 2001). The ruins display some of the finest Inca agricultural terracing, superb stonework, ancient water shrines and an astronomical observatory with fantastic views of the valley.

Ben Kamm from California has explored these ruins many times, observing this *Echeveria* for the first time in 2008 on the cliffs above the honeycomb of plundered tombs overlooking the Kitamayo Gorge and Hanan P'isaq. These were small red-purple rosettes to 2.5 cm that looked very much like *E. westii*, growing on sun exposed rocks with lichens and moss, at 3575 m (Fig. 1i). Then he descended into the Kitamayo Gorge where it drops below Hanan P'isaq, a very steep and dangerous route. While scrambling down a 5 m cliff he found *Echeveria* plants growing in deep shade, bright blue-grey terminal rosettes to 10 cm diameter on 2.5 cm diameter grey hanging stems to nearly 1 m long. Next year he hiked above the archaeological site and noted a population of plants, from juveniles to mature specimens, in the upper Kitamayo watershed growing on the steep rocky mountainside facing east, 3480 m. Here the *Echeveria* grow with *Valeriana* sp., *Peperomia pseudoverruculosa* Mathieu, *Peperomia* aff. *lanuginosa*, *Pilea serpyllacea*, "Qaqa wiq'ontoy" *Tillandsia nana* and *usneoides*, *Villadia virgata*, *Corryocactus erectus*, "pinkupinku" *Epbedra americana*, *Salvia oppositiflora*, *Polypodium* and *Adiantum* ferns, *Bomarea* sp., and young "Achupalla" *Puya ferruginea* plants, in all stages of development growing on rock outcrops, cliffs and occasionally Inca walls in the main archaeological site, both above and below



1j. Group of *Echeveria cuscoensis* at Yanacocha Lagoon. (W.G.)

the Intiwatana section. About 1 km outside of the modern town of Pisac, at 3000 m on rocky cliffs near the mountain base, he found the largest, lushest plants yet seen, olive-green to pale blue-grey rosettes to 15 cm diameter, growing again with several *Tillandsia* species, *Pilea serpyllacea*, *Peperomia* aff. *lanuginosa*, “Hawaq’ollay” *Trichocereus cuscoensis*, “P’atakiska” *Austrocylindropuntia subulata* subsp. *exaltata*, and *Puya feruginea*. It should be noted that at all locales *Echeveria* grow with lichen and moss. These often appear to be the substrate within which seed germinates and young plants establish, and may play a key role in nutrient availability for young *Echeveria*.

Local researchers Washington Galiano and Percy Núñez, both from Universidad Nacional San Antonio Abad del Cusco, have also found this species in the eastern border of the province of Urubamba, also in the upper basin of the Sacred Valley. It grows abundantly around Lagoon Yanacocha, “Black lagoon”, a 240 m long and 14 m deep natural pool with a rather dark bottom, reached after a four hour trek beginning at Huayocari Estate and surrounded by a forest of beautiful “Q’euña” *Polylepis* sp. trees (Fig. 1j). Also Julio Ochoa has found recently this species closer to the river Vilcanota at Huayccollo, Huayllabamba, in a dry subtropical low montane forest watered by a stream that drains from Yanaqocha, with subxerophilous shrubs like “Chillka” *Baccharis* sp., “Pachapacha” *Ophryosporus peruvianus*, “P’ispita” *Acalypha aronioides*, “Achupalla” *Puya densiflora*, “Wiq’ontoy” *Tillandsia* sp., and trees like “Tara” *Caesalpinia tinctoria*, “Molle” *Schinus molle* and “Waranway” *Tecoma sambucifolia*.

At the other side of the Willkamayu river facing Huayllabamba we find the quechua community of Chinchero, a town of master weavers that have



1k. “Loraypu” design in weaving representing *Echeveria cuscoensis*. (B.K.)

done much to preserve and reclaim knowledge of this skill that dates back to at least the pre Columbian Inca era. Here Grimalda and Fidel Quispe are part of this ancient lineage. They grow an *Echeveria* species in their garden, not native but Mexican, probably *E. secunda*, likely purchased in the Cusco flower market. They refer that the true native *Echeveria* used to be common in Chinchero and around the upper Sacred Valley and can still be found near Yucay and Huayllabamba, although they are now very scarce, not because of overcollecting, but because very few people use them medicinally anymore and so no one “tends” the wild plants and they are disappearing!

The Quispes say that the native *Echeveria* were once a highly important medicine; 3 drops of fresh juice squeezed between fingers from the leaf directly into the eyes or after roasting were used for soreness, infections and even cataracts. The juice from a leaf heated with a match or boiled was squeezed into the ears for earache. They shared that the Quechua name for this plant in the Vilcanota River area is “Loraypu” which refers to the rhomboid shape of the leaves. In ancient as well as contemporary weavings this diamond shape is represented and is actually the “emblem” of Chinchero (Fig. 1k). The name is also used for cultivated introduced *Aeonium* species and by extension to all rosette forming Crassulaceae.

2. *Echeveria decumbens* Kimmach

Echeveria decumbens Kimmach 1995, *Cact. Succ. J. (Los Angeles)* 67(1): 3–5.

Holotype: PERU. Dept. Cusco. Prov. Calca. 15 km north of Calca on road to Amparaes, 3200 m, October 9, 1982. *W. Baker 4143A* HBG 75907 (HNT, holotype, US isotype) (Fig. 2a).

A succulent glabrous, proliferous herb. **Roots** 2–5 or more, fascicular, 2–4 cm long, 1.2–2 mm diam., light gray. **Stem** procumbent, up to 10 cm long, when erect not more than 3–4 cm high, 0.3–0.5 (–0.8) cm diam., brownish gray. **Rosettes** 1–3, 4–7 cm diam (Fig. 2b). **Leaves** 20–26, sessile, very narrow obovate to oblanceolate, or narrow oblong at two proximal thirds, then gradually expanding, (1.5–) 2–4 cm long, 0.5–0.8 cm wide at base, 0.7–1.2 cm wide 1 cm from apex, 0.5–0.7 cm wide at middle, 2–3 mm thick, upper side flat to slightly concave, light green when young, then olive- yellowish-green, somewhat reddish on apical half where exposed to light, lower side convex, somewhat keeled, light green, acute to sub-cuspidate, with a slightly recurved hyaline mucro 2 mm long at apex, base bi-lobed hyaline (Fig. 2c).

