

PLANT PORTRAIT

1145. *Nervilia singaporensis* Niissalo

Orchidaceae

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Summary

We describe and illustrate *Nervilia singaporensis* Niissalo, a small Southeast Asian terrestrial orchid which has only been collected in Singapore. This is a mostly cleistogamous species, superficially similar to other cleistogamous species in the *Nervilia adolphilpunctata* species alliance. Most flowers never open but develop immediately to seed capsules. Unlike many species in the genus, *N. singaporensis* lacks strict vegetative, dormant and flowering seasons and flowering and fruiting plants can be found year-round, sometimes simultaneously with the leaves. This genus is poorly understood in Malesia, which could explain why this species has not been recorded in other countries.

Nervilia Comm. ex Gaudich. (Orchidaceae) is a genus with a wide distribution ranging from Africa and Asia to Australasia (Pridgeon et al., 2005). They are mostly rootless, tuberous plants with a single palmately veined leaf, often with obvious lobes. In Malesia, the genus is poorly studied. In particular, the *Nervilia adolphilpunctata* species alliance in *Nervilia* sect. *Linervia* Schltr. is noted for its taxonomic complexity, but most of the taxonomic work has focused on mainland Southeast Asia, South Asia and East Asia (e.g. Gale & Watthana, 2014; Gale et al., 2018). Currently the number of species in the complex is c. 30 (Gale et al., 2018). Until recently, material from this alliance in Singapore was included under an umbrella name *Nervilia punctata* (Blume) Makino (e.g. Davison et al., 2008; Chong et al., 2009).

After more than a century without any observations, a living population of *Nervilia* in Singapore was found in 2019, and it became obvious that the Singapore material is distinct from *N. punctata*. The population was quickly named as a new species, *Nervilia singaporensis* Niissalo (Niissalo et al., 2020). It was first collected by H.N. Ridley in 1889 but there were no

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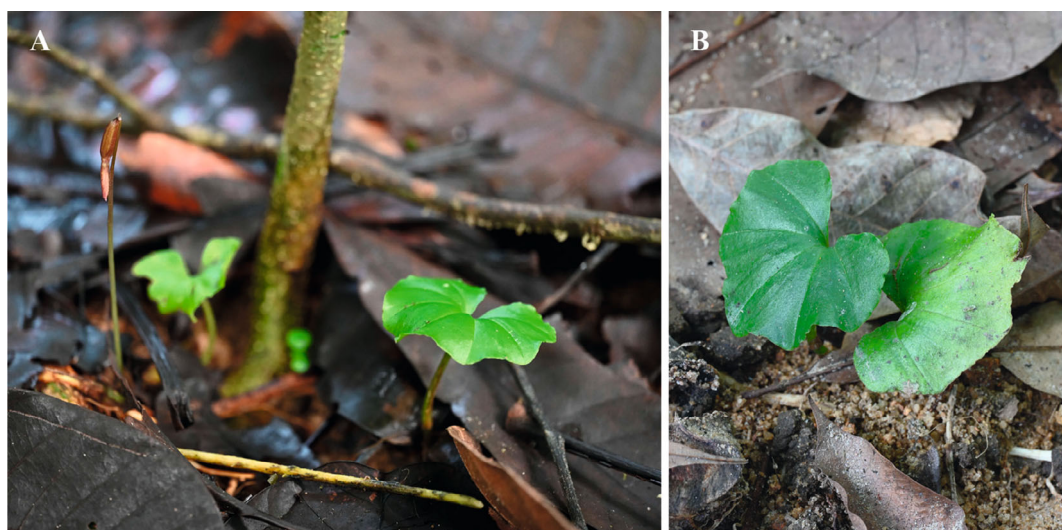


FIGURE 1 *Nervilia singaporensis* plants in habitat. A) small clump with green leaves and a developing fruit; B) two leaves on a sterile plant. Photographs Matti A. Niissalo.

collections of it between 1907 and 2019. At the time of the original description, it was only known from Bukit Timah, but it has since also been found in other forested areas in Singapore (Plate 1145, Figure 1).

