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Discovery of substantial *Oxalis* (Oxalidaceae) diversity and endemism in an arid biodiversity hotspot

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Abstract

Despite globally acknowledged diversity levels, the flora of the arid Richtersveld of South Africa remains poorly known for certain plant lineages, including the eudicot genus *Oxalis*. Cryptic habit, inaccessible and harsh terrain and the lack of focussed systematic attention has led to the assumption that the region is depauperate in this genus. However, recent exploration proved quite the opposite and revealed a wealth of *Oxalis* species, including at least ten undescribed species and many significant range extensions of known taxa. We are in the process of describing these new species, but an overarching work, placing the abundant new knowledge in the context of southern African *Oxalis*, is necessary. In this study we revise the state of knowledge regarding Richtersveld *Oxalis* and provide brief descriptions, diagnostic characters and a morphological identification key for the 20 species confirmed to occur in the region. Nine of the ten new species are currently only known from the Richtersveld, with seven having extremely limited known distributions. Surprisingly, levels of endemism in the Richtersveld are higher than the relatively well-explored central Namaqualand *Oxalis* flora, and suggest that, far from being depauperate in *Oxalis*, the Richtersveld region should be considered a centre of endemism for the genus in southern Africa.

Introduction

The Richtersveld of South Africa occupies an area of only 7325 km^2 yet it contains 336 known endemic plant taxa (Cowling *et al*. 1999). It is acknowledged as one of the richest desert floras of the planet (Cowling *et al*. 1998) and forms part of a 'biodiversity hotspot' defined to set conservation priorities (Myers *et al*. 2000). Two main biomes are present in the Richtersveld: true desert and the semi-arid Succulent Karoo, and both are represented by a rich diversity of vegetation units within the region (Mucina & Rutherford 2006). The area has a varied geology, which includes formations of granite, gneiss, limestone, schist, layered shale and scattered white quartz (Williamson 2000). Average annual rainfall of 150 mm falls mostly during winter (Fleminger 2008) and is supplemented by early morning fog during summer (Williamson 2000). Pressure on natural resources due to semi-nomadic pastoral land use, mining and climate change pose threats to the fragile Richtersveld habitat (Rutherford *et al*. 1999a, b, Mucina & Rutherford 2006). As most undescribed plant species are thought to occur in areas with high levels of endemism (Joppa *et al*. 2011), and the Richtersveld is particularly under-collected for cryptic plant lineages, numerous endemic taxa may currently be threatened with extinction even before their discovery.

Oxalis Linnaeus (1753: 433) is acknowledged as a major component of the geophyte floras of the Cape Floristic Region (CFR; Proçhes *et al*. 2006) and the adjacent Succulent Karoo directly to the south of the Richtersveld. These two regions are considered global biodiversity hotspots (Myers *et al*. 2000) and were recently combined into a single unit constituting the Greater Cape Floristic Region (GCFR) *sensu* Born *et al*. (2006). The centre of diversity (> 90% of approx. 210 species) and putative origin for African *Oxalis* is within the GCFR (Oberlander *et al*. 2011). Many GCFR *Oxalis* species have restricted distribution ranges, with 70 species and subspecific taxa currently included in the Red List of South African Plants (Raimondo *et al*. 2009).

Oxalis is underexplored in the GCFR border regions, with the *Oxalis* flora of the Richtersveld in particular being extremely poorly understood. This can be attributed to a variety of reasons: the area is large, remote and inhospitable,

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References

Bolus, L. (1916) Novitates Africanae. *Annals of the Bolus Herbarium* 2(1): 1–27.

Bolus, H.M.L. (1930) Notes: Afr. austr. (Cape Prov.). *Journal of Botany, British and Foreign* 68: 75.

Born, J., Linder, H.P., & Desmet, P. (2007) The greater Cape Floristic Region. *Journal of Biogeography* 34: 147–162. http://dx.doi.org/10.1111/j.1365-2699.2006.01595.x

Cowling, R.M., Rundel, P.W., Desmet, P.G. & Esler, K.J. (1998) Extraordinary high regional-scale plant diversity in southern African arid lands: subcontinental and global comparisons. *Diversity and Distributions* 4: 27–36.

Cowling, R M., Esler, K.J. & Rundel, P.W. (1999) Namaqualand, South Africa: An overview of a unique winter-rainfall desert ecosystem. *Plant Ecology* 142: 3–21.

Dreyer, L.L., Roets, F. & Oberlander, K.C. (2009) *Oxalis saltusbelli*: A new *Oxalis* (Oxalidaceae) species from the Oorlogskloof Nature Reserve, Nieuwoudtville, South Africa. *South African Journal of Botany* 75, 110–116. http://dx.doi.org/10.1016/j.sajb.2008.08.004

Dreyer, L.L., Roets, F. & Oberlander, K.C. (2013) Two new *Oxalis* (Oxalidaceae) species from the Richtersveld National Park, South Africa. *Phytotaxa* 89: 53–63. http://dx.doi.org/10.11646/phytotaxa.89.2.2

Fleminger, D. (2008) *Richtersveld cultural and botanical landscape, including Namaqualand.* 30° South Publishers, Johannesburg, 272 pp.