Flowering stem a raceme, rarely erect, horizontal or declining, rachis 12–30 cm long, 2–4 mm diam. at base, 1.5–3 mm diam. at apex, light green to pink at distal third or where exposed (Fig. 2d). **Peduncular bracts** 16–26, appearing from the base, the lower ones spaced 1–2.5 cm apart, the upper ones more crowded to 0.5 cm, somewhat recurved, narrow oblanceolate, 0.6–1.2 cm long, 0.4–0.6 cm wide, 2.5–3.5 mm thick, same color as leaves, with a tri-lobed, transparent spur at base ca. 1 mm long. **Flowers** 9–20, appearing from May to November, present only on the distal third of the raceme, 1–1.3 cm long and 0.4–0.5 cm in diam. **Pedicels** ascending to sub-horizontal, sinuous, 1–2.5 cm long, 1–1.5 mm diam., pinkish, with 2–3 linear-deltoid bracteoles on apical half, 2–3 mm long and 0.5–0.6 mm wide, pinkish. **Calyx** lobes united at base 1 mm, sepals unequal linear lanceolate, acuminate, adpressed to corolla or separated in a right angle, apices slightly recurving, (3–) 5–8 mm long, 1.5–3 mm wide, olive green. **Corolla** urceolate, sub-pentagonal, 4.5–6 mm thick near base, 3.5–5 mm thick near apex, 1–1.3 cm long, petals linear lanceolate, acuminate, acute, 0.9–1 cm long, 2.5–3.5 mm wide, outer surface red, keeled, slightly yellowish on apical half and on keel, apex uncinatate, recurving, inner



2a. *Echeveria decumbens*, a cultivated plant from the type clone. (G.P)



2b. Rosette of *Echeveria decumbens* cultivated by Silvia Choquehuana at Yanahuara. (G.P)

surface red, yellowish on basal half. **Stamens** 10, the 5 epipetalous 5–6 mm long, the antesealous 6–7.5 mm long, filaments cream, 0.6 mm thick at base, gradually tapering to 0.3 mm. **Anthers** quadrate, yellow, 0.8–1.2 mm long and 0.7–0.8 mm wide. **Gynoeceum** turbinate, 7–9 mm long, 4–5 mm thick. **Carpels** 5, cream. Styles 1.5–2.5 mm long, parallel, almost touching each other, greenish or reddish at apex, stigma white.



2c. Detail of leaves of *Echeveria decumbens*. (G.P)

Nectaries quadrate, whitish. **Chromosome number** =175+/-5 (according to Uhl and Kimmach) (Fig. 2e).

Other localities: PERU. Dept. Cusco, Prov. Calca, Dist, Calca, Dist, Lares, Yerbabuenayoc, on rocks, 3200 m, Jan 30, 1958, C. Vargas 011966 (CUZ 4796)(Probable).

This species was probably first collected by César Vargas in 1958 at Yerbabuenayoc and determined erroneously as *Echeveria peruviana* Meyen, in his herbarium sheet. Notes written by hand on the plate remark the small size of the leaves and flowers. This species remained undescribed until the Californian Gardener William Baker collected the type plant in October 1982 at a rocky, grassy, shaded slope between Calca and Amparaes, a locality yet unknown exactly, while travelling with amaryllid specialists William Gielow and Karyn Ecker. Some samples were brought to the United States and Myron Kimmach described it in 1995 from plants cultivated at the Huntington Botanical Garden, naming it “decumbens” because of its almost horizontal flowering stem. It has been extensively searched for in the type locality and also around Lares but never found again in habitat. It is likely to occur in more southern and eastern locations.



2d. Inflorescence of *Echeveria decumbens*. (G.P)



2e. From left to right: bracts (3), sepals (2), petals (3), complete flower, sectioned flower showing gynoecium, above: Flower with pedicel and peduncular bracts. (G.P)



3a. *Echeveria decumbens* var. *urubambensis* at type locality. (B.K.)

3. *Echeveria decumbens* Kimnach var. *urubambensis* Pino, Núñez & Kamm var. *nova*

Holotype: PERU. Dept. Cusco, Prov. Urubamba, Dist. Ollantaytambo, Patacancha Valley, Bridge crossing after the town of Huilloc, 3550 m, S13°12'05", W72°12'08", Nov 15, 2014, G. Pino 2720 (USM 295253) (Fig. 3a).

A succulent glabrous, proliferous herb, eventually forming clusters of 30–40 cm diam. **Roots** many, fascicular. **Stem** procumbent, up to 20 cm long and up to 5 cm high, 0.5–1.5 cm diam., brownish gray. **Rosettes**, 1–8 (–30), 3–7 cm diam. **Leaves** 18–22, sessile, very narrow obovate to narrow sub-spathulate, 2.5–3.5 cm long, 0.3–0.6 cm wide at base, 0.8–1.4 cm wide 1 cm from apex, 0.6–0.9 cm wide at middle, 2–3 mm thick, upper side flat to slightly concave, slightly convex and obscurely keeled in the rainy season, glaucous to olive green, intense green in the rainy season, somewhat reddish on apical half where exposed to light, lower side convex, somewhat keeled, olive green, acute, with a slightly recurved hyaline mucro 2 mm long at apex, base bi-lobed hyaline (Fig. 3b).

Flowering stem a horizontal or declining raceme, **rachis** 8–15 cm long, 2–3 mm diam. at base, 1.5–2.5



3b. Leaves of *Echeveria decumbens* var. *urubambensis*. (G.P.)

mm diam. at apex, light green, pink at distal third. **Peduncular bracts** 8–12, appearing from the base, spaced 0.5–1 cm apart, elliptic to narrow obovate, 1–1.7 cm long, 0.4–0.8 cm wide, 2–3 mm thick, apex acute, both sides convex, same color as leaves (Fig. 3c). **Flowers** 1–3, appearing from May to November, present only on the distal third of the raceme, 1.5–1.8 cm long and 0.8–1 cm in diam. **Pedicels** sub-horizontal, straight, 0.5–1.5 cm long, 1–1.5 mm diam., pale green to pinkish, with 0–1 bracteoles on apical half, same as peduncular bracts. **Calyx lobes** united at base 1 mm, sepals unequal linear lanceolate, obtuse, adpressed to corolla or separate in a right angle, 8–12



3c. Plant ex situ showing flowering stem of *Echeveria decumbens* var. *urubambensis*. (G.P.)



