

## Lost for a Century: Rediscovery of the Endemic Ridley's Jewel Orchid, *Zeuxine exilis* Ridl., on Christmas Island, Indian Ocean

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### Abstract

In a botanical expedition to Christmas Island in 1904, Sir Henry Ridley\*, the first director of the Singapore Botanic Garden, discovered and thereafter described an endemic ground orchid, *Zeuxine exilis* Ridl. Botanical expeditions and surveys over the century since the original discovery failed to relocate *Z. exilis*. We report here the rediscovery of *Z. exilis* in rainforest in the western section of the island, and in Ridley's honour, propose "Ridley's jewel orchid" as its common name. The distribution and conservation status of *Z. exilis* remains to be determined. Despite a century of ecological insults to this unique oceanic island, primarily through phosphate mining and the introduction of invasive species, the rediscovery of this endemic orchid renews hope that the imperiled biodiversity on this island is resilient and can be conserved.

### Introduction

More than a century ago, Sir Henry N. Ridley\*, founding director of the Singapore Botanic Gardens, visited Christmas Island on two occasions, first for just 10 hours in 1890 (Ridley, 1891) and again in 1904, for about five weeks (Ridley, 1905a). This oceanic island, 360 km south of Java in the northeastern Indian Ocean (10°29' S, 105°38' E) is covered in tall tropical rainforest where it has not been cleared for phosphate mining. Ridley's expeditions yielded important collections that served as the basis for his comprehensive treatment of the island's flora (Ridley, 1905b). He described several new species as endemic to the island, and one of these, *Zeuxine exilis* Ridl. (Orchidaceae), has not been collected since, and was presumed extinct. Here we report on the rediscovery of this endemic orchid, 105 years after its first and only collection.

\*Correction:

Ridley was not made "Sir". Ridley was made "Commander St Michael & St George" (CMG), and not Knight CMG (KCMG), which would have made him Sir.

## The rediscovery and identification of *Zeuxine exilis*

Specimens of an unidentified ground orchid were collected on 17 Nov 2009 from rainforest in the western area of the island. An initial identification as *Z. exilis* was made by reference to Du Puy *et al.* (1993) and by comparison with digital images of herbarium specimens from the Singapore Botanic Gardens (Fig. 1A) and the Royal Botanic Gardens, Kew. An authoritative determination was provided by Dr. M. Clements, orchid specialist at the Centre for Plant Biodiversity Research, Australian National Herbarium (CANB) Canberra, Australia. Given the undetermined conservation status of *Z. exilis*, we do not report specific localities. Specimens are currently being lodged with the Australian National Herbarium.

Although most individuals of *Z. exilis* observed in the field were senescing (see below), we located several fresh plants (Fig. 1B-F). The attributes observed are consistent with Ridley's initial description (Ridley, 1905b, p. 236, presented below with SI units):

“Whole plant 30-45 cm tall, succulent, rhizome shortly creeping, roots fleshy. Leaves lanceolate, acute, light green, 2.5-7.5 cm long, 1.2-2 cm wide, glabrous, shortly petioled; sheaths papery, 1.2 cm long. Stem white-hairy, peduncle 7.5-15 cm long, raceme many-flowered, 2.5-7.5 cm long. Bracts lanceolate, acuminate, hairy. Sepals reddish, hairy, lanceolate, acute, 3 mm long. Petals thin, white, adnate to the upper sepal. Lip base saccate with broad wings, then narrowed, limb broadly bilobed, lobes broad oblong, divaricate edges crenulate, processes in the base of the lip slender, subulate, curled, whole lip white with a central yellow bar. Column short, anther lanceolate, beak up-curved, dull red, pollinia elongate, pyriform, disc large, oblong. Rostellum lobes linear, acuminate. No accessory processes. Capsule pubescent, elliptic, 6 mm long. Centre of the island, among ferns, not rare. Endemic.”

Given its all too brief history, *Z. exilis* has never enjoyed a common name. We name this species as “Ridley's jewel orchid” in honour of his important contributions to botany on Christmas Island, and his discovery and description of *Z. exilis* in particular.