POLLINATION

The species is largely cleistogamous but there are no detailed studies on the rates of self-pollination. The flowers usually develop into fruit almost immediately. The capsule splits 3–4 weeks after the inflorescence has reached flowering length. At least in most flowers, the anther cap does not fully cover the pollinia and there is no rostellum, so the pollinia are free to touch the stigmatic surface, perhaps already early in the flower development. Occasionally, buds develop fully, go through anthesis and remain open for c. three days. These open flowers emerge from the same tubers as the cleistogamous flowers, often during the same flowering event. They sometimes wither without producing fruits, but we have observed pollinia touching the stigma in the open flowers. It is not clear if there is a mechanism for the pollinia to attach to a pollinator. In the flowers we have observed, the pollinia have been firmly attached to the stigmatic surface at anthesis, so they could not be removed without destroying the pollinia, and it is possible that the pollen germinates on the stigma before the flower fully develops. More observations are needed on the behaviour of pollinia and anther caps on the open flowers, but this is difficult as they are rarely seen. We have not dissected developing flower buds to determine the timing of pollen placement on the stigma (Figure 2).

CULTIVATION

PROPAGATION. The species can be germinated *in vitro*. We have estimated the number of seeds in one well-developed, large, self-pollinated capsule, at c. 10,000 seeds. It appears that the number of seeds varies considerably between capsules. Seeds are relatively easily acquired, as nearly all flowering plants produce fruits. Germination rate is low. Germination takes c. 2–4 months



PLATE 1145 *Nervilia singaporensis*

ANGELINA CHEONG

in darkness and in light using Vacin and Went medium (Vacin & Went, 1949) supplemented with 75 ml /l coconut water, pH 5.25, agar 10 g/l; or ½ strength Murashige and Skoog medium (Murashige & Skoog, 1962) + 20 g/l sugar, 20 g/l potatoes, 1 g/l peptone, 100 ml/l coconut, 1 g/l activated charcoal, pH 5.6, agar 7 g/l. The plants develop fast and reach flowering size around one year later. Planting out of both green plants and dormant tubers has been successful, with no obvious difference in the success rate. They continue to produce stolons, new tubers, flowers and fruits in vitro (Figure 3).

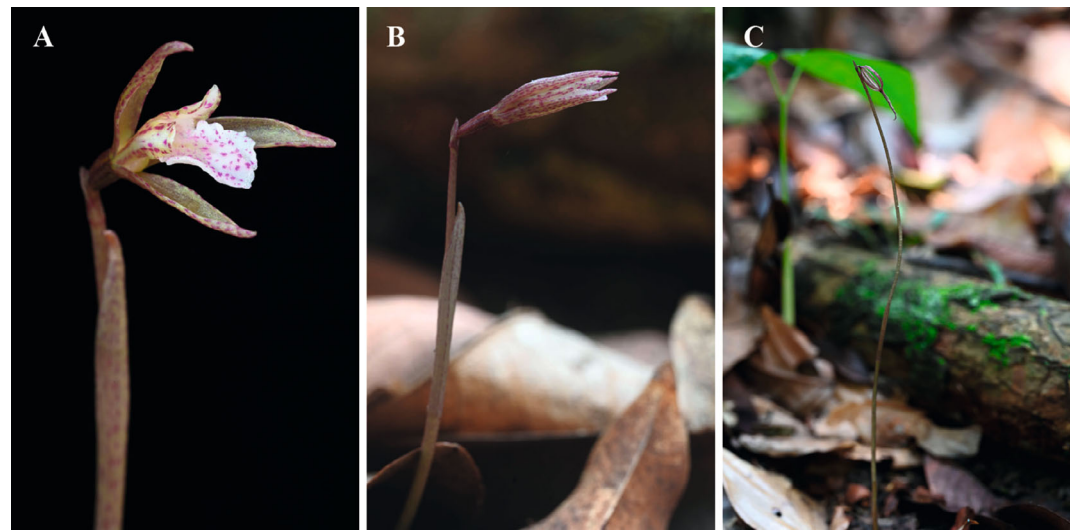


FIGURE 2 A, Naturally opened flower of *Nervilia singaporensis* on a plant in habitat; B, C, flowering and fruiting plant planted in a semi-natural environment at the Gardens. Photographs Matti A. Niissalo.