3d. From left to right: flower of *Echeveria decumbens* var. *urubambensis* with pedicel and peduncular bracts, bracts (2), sepals (2). (G.P.)



3e. *Echeveria decumbens* var. *urubambensis* at Pumahuanca. (P.N.)



3f. Right: *Echeveria decumbens* and left: var. *urubambensis*, cultivated by Silvia Choquehuanca at Yanahuara. (G.P.)

Table 1. Comparison of features of *Echeveria decumbens* var. *decumbens* and var. *urubambensis*.

		var. <i>decumbens</i>	var. <i>urubambensis</i>
Overall habit		Not seen in nature	Forms clusters of up to 40 cm diam.
Rosettes	number	1–3	1–8 (–30)
	diameter	4–7 cm	3–7 cm
	number of leaves	20–26	18–22
Leaves	shape	Narrow obovate to oblanceolate, apex sub cuspidate to acute.	Narrow obovate to sub-spathulate, apex mostly acute
	size	(1.5–) 2–4 cm long 0.5–0.8 cm wide at base 0.5–0.7 cm wide at middle 2–3 mm thick	2.5–3.5 cm long 0.3–0.6 cm wide at base 0.6–0.9 cm wide at middle 2–3 mm thick
	color	light green when young, then olive-yellowish green.	glaucous to olive green, intense green in the rainy season.
Flowering stem length (cm)		12–30	8–15
Peduncular bracts		16–26, narrow oblanceolate 0.6–1.2 cm long, 0.4–0.6 cm wide 2.5–3.5 mm thick	8–12, elliptic to narrow obovate, 1–1.7 cm long, 0.4–0.8 cm wide, 2–3 mm thick
Flowers	number	9–20	1–3
	dimensions	1–1.3 cm long 0.4–0.5 cm diam.	1.5–1.8 cm long 0.8–1 cm in diam.
	pedicels	ascending to sub-horizontal, sinuous, 1–2.5 cm long	sub-horizontal, straight, 0.5–1.5 cm long
	sepals	linear lanceolate, acuminate 5–8 mm long 1.5–3 mm wide	linear lanceolate, obtuse 8–12 mm long 2–3.5 mm wide
Corolla	shape	urceolate	sub-pentagonal
	dimensions	4.5–6 mm thick near base, 3.5–5 mm thick near apex, 1–1.3 cm long	0.9–1 cm thick near base, 0.8–0.9 cm thick near apex, 1.6–1.8 cm long
Petals		0.9–1 cm long, 2.5–3.5 mm wide outer surface red, keeled, slightly yellowish on apical half and on keel. inner surface red, yellowish on basal half.	1.6–1.8 cm long, 3.5–4.5 mm wide outer surface cream-yellow on apical half, reddish on basal half and keel. inner surface yellow.

mm long, 2–3.5 mm wide, olive green. **Corolla** urceolate, sub-pentagonal, 0.9–1 cm thick near base, 0.8–0.9 cm thick near apex, 1.6–1.8 cm long, **petals** linear lanceolate, acuminate, acute, 1.6–1.8 cm long, 3.5–4.5 mm wide, outer surface keeled, cream yellow on apical half and reddish on basal half and keel, apex uncinat, recurving, inner surface yellow (Fig. 3d).

Other localities: PERU. Dept. Cusco, Prov. Urubamba, Dist. Ollantaytambo, Patacancha Valley (above Ollantaytambo). Rock outcrops and cliffs just past the town of Huilloc, 3800 m, S 13°09'06", W 72°26' 17", Apr 24, 2010, Ben Kamm 10427.1. Dist. Urubamba, Road from Urubamba to Pumahuanca, Andean Montane forest, 3200 m, Apr 21, 2015, P. Núñez V. R. Sánchez G.

The typical *E. decumbens* has never been found in habitat again. Plants with similar leaves but larger flowers were found west of the type locality by Ben Kamm in May 2010, while he explored the Patacancha watershed above Ollantaytambo. This stream is

an affluent of the Urubamba River, which is no more than the same Vilcanota River after crossing the town of Urubamba. The lower section of the Patacancha valley, such as Muskapukyu, was a region of intense agriculture, with vast terraces ascending far up the mountain sides. These are some of the most extensively terraced slopes observed in the Andes. Above this area of the Patacancha stream, past Huilloc, near 3800 m, an impressive population of *Echeveria* grows in the crevices of rock outcrops and cliffs along with *Tillandsia* species, a shrubby form of *Oxalis peduncularis*, and a *Dendropanax* shrub. Here *Echeveria* forms small clusters to very large mounding clusters 60 cm across, growing at partial shade. This happens to be a much lusher, cooler region than the lower Patacancha valley near the ruins. In year 2015, Percy Núñez also found plants of this variety at about 6 km on a straight line Southeast of Huilloc, on the trail from the town of Pumahuanca to the (Pumawank'a or Yukay) peak standing at 5318 m. This is a lush narrow

path that follows a crystal clear stream which trickles down from the Puma-huanca glacier, an almost dark gully all surrounded by vegetation (Fig. 3e).