Jacquin, N.J. (1794) *Oxalis: Monographia iconibus illustrata.* C. F. Wappler, Vienna, 206 pp. http://dx.doi.org/10.5962/bhl.title.888

Joppa, L.N., Roberts, D.L., Myers, N. & Pimm, S.L. (2011) Biodiversity hotspots house most undiscovered plant species. *Proceedings of the National Academy of Sciences of the USA* 108: 13171–13176. http://dx.doi.org/10.1073/pnas.1109389108

Kuntze, C.E.O. (1891) *Revisio Generum Plantarum*. Arthur Felix, Leipzig, 374 pp. http://dx.doi.org/10.5962/bhl.title.327

Linnaeus, C. (1753) *Species Plantarum.* Impensis Laurentii Salvii, Stockholm, 1200 pp.

Manning, J.C. & Goldblatt, P. (2008) Oxalidaceae: A new species of *Oxalis* from the Hantam-Roggeveld plateau, Northern Cape, South Africa. *Bothalia* 38: 75–78.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858. http://dx.doi.org/10.1038/35002501

Mucina, L. & Rutherford, M.C. (Eds.) (1996) *The Vegetation Map of South Africa, Lesotho and Swaziland*. (Pretoria, South Africa: South African National Biodiversity Institute).

Oberlander, K., Dreyer, L.L. & Esler, K.J. (2002) Biogeography of *Oxalis* (Oxalidaceae) in South Africa: a preliminary study. *Bothalia* 32: 97–100.

Oberlander, K.C., Dreyer, L.L. & Curran, H.R. (2009) An unusual new species of *Oxalis* (Oxalidaceae) from the Knersvlakte, South Africa. *South African Journal of Botany* 75: 239–245. http://dx.doi.org/10.1016/j.sajb.2008.11.004

Oberlander, K.C., Dreyer, L.L. & Bellstedt, D.U. (2011) Molecular phylogenetics and origins of southern African *Oxalis*. *Taxon* 60: 1667–1677.

Oliver, E.G.H. (1993) Oxalidaceae—a new species of *Oxalis* from the Western Cape. *Bothalia* 23: 72–74.

Procheș, Ș., Cowling, R.M., Goldblatt, P., Manning, J.C. & Snijman, D.A. (2006) An overview of the Cape geophytes. *Biological Journal of the Linnean Society* 87: 27–43. http://dx.doi.org/10.1111/j.1095-8312.2006.00557.x

Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyana, P.A. (Eds.) (2009) *Red List of South African Plants.* Pretoria: South African National Biodiversity Institute.

Roets, F., Oberlander, K. & Dreyer, L.L. (2013) Two new *Oxalis* species (Oxalidaceae) from the Ai-Ais / Richtersveld Transfrontier Park, South Africa. *Blumea* 57: 229–235. http://dx.doi.org/10.3767/000651913x663631

Rutherford, M.C., Midgley, G.F., Bond, W.J., Powrie, L.W., Roberts, R. & Allsop, J. (1999a) South African country study on climate change. Plant biodiversity: vulnerability and adaptation assessment. Report. National Botanical Institute, Kirstenbosch, Cape Town, South Africa.

Rutherford, M.C., Powrie, L.W. & Schulze, R.E. (1999b) Climate change in conservation areas of South Africa and its potential impact on floristic composition: a first assessment. *Diversity and Distributions* 5: 253–262.

http://dx.doi.org/10.1046/j.1472-4642.1999.00061.x
Salter, T.M. (1935) Plantae Novae Africanae series III. *Journal of South African Botany* I: 111–125.
Salter, T.M. (1936) Plantae Novae Africanae series VI. *Journal of South African Botany* II: 47–60.
Salter, T.M. (1936) Plantae Novae Africanae series VII. *Journal of South African Botany* II: 145–163.
Salter, T.M. (1940) Plantae Novae Africanae series XIII. *Journal of South African Botany* VI, 1–20.
Salter, T.M. (1944) The genus *Oxalis* in South Africa: a taxonomic revision. *Journal of South African Botany* Supplementary Vol. 1. Cape Times Limited, Cape Town, 355 pp.
Sun, Y., Skinner, D., Liang, G. & Hulbert, S. (1994) Phylogenetic Analysis of *Sorghum* and Related Taxa Using Internal Transcribed Spacers of Nuclear Ribosomal DNA. *Theoretical and Applied Genetics* 89: 26–32.
http://dx.doi.org/10.1007/bf00226978
Turczaninou, N.S. (1858). *Bulletin de la Société Imperiale des Naturalistes de Moscou* 31: 435.
Williamson, G. (1999). A new succulent *Oxalis* (Oxalidaceae) from the Richtersveld. *Aloe* 36: 68–70.
Williamson, G. (2000) *Richtersveld, the enchanted wilderness.* Umdaus Press, Pretoria, 258 pp.