### Natural history of *Zeuxine exilis*

The genus *Zeuxine* comprises approximately 70 species, mostly distributed in the tropics from Africa through southern and southeast Asia to Australia and the Pacific (Ormerod *et al.*, 2003). Species in the genus vary in their life histories from annual to perennial. On Christmas Island, Ridley collected

*Z. exilis* in full flower in Oct 1904, whereas we found mostly senescent plants in Nov 2009. This suggests that *Z. exilis* appears aboveground for relatively brief periods. It is unclear whether plants die off completely or just back to rhizomes. Reproductive systems in *Zeuxine* vary from outcrossing in *Z. gracilis* to apomixis in *Z. strateumatica* (Sun and Wong, 2001). *Zeuxine exilis* may be apomictic given that all flowers appear to set fruit. We found individuals in both heavily shaded rainforest understorey and in disturbed, higher-light environments next to roads. Clearly, more information on the life history, breeding system, and population biology of *Z. exilis* is needed. Furthermore, *Z. exilis* is morphologically similar *Z. gracilis* and their taxonomical differences need clarification.

### Discussion

Rugged terrain and limited time forced the earliest naturalists visiting Christmas Island, J. J. Lister in 1887 (Lister, 1888) and H. N. Ridley in 1890 (Ridley, 1891), to confine their activities to the area immediately surrounding Flying Fish Cove, the only safe anchorage. The upper plateau was not surveyed by a naturalist until C.W. Andrews stayed on the island for 10 months in 1897/98 (Andrews, 1900). Although he collected several orchid species, he did not find *Z. exilis*. Ridley made his second collecting trip to the island in October 1904, this time for about five weeks. He made several collecting forays in the northeast of the island (Ridley, 1905a), but also made an expedition of several days duration in which he traversed the island across the upper plateau from northeast to southwest (Fig. 2). It was on this trip that Ridley collected a species of *Zeuxine*, and later formally described it as an endemic species, *Z. exilis*, in a major work, *The Botany of Christmas Island* (1905b).

Ridley's specimens from that day were eventually sent to the Singapore Botanic Gardens (SING 0046902, see Fig. 1A), the Royal Botanic Gardens at Kew (K00079379), and the Natural History Museum, London (BM00007629). Both the SING and BM specimens are labeled holotypes, while the Kew specimens are labeled lectotypes. Apparently, there is a need to lectotypify the species to resolve the designation of the type status. The specimen collection labels on both the Singapore Botanic Gardens and Kew Gardens' sheets have the collection date and location simply stated as "Murray Hill Track, Oct 1904". In 1904, this track extended a considerable distance, some 15 km, from Flying Fish Cove in the northeast, to Murray Hill and beyond in the west.

We can now pin down the exact collection date and narrow considerably the area in which Ridley discovered *Zeuxine exilis*. In addition to the formal description of his collections (Ridley, 1905b), he gave an almost daily