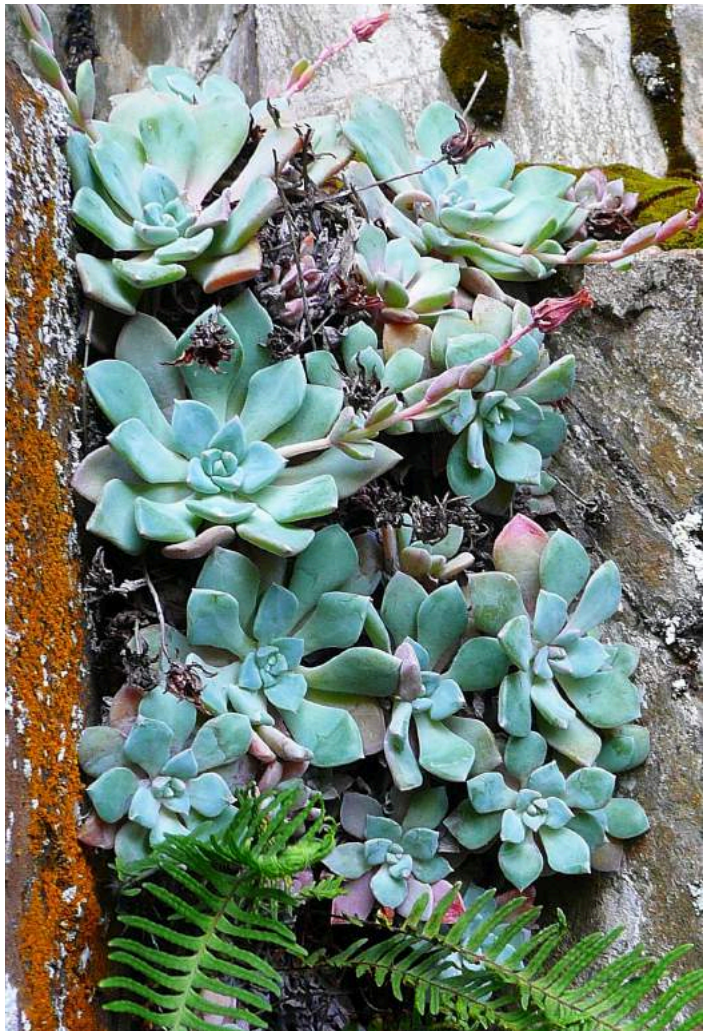
Careful inspection of these plants reveals some differences with variety *decumbens* that deserve describing a new variety (Table I). Vegetatively, plants from the type locality form rosettes with some more leaves, that have a more yellowish or brownish hue compared with the dark or intense green of the new variety. Both varieties can show glaucous leaves in the dry period but this is more noticeable in variety *urubambensis* (Fig. 3d). The main difference is the inflorescence, which is longer and many flowered in variety *decumbens*, but with smaller and redder flowers, with longer and sinuous pedicels. The new variety has few flowers, is larger in size, more yellowish and with straight, shorter pedicels.

The name of this new variety refers to its occurrence within the province of Urubamba, which is also the name of the river that irrigates the lower basin of the Sacred Valley of the Incas. Both varieties seem to be scarce in the area and they usually grow in shaded, moist places, at higher elevations than the other local species of the valley, where they get more rainfall and drizzle.

4. *Echeveria laresensis* sp. nova Pino & Kamm

Holotype: PERU. Dept. Cusco, Prov. Calca, Dist. Lares, On cliffs, trail upward hill crossing bridge after Lares hot springs, 3270 m, S 13°06'38", W 72°03'24", Nov 16, 2014, G. Pino 2736 (USM 295254) (Fig. 4a).

A succulent glabrous, proliferous herb eventually forming clusters to 25 cm diameter with up to 10 rosettes. **Roots** many, fascicular and fibrous, 3–5 cm long, 0.5–0.6 mm diam., light gray, growing mostly from each node of semi-stoloniferous stems. **Stems** procumbent, 6–20 cm long or more, 0.4–0.6 cm diam., scarcely branching from the base, branches 1–6,



4a. *Echeveria laresensis* at the type locality. (B.K.)

decumbent in very old plants, with nodes every 3.5–4.5 cm with remaining leaves of dry rosettes. **Rosettes** 1, usually at the end of main stem or branch, (2–) 3–8 (–11) cm diam. (Fig. 4b). **Leaves** 16–20, sessile, narrowly obovate, acute to cuspidate, 1.5–4.5 (–7) cm long, 0.5–0.7 cm wide at base, 1–1.4 cm wide 1 cm from apex, 0.8–1.2 cm wide at middle, 2–3 mm thick, upper side flat to slightly concave, light glaucous green, pruinose with lighter areas, margins whitish, lower side convex, sub-carinate, light glaucous green or purplish in the sun, with a 0.5 mm mucro at apex, base hyaline (Fig. 4c).

Flowering stem an oblique or horizontal raceme, rachis 12–18 cm long, 2.5–3.5 mm diam. at base, 1.8–2 mm diam. at apex, light glaucous green, turning pink since proximal third or half. **Peduncular bracts** 7–13, spaced evenly 0.8–1.8 cm apart, narrowly ovate, 1.3–2 (–3.5) cm long, 0.5–0.9 cm wide, 3–4



4b. *Echeveria laresensis* ex situ showing stems. (G.P)



4c. Detail of the leaves of *Echeveria laresensis*. (G.P)

mm thick, glaucous green, carinate and somewhat reddish at the outer side (Fig. 4d). **Flowers** 3–6, appearing from October to March, present only on the distal fourth of the raceme, 1–1.7 cm long and 0.8–0.9 cm in diam. **Pedicels** ascending or oblique, 0.8–1 cm long, 1.7–2 mm diam., pink, with 1–2 lanceolate or narrowly ovate bracteoles near calyx, 1–1.4 cm long and 3–4 mm wide, olive green. **Calyx lobes** united at base, sepals unequal ovate acute, connate or spreading in a right angle, upper side slightly recurving, 4–5 mm long, 1.5–2 mm wide, olive green. **Corolla** urceolate, sub-pentagonal, 7–8 mm thick near base, 4–5 mm thick near apex, 1–1.7 cm long, **petals** linear lanceolate, acuminate, 1–1.2 cm long, 3.5–4 mm wide, outer surface keeled, yellowish on apical half and reddish on basal half, apex uncinat, recurving, inner surface yellow on distal half, orange in basal half. **Stamens** 10, the 5 epipetalous 7–8 mm long, the antesealous 9–11

mm long, filaments cream, 0.8 mm thick at base, gradually tapering to 0.3 mm. **Anthers** quadrate, yellow, 0.8–1.2 mm long and 0.7–0.8 mm wide. **Gynoecium** turbinate, 10–12 mm long, 5–6 mm thick. Carpels 5, yellow. **Styles** 2–3 mm long, parallel, almost touching each other, greenish, stigma white. **Nectaries** quadrate, whitish, 1 × 2 mm. **Fruit** a dehiscent capsule 1–1.2 cm long, 0.8–1.2 cm diam. dark brown (Fig. 4e).

Other localities: PERU. Dept. Cusco, Prov. Calca, Dist. Lares, Steep mountainside across from Lares Hotsprings, growing with *Tillandsia* sp., *Peperomia* sp. and *Oxalis* sp. 3425 m, April 28, 2010, Ben Kamm 10428.10.

This species has only been found in Lares Hotsprings, a well-known resort crossing the mountain range east of the Urubamba Valley. Lares is reached by car from the Vilcanota Valley in Calca, (Khallka) crossing important ruins like Anqasmarka up over the 4461 m Willkapunku pass then descending after Pampacorral to Lares Hotsprings near 3250 m. Alternatively it can be reached by trekking from the Patacancha Valley up over the 4400 m Ipsayqocha pass then descending through the weaving town of Huacahuasi. Lares is a much warmer, somewhat dryer region than the Patacancha Valley. These *Echeveria* appear as solitary plants to small mounds of a few rosettes growing on rocky overhangs all along the trail to the hot spring entrance. These are far out of reach, usually directly underneath *Puya* sp., *Coriaria ruscifolia* v. *microphylla*, and *Tecoma sambucifolia* shrubs. Plants are also planted on the roof of the hot



4e. From left to right: sepals (2), petals (2), sectioned flower showing gynoecium, bracts (2). (G.P)



4d. Inflorescence of *Echeveria laresensis*. (G.P)



4f. Plant of *Echeveria laresensis* grown on wall by Lino Alanya. (G.P)

springs entrance building and on the clay walls of a shop belonging to Lino Alanya, a local enthusiast who collects plants from all around and takes good care of them (Fig. 4f). Plants at first glance look like enormous, glaucous *Echeveria decumbens* (Fig. 4g). Crossing over the Rio Trapiche, directly across from the hot springs, there are plants growing on the steep rocky mountainside with several *Tillandsia* species, *Peperomia rotundata*, *Peperomia galioides*, succulent *Oxalis* sp., *Puya* sp., *Myrteola* sp., *Elaphoglossum* sp. and several other ferns. Most plants here make small 4–14 cm loose clusters of just 2–5 rosettes. The largest cluster observed there was 14 cm in diameter, made up of 10 rosettes.



4g. Plant of *Echeveria laresensis* in habitat. (G.P)

5. *Echeveria ochoae* Pino & Galiano sp. nova

Holotype: PERU: Dept. Cusco, Prov. Urubamba, Dist. Ollantaytambo, Yawar waq, beginning of Inca Trail to Machupicchu, 200 m crossing after Pisqak'uchu train station at km 82, on very loose rocky slope facing east the Urubamba river, in the buffer zone of the Historical Sanctuary of Machupicchu, 2670 m, S 13°13'19", W 72°24'04", May 12, 2016, G. Pino, W.H. Galiano, J.Ochoa. 2773 (USM 295256) (Fig. 5a).

A succulent glabrous, solitary or proliferous herb. **Roots** many, born from base of rosettes and along creeping stems at nodes, fascicular and fibrous, 3–5 (–15) cm long, 0.5–2 mm diam., light grayish brown. **Stem** erect in young plants, then procumbent, 0.5–1.5 cm diam., light brown, becoming light glaucous green near tips, scarcely 2–3 branching only from the base, main stem or branches up to 50 cm long in very old plants, with slightly enlarged nodes every 6–12 cm, prominent transverse leaf scars 4–6 mm long every 4–10 mm, more crowded at nodes; dry leaves and roots frequently attached to the stem at nodes and near distal rosette (Fig. 5b). **Rosettes** generally one at the end of stem or branch that then becomes erect, 4–12 (–18) cm diam., cupuliform (Fig. 5c, 5d). **Leaves** 18–36, sessile, wide obovate to spatulate, 2–8 cm long, 0.5–1.4 cm wide at base, 1.4–2.5 cm wide 1



5a. *Echeveria ochoae* in habitat at Pisqak'uchu. (J.O)



5b. *Echeveria ochoae* ex situ showing trailing stem with persistent dry leaves. (G.P.)



5c. Lateral view of rosette of *Echeveria ochoae*. (G.P.)



5f. Top view of rosette of *Echeveria ochoae* to show its leaves. (G.P.)



5d. Young plants of *Echeveria ochoae*. (G.P.)



5e. Leaves of *Echeveria ochoae*. (G.P.)



5g. Flowering stem of *Echeveria ochoae* in anthesis (J.O.)

cm from apex, 2–4 cm wide at middle, 3–4 mm thick, upper side flat to concave, curved inwards, light olive green to glaucous green, reddish near margins and in outer leaves, margins obscurely curved inwards, lower side flat to obscurely carinate, light green to reddish where exposed, apex acute to cuspidate, with an acute slightly recurved hyaline mucro 1 mm long at apex, base hyaline (Fig. 5e, 5f).