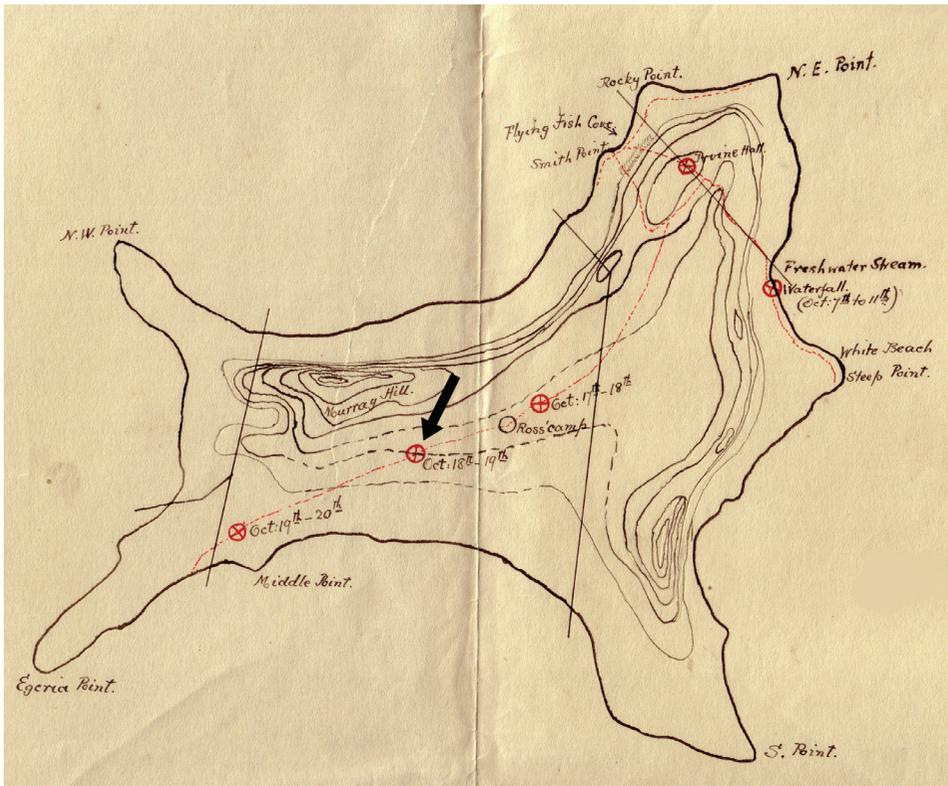
description of his collecting activities (Ridley, 1905a), including the day he discovered *Z. exilis*. He describes finding this plant on 18 Oct, 1904, close to where he and the party spent the night of 18/19 October, southwest of Ross' 'old encampment'. Ridley did not provide a map to show even approximately where this location may have been, and since then, formal descriptions of the orchids of Christmas Island (Wood, 1982; Du Puy *et al.*, 1993) have been forced to report Ridley's original, imprecise locality. However, many years after the 1904 expedition, Ridley's fellow expeditioner, Dr Karl Hanitsch, the first curator of the Raffles Museum, prepared handwritten notes for a lecture he gave to the Ashmolean Natural History Society of Oxfordshire on 15 May, 1923 (Hanitsch, 1923). This unpublished manuscript contains a map of Christmas Island marked with the exploring party's route and campsites (Fig. 2). The coastline and contours in this map have obviously been copied from the foldout map in Andrews' (1900) monograph, and we presume that Hanitsch drew on his original field notes from 1904 to plot the route. Knowing the exact date that Ridley collected *Z. exilis*, and where the party was on that day from Hanitsch's map, we can now narrow the type locality to somewhere in the vicinity of present-day Aldrich Hill, or perhaps to its west.

*Zeuxine exilis* has not been collected since, even though the island has been re-surveyed several times. Comprehensive collections were made by D.A. Powell and H'ng Kim Chey in the 1980s and by B.A. Mitchell in 1984 (Mitchell, 1985). These collections have been lodged at Kew and the Australian National Herbarium in Canberra, respectively. D.J. Du Puy visited the island twice in 1987 in preparation for his treatment of the flora of Christmas Island (Du Puy, 1993). Here Du Puy listed *Z. exilis* as 'apparently extinct' (p. 13), and 'possibly endangered' (p. 521). Previously, in an unpublished report that focused on native and endemic plants with limited distributions, he had listed *Z. exilis* as 'extinct' (Du Puy, 1988). Since then two other attempts have been made to locate this orchid, both without success (Holmes and Holmes, 2002; R. de Kok, Royal Botanic Gardens Kew, pers. comm., 2009). Even though *Z. exilis* has been considered extinct by botanists, it has no official status as such under the Environment Protection and Biodiversity Conservation Act (1999) in Australia.

Ridley's original account of *Z. exilis* described it as 'not rare.' Why then has it taken more than a century for it to be seen again? We believe that Ridley's jewel orchid was not present in the western area of the island where it was rediscovered until the last few years. We conducted intensive seedling surveys across this area over 10 years from the late 1980s (Green *et al.*, 1997, 2008) and never encountered it. These surveys included the transition from dry to wet season (Oct-Dec) when *Z. exilis* should be evident. Similarly, inappropriately timed surveys cannot explain the failure of Du



**Figure 1.** *Zeuxine exilis* Ridl. A. Holotype of *Zeuxine exilis* Ridl. (SING 0046902; scale bar is 10 cm); B. *Z. exilis* in situ in rainforest, 17 Nov, 2009 (bar is 5 cm); C. Lanceolate leaf (bar is 4 cm); D. Creeping rhizome (bar is 3 cm); E. Flowers (bar is 3 mm); F. A raceme showing flowers, with developing and dehiscent capsules (bar is 3 cm).