Flowering stem 1–3 erect or upcurving racemes lateral from each rosette, rachis 15–20 (–30) cm long, 4–6 mm diam. at base, 2–3 mm diam. at apex, white

to pinkish in proximal third, intense pink in two distal thirds (Fig. 5g). **Peduncular bracts** 7–9, crowded on the proximal half, spaced every 0.3–0.6 cm near base and 0.6–1 cm or deciduous towards tip, narrowly ovate, straight and adpressed to the scape, tips acuminate, 1.2–2.6 cm long, 0.4–1 cm wide, 4–5 mm thick, inner side canaliculate, outer side keeled, same color as leaves. **Flowers** 6–12, appearing from September to October, present only on the distal third of the raceme, 1.5–1.8 cm long and 0.9–1 cm in diam. **Pedicels** oblique, 0.8–2.5 cm long, 1.8–2.2 mm diam., intense pink, with a normal bracteole at the base and another slender bracteole near calyx, 0.5–0.9 cm long, 1.5–2.5 mm wide, very narrowly ovate to linear, reddish green, outer side convex, inner side curved inwards and concave, apex incurvate or uncinat. **Calyx lobes** united at base, sepals unequal ovate acute to triangular, adpressed to corolla, 5–6 mm long, 3–4 mm wide, reddish green. **Corolla** urceolate, sub-pentagonal, 8–9 mm thick near base, 5–6 mm thick near apex, 1.7–1.9 cm long, petals linear lanceolate, acuminate, 1.4–1.6 cm long, 2–2.5 mm wide, outer surface keeled, pale yellowish on apical third and pinkish on basal two thirds, apex uncinat, recurving, inner surface yellow on distal half, light pink in basal half. **Stamens** 10, the 5 epipetalous 7–9 mm long, the antesealous 9–10 mm long, filaments cream, 0.7–1 mm thick at base, gradually tapering to 0.3 mm. **Anthers** ovoid, intense yellow, 1–1.5 mm long and 0.6–0.8 mm wide. **Gynoecium** turbinate, 10–12 mm long, 4–5 mm thick. **Carpels** 5, white. Styles 3–4 mm long, parallel, almost touching each other, greenish, **stigma** white. **Nectaries** reniform, cream, 1 × 2.2 mm (Fig. 5h). **Fruit** a dehiscent capsule 1.2–1.5 cm long, 0.8–1.6 cm diam. (spreading dry petals), dark brown, appearing from November to January.



5h. From left to right: Flower, sectioned flower showing gynoecium, bracts (2, above), sepals (3, below), gynoecium, petals (3), dry fruit. (G.P.)

The Inca trail is the most famous hike in Peru and perhaps all of South America. This arduous, four day walk begins at the river Urubamba bank, the floor of the Sacred Valley. It then climbs up at least three steep high mountain passes — one of which reaches an elevation of 4,200 m — and passes through cloud forests and jungle, visiting some breath-taking Tambo ancient ruins like Wayllabamba, Phuyupatamarca and Wiñaywayna. After 40 km it finally arrives at the Intipunku (Sun Gate) from where you can get a glimpse of the emerald peak of the magical mountain of Wayna Picchu. At its base the mystical mist-shrouded terraced lost city of the Incas, Machu Picchu, can be found.

This citadel was rediscovered more than one century ago by the American explorer Hiram Bingham, at a hidden place at 2400 m, 80 km north of Cusco city. It was probably built in the 15th century in the time of Inca emperor Pachakutiq and then abandoned a century later at the time of the Spanish conquest. It was never found by the Spaniards, who thus did not destroy it, as they did with other Inca buildings. It is made of polished stones so skillfully cut to fit one another, that not even a needle could fit in the gap between them. The area surrounding the ruins (326 km²) was declared a Historical Sanctuary in 1981 and a UNESCO World Heritage Site in 1983. An international poll voted it as one of the New Seven Wonders of the World in 2007.

At km 82 of the railroad to Machu Picchu, Julio Gustavo Ochoa Estrada, a local biologist and graduate of the University San Antonio Abad of Cusco, found this plant at Yawar waqaq, the beginning of the Inca Trail, just crossing Pisqak'uchu train station, on a very steep slope with loose rocks facing east the Urubamba river, in the buffer zone of the Historical Sanctuary. Here this *Echeveria* grows in a relatively dry subtropical low montane forest. This is a secondary woodland highly modified by human activity since ca. 800 BC, with sub-xerophilous thorny shrubs like "Pikipiki" *Baccharis boliviensis*, "Cheqchi" *Berberis dryandriphylla*, "Chamana" *Dodonaea viscosa*, "Llalluli" *Barnadesia macbridei*, "Chuchaw" *Furcraea andina*; cacti like "Hawaq'ollay" *Echinopsis cuzcoensis* and *Coryocactus squarrosus*, many bromeliads like "Achupalla" *Puya ferruginea* and *densiflora*, "Wiq'ontoy" *Tillandsia nana*, *usneoides*, *paleacea* and *capillaris*, and occasional low trees like "Tara" *Caesalpinia tinctoria*, "Molle" *Schinus molle* and "Waranway" *Tecoma sambucifolia*. Here the mean annual maximum temperature is 18.1



6a. *Echeveria westii* in habitat at Ollantaytambo. (B.K.)

°C. and the minimum 11.7 °C. Mean total rainfall per year is about 1124.7 mm.

In the Urubamba River area, locals call these plants "Lurapu" and claim that its sap is effective against deafness. This species is named after its discoverer, Ochoa, who is the national scientific consultant for the program of inventory management for the conservation of biodiversity of the Historical Sanctuary of Machu Picchu. He reported the rediscovery of the Machu Picchu arboreal chinchilla rat *Cuscomys oblativus* in 2009, a beautiful cat-sized rodent that may have been a pet for the Incas (Ochoa 2012). For the last 20 years, he has directed the Program of Conservation and Biocultural management of the National Archaeological Park of Machu Picchu of the Ministry of Culture of Cusco.

Echeveria ochoae is closer to *E. cuzcoensis* than the other species here described, however, plants show conspicuous stems with larger rosettes and looser, wider and lighter colored leaves, producing more erect and densely flowered inflorescences, and they thrive in a drier and lower environment, blooming almost one month before this species.



6b. Plants of *Echeveria westii* at different ages. (G.P.)



6c. Leaves of *Echeveria westii*. (G.P.)

6. *Echeveria westii* Walther

Echeveria westii Walther. in *Echeveria*, p. 361, 1972.

Holotype: PERU. Dept. Cusco, Prov. Urubamba, Dist. Ollantaytambo, On arid rock outcrops among mosses and species of *Peperomia* and *Tillandsia* at Ollantaytambo ruins, 3000 m, 9 Nov 1957, Paul Hutchison 1959/1800 (UC 1200467) (Fig. 6a).