**Figure 2.** Hanitsch's original hand-drawn map of the 1904 expedition to Christmas Island (see Hanitsch, 1923). Expedition route is a red dashed line; camping locations with dates indicated by red crossed circles. Arrow indicates campsite on 18/19 Oct 1904 near the site where Ridley collected *Zeuxine exilis*.

Puy (1988), Holmes and Holmes (2002), or the team from Kew in 2005 (R. de Kok, pers. comm.) to relocate the orchid. We can only note that the reappearance of the orchid coincides with major changes in rainforest understory structure as a result of widespread invasion by the yellow crazy ant (*Anoplolepis gracilipes*) and its impacts (O'Dowd *et al.*, 2003). Until the distribution and abundance of Ridley's jewel orchid is determined across the island, the reasons for its unexpected but welcome reappearance, 105 years after Ridley's discovery, remain enigmatic.

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## References

- Andrews, C.W. 1900. *A Monograph of Christmas Island*. British Museum (Natural History), London.
- Du Puy, D.J. 1988. Mapping of Christmas Island native and endemic plants with limited distributions. Unpublished report to the Australian National Parks and Wildlife Service, Canberra, A.C.T., Australia.
- Du Puy, D.J. 1993. Christmas Island, pp. 1-30. In: *Flora of Australia*, vol. **50**, *Oceanic Islands*. Australian Government Publishing Service, Canberra, A.C.T., Australia.
- Du Puy, D.J., D.L. Jones, and E. Edgar. 1993. Orchidaceae, pp. 516-528. In: *Flora of Australia*, vol. **50**, *Oceanic Islands*. Australian Government Publishing Service, Canberra, A.C.T., Australia.
- Environment Protection and Biodiversity Conservation Act. 1999. Australian Government, Department of Environment, Water, Heritage and the Arts. Canberra, A.C.T., Australia. <http://www.environment.gov.au/epbc/about/index.html> (accessed 6 December 2009).
- Green, P.T., D.J. O'Dowd, and P.S. Lake. 1997. Control of seedling recruitment by land crabs in rain forest on a remote oceanic island. *Ecology* **78**: 2474-2486.
- Green, P.T., D.J. O'Dowd, and P.S. Lake. 2008. Recruitment dynamics in a rainforest seedling community: context-independent impact of a keystone consumer. *Oecologia* **156**: 373-385.
- Hanitsch, K.R. 1923. A visit to Christmas Island. Unpublished manuscript. Oxford University Museum archives, Oxford.

- Holmes, J. and G. Holmes. 2002. Conservation status of the flora of Christmas Island, Indian Ocean. Unpublished report to Parks Australia North, Christmas Island, Indian Ocean.
- Lister, J.J. 1888. On the natural history of Christmas Island, in the Indian Ocean. *Proceedings of the Zoological Society of London* **1888**: 512-564.
- Mitchell, B. A. 1985. A vegetation survey of Christmas Island. Unpublished report for the Australian National Parks and Wildlife Service. 40 pp., including Appendix II. List of collections made on Christmas Island for the National Botanic Gardens Herbarium during June/July and November/December 1984.
- O'Dowd, D.J., P.T. Green, and P.S. Lake. 2003. Invasional 'meltdown' on an oceanic island. *Ecology Letters* **9**: 812-817.
- Ormerod, P., P.J. Cribb, and A.M. Pridgeon. 2003. *Zeuxine*, pp. 151-153. In: A.M. Pridgeon, P.J. Cribb, M.W. Chase and F.N. Rasmussen (eds.). *Genera Orchidacearum*: vol. 3 (Vanilloideae and Orchidoideae, part 2). Oxford University Press, Oxford.
- Ridley, H.N. 1891. A day at Christmas Island. *Journal of the Straits Branch, Royal Asiatic Society* **23**: 123-139.
- Ridley, H.N. 1905a. An expedition to Christmas Island. *Journal of the Straits Branch, Royal Asiatic Society* **45**: 137-155.
- Ridley, H.N. 1905b. The botany of Christmas Island. *Journal of the Straits Branch, Royal Asiatic Society* **45**: 156-271.
- Sun, M. and K.C. Wong. 2001. Genetic structure of three orchid species with contrasting breeding systems using RAPD and allozyme markers. *American Journal of Botany* **88**: 2180-2188.
- Wood, J.J. 1982. The orchids of Christmas Island. *The Orchadian* **7**: 142-146.