A succulent glabrous herb. **Roots** many, fascicular, 3–5 (–8) cm long, 1–1.5 mm diam., light grayish brown. **Stem** short, erect, usually unobserved, when noticeable, 1–6 cm long, subterranean or aerial, 0.5–1.5 (–2) cm diam., brown. **Rosettes** 1 usually at the end of stem, rarely up to 3, 3–4.5 (–8) cm diam. (Fig. 6b). **Leaves** 12–18 (–26), sessile, rhomboid-obovate when young, narrow obovate in mature plants, cuneate at base, blunt acute, occasionally acuminate, (1–) 2–3.5 (–4) cm long, 0.3–0.5 cm wide at base, 1–1.4 cm wide 1 cm from apex, 1–1.5 cm wide at middle, 3–5 mm thick, upper side flat to slightly concave or canaliculate in old plants, recurved when in flower, olive green to purplish green, sometimes orangish and even glaucous in old flowering plants, margins blunt, obscurely incurved in old plants, lower side obscurely keeled, convex to carinate, purplish or reddish, apex redder or brownish, rarely with a 1 mm mucro, slightly incurved, base hyaline pinkish (Fig. 6c).



6d. Ex situ plants of *Echeveria westii* in anthesis. (G.P.)



6e. From left to right: peduncular bracts (3), some of them rooting, bracteole, tip of inflorescence with flowering bud of *Echeveria westii* (G.P.)



6f. Detail of the flowers of *Echeveria westii*: sepals (3), flower, sectioned flower showing gynoecium, petals (2). Inset: detail of gynoecium, anthers and nectaries. (G.P.)

Flowering stem an oblique raceme, **rachis** 5–20 cm long, 2–4 mm diam. at base, 1.5–3 mm diam. at apex, deep red. **Peduncular bracts** 8–14, proximally rapidly deciduous or absent, appearing only on distal third, there crowded evenly 0.2–0.4 cm apart, narrow obovate-elliptic, acute, 0.8–1.6 cm long, 0.5–0.9 cm wide, 2–3 mm thick, light glaucous green to purplish,

apex and distal half redder, both sides convex, producing axillary plantlets from the bracts, even when still attached to the plant (Fig. 6d, 6e). **Flowers** 1–2 (–3), appearing from November to December, present only on the end of the raceme, 1.1–1.3 cm long and 0.5–0.7 cm in diam. **Pedicels** oblique, 0.4–0.9 (–1.6) cm long, 1.5–2 mm diam., dark pink, with one



6g. Dry fruits of *Echeveria westii*. (G.P.)

oblong-linear incurvate bracteole at the base, 0.6–0.9 cm long and 1.5–2 mm wide, acute, sub-terete, same color as bracts. **Calyx lobes** united at base, **sepals** unequal narrowly ovate acute, adpressed to corolla or in acute angle, 7–10 mm long, 2–3 mm wide, same color as leaves (Fig. 6e). **Corolla** urceolate, sub-pentagonal, 5–7 mm thick near base, 3–5 mm thick near apex, 1.1–1.3 cm long, **petals** linear lanceolate, acuminate, 1–1.2 cm long, 2–2.5 mm wide, outer surface keeled, light yellow, orange-pink on base, apex recurving, inner surface yellow. **Stamens** 10, the 5 epipetalous 6–7 mm long, the antesealous 7–9 mm long, **filaments** cream, 0.4–0.7 mm thick at base, gradually tapering to 0.2 mm. **Anthers** quadrate, yellow, 1–1.5 mm long and 0.4–0.6 mm wide. **Gynoecium** turbinate, 6–8 mm long, 3–4 mm thick. **Carpels** 5, yellow. **Styles** 2–3 mm long, parallel, almost touching each other, greenish white, stigma reddish (Fig. 6f). **Nectaries** reniform, deep yellow, 1 × 2 mm. **Fruit** a dehiscent capsule 1–1.1 cm long, 1–1.4 cm diam., reddish brown (Fig. 6g).

Other localities: PERU. Dept. Cusco, Prov. Urubamba, Dist. Ollantaytambo, On rock outcrops around the back of the main ruins, facing the Urubamba River, growing with *Peperomia hartwegiana* Miq, *Cheilanthes* sp, and *Villadia virgata*, 2500 m, S 13°15'22" W 072°16'02", May 21, 2008, *Ben Kamm* 08521.7. On rocks on Pinkuylluna mountain, above the town of Ollantaytambo, 3150 m, May 22, 2008, *Ben Kamm* 08522.2. On the trail to Pinkuylluna ruins, among rocks, 2900 m, S 13°15'26", W 72°15'43", May 12, 2016, *G. Pino, W.H. Galiano, J.Ochoa*. 2779



6h. *Echeveria westii* at Pinkuylluna with similar purplish colored *Oxalis* and *Pilea* sp. (G.P.)

(USM 295257). Sacred Valley, road from Yanahuara to Ollantaytambo, rocky slopes in front of Bridge to Paucarbamba, Maras, 2600 m, S 13°16'58", W 72°12'02", May 12, 2016, *G. Pino, W.H. Galiano, J.Ochoa*. 2782 (USM 295258).

This species was originally described by Walther in the 1950s from plants collected by Hutchison, on the ruins of Ollantaytambo. Since then it has hardly been collected, probably because of its location on the almost inaccessible cliffs above the complex, and perhaps also protected by the custody of this archaeological place.

The town of Ollantaytambo and its adjacent archaeological site lie at 2800–2900 m, just where the Patakancha river drains into the Urubamba river in the northern part of the Sacred Valley. The ruins with their massive terraces are claimed by pop-researchers to be laid out against the mountainside in the profile of a llama (Elorrieta Salazar 2001), but this is contested by others (Dean 2010). Once the royal estate of the Inca Pachakutiq, this was the last place of Inca resistance to the Spaniards in the rebellion of 1536, before their flight to their final stronghold of Vilcabamba.

Table II. Comparison of plants of *Echeveria cuscoensis*, *E. laresensis*, *E. ochoae* and *E. westii*.

		<i>E. cuscoensis</i>	<i>E. laresensis</i>	<i>E. ochoae</i>	<i>E. westii</i>
Rosette	diameter (cm)	6–8	3–8	4–12	3–4.5
	number of leaves	18–32	16–20	18–36	12–18
Leaves	shape	rhomboid obovate to sub-spathulate	narrowly obovate, acute to cuspidate	obovate to spatulate	rhomboid-obovate when young, narrow-obovate when old
	dimensions	2–5 cm long, 1.1–1.7 cm wide at middle	1.5–4.5 cm long, 0.8–1.2 cm wide at middle,	2–8 cm long,, 2–4 cm wide at middle,	1–3.5 cm long, 1–1.5 cm wide at middle,
	thickness (mm)	6–9	2–3	3–4	3–5
	adaxial surface	concave to canaliculate, faceted, light olive green in the shade, reddish when exposed or dry	flat to slightly concave, light glaucous green, pruinose with lighter areas	flat to concave, in-curved, light olive green to glaucous green, reddish near margins and in outer leaves	flat to slightly concave, recurved when in flower, olive green to purplish green
	margins	lighter, obscurely curved inwards	whitish	obscurely curved inwards	blunt
	abaxial surface	keeled or convex	convex, sub-carinate, light glaucous green or purplish in the sun	flat to obscurely carinate, light green to reddish where exposed	obscurely keeled, convex to carinate, purplish or reddish
Inflorescence	number & disposition	1 oblique or horizontal raceme	1 -2 oblique or horizontal raceme	1–3 erect or upcurving raceme	1 oblique raceme
	dimensions	8–20 (–28) cm long, 3–4 mm diam. at base, 2–3 mm diam. at apex	12–18 cm long, 2.5–3.5 mm diam. at base, 1.8–2 mm diam. at apex	15–20 (–30) cm long, 4–6 mm diam. at base, 2–3 mm diam. at apex	15–20 (–30) cm long, 4–6 mm diam. at base, 2–3 mm diam. at apex
	color	light green to pink at proximal third, bright red at distal half or third	light glaucous green, turning pink since proximal third or half.	white to pinkish in proximal third, intense pink in distal thirds	deep red
Flowers	number	3–6, present only on the distal quarter or fifth of the raceme	3–6, present only on the distal quarter of the raceme	6–12, present only on the distal third of the raceme	1–2 (–3), present only on the end of the raceme
	dimensions	1.4–1.6 cm long, 0.6–0.7 cm in diam.	1–1.7 cm long, 0.8–0.9 cm in diam.	1.5–1.8 cm long, 0.9–1 cm in diam.	1.1–1.3 cm long 0.5–0.7 cm in diam.
	blooming period	October to November	October to March	September to October	November to December
Sepals	shape	narrowly ovate acute, spreading at 45°	ovate acute, connate or spreading at right angles	ovate, acute to triangular, adpressed to corolla	narrowly ovate acute, adpressed to corolla or at acute angle
	dimensions (L × W, mm)	7–11 × 2–3.5	4–5 × 1.5–2	5–6 × 3–4	7–10 × 2–3
Petals	dimensions (L × W)	1.5–1.6 cm × 3–4 mm	1–1.2 cm × 3.5–4 mm	1.4–1.6 cm × 2–2.5 mm	1–1.2 cm × 2–2.5 mm
	color	yellowish on apical half and red orange on basal half	yellowish on apical half and reddish on basal half	pale yellowish on apical third and pinkish on basal two thirds	light yellow, orange-pink on base

The village of Ollantaytambo retains its original Inca layout of narrow cobblestone streets with their intact irrigation systems still nourishing the town.

Only a few people have observed this species growing in the wild since its discovery, such as Ben Kamm from California, who found it beyond the back of the main ruins, just outside the so-called “defensive wall”, around the side of the mountain to where the slopes face west towards the Urubamba River on its way to Machu Picchu, where a path leads up to the Intiwatana above the archaeological site and is closed to the public up to date. This is just beyond the residential complex of the ruins, and here they grow in abundance on rock outcrops often in the shade of a bunch grass (*Stipa?*), *Cheilanthes bonariensis* ferns, *Puya* sp., several *Tillandsia* species, the occasional *Agave cordillerensis* or small shrubs (*Solanum* sp., *Croton* sp., *Abutilon* sp., and *Salvia oppositiflora*). Plants in strong exposed light are very compact and have a beautiful red-purple color. Interestingly many other succulent species growing alongside them in this seasonally arid, warm end of the Urubamba Valley take on similar reddish hues—*Peperomia hartwegiana*, *Pilea serpyllacea*, *Oxalis peduncularis* and a lithophytic orchid species (Fig. 6h). *Echeveria* in the shade tend to be a little larger and even glaucous blue-grey, beginning to look similar to *Echeveria cuscoensis* but not as large. Table II presents a comparison of all the *Echeveria* species growing in the Urubamba area. Other associated vegetation growing here are *Peperomia nivalis* var. *lepadiphylla*, an orange flowered *Mentzelia* sp., *Corryocactus erectus*, *Austrocylindropuntia subulata* subsp. *exaltata*, and *Villadia virgata*.

Echeveria westii also grows on the Intipunku, above the town and on the rock outcrops and cliffs on Pinkuylluna mountain in front of the ruins, near the Inca Qolqas (masterfully engineered storage facilities/granaries) above the town of Ollantaytambo at 3100 m and above. Plants here get a lot of exposure and tend toward being smaller and more compact, reddish to even orangeish in color, in all stages of development. They grow here with the same companion species matrix as the other populations along with a larger terrestrial orchid species. Some plants can also be found on the rocky slopes between the town of Yanahuara and Ollantaytambo, growing high far out of reach.

A short walk back the Patakanha Valley from the main ruins leads to the mysterious Inkamisana Sanctuary, this is an archaeological site—strange ceremonial/astronomical carvings within the living rock of the cliffs. Here Kamm has observed a few *E. westii* plants

growing on the cliffs out of reach.

Plants from the type locality were taken to California and grown for years by Myron Kinnach. Observing these plants, Pilbeam (2008) comments that without flowers, it could be easily mistaken for a rosette-forming *Sedum* or a *Sedum* / *Echeveria* hybrid. Also, flowering stems when born are reminiscent of some *Pachyphytum* in the fact of having a bare stem and congested bractlets at the tip, but then they produce typical *Echeveria* flowers, although very few, sometimes only one.

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