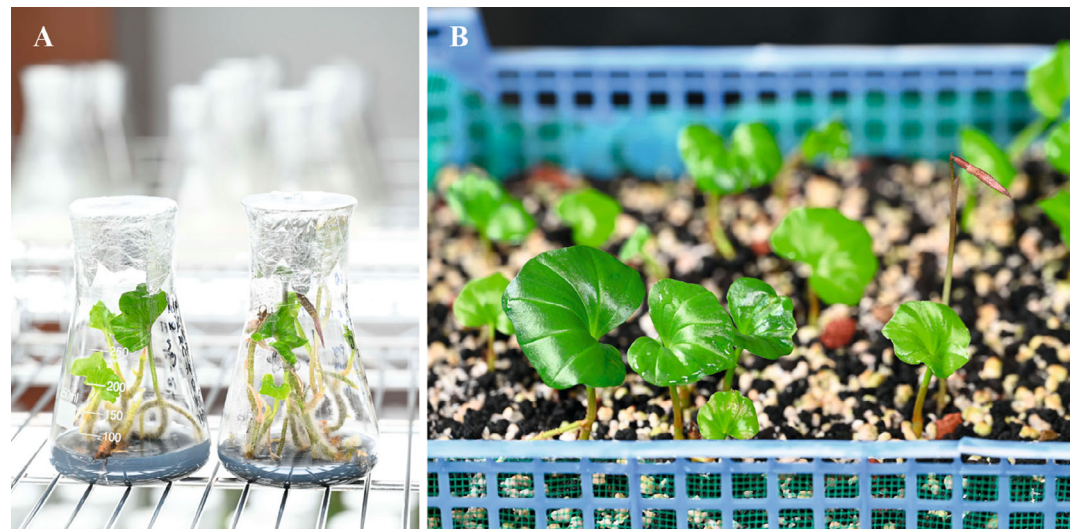


FIGURE 3 Cultivation of *Nervilia singaporensis* at Singapore Botanic Gardens. A) Mature seedlings in tissue culture, producing leaves, stolons, flowers and fruits; B) ex vitro plants in cultivation trials. Photographs Matti A. Niissalo.

It is also possible to propagate *Nervilia singaporensis* vegetatively. It can multiply by producing several stolons with terminal tubers. One plant can produce three new tubers per growth cycle.

CULTIVATION CONDITIONS. Plants grown from wild-collected seeds have been cultivated in the Singapore Botanic Gardens since 2023, and a small number of wild-collected plants have been grown for several years. Based on initial results, the species adapts well to nursery conditions. It seems to prefer evenly moist but not wet substrate, humid air with good air movement, and it can be grown in various porous substrates in bright but filtered light, but it does not adapt well to a pure bark substrate. Plants can also be grown in cooler temperatures under climate control, in a closed terrariums with sphagnum moss as the growing medium. The plants seem to be long-lived, with a new flush of growth soon after flowering. As with the wild plants, they are sometimes evergreen, but often the leaves die down before the flowers emerge. We are undertaking further cultivation trials on this species and have planted a small number of individuals in semi-natural conditions at Singapore Botanic Gardens, with plans to reinforce the populations in Singapore's nature reserves.

So far, most seed-grown plants have been from Bukit Timah Nature Reserve. Population genetic approaches will guide which other subpopulations need to be preserved *ex situ*. Other than as a curiosity, the species is likely to have little value for orchid collectors due to the flowers that rarely open.

NOMENCLATURE AND DESCRIPTION

Nervilia singaporensis Niissalo, Gard. Bull. Singapore 72(1): 4 (2020). Type: SINGAPORE. Bukit Timah Nature Reserve, 3 Dec 2019, *M.A. Niissalo SING2019-1365* (holotype SING [SING0273892]).

Glabrous deciduous or evergreen terrestrial herb, often flowering leafless, up to 6 cm tall in leaf, up to 9 cm tall in flower and up to 26 cm tall in fruit. *Tuber* whitish, approximately spindle-shaped, 10–23 mm long, 7–12 mm in diameter, partially covered in pale brown, soon degrading sheaths and sometimes with a few short protrusions (possibly vestigial roots) emerging from internodes. *Stem* subterranean, emerging vertically from the apical node of a tuber, 2–4.7 cm long, covered in a fine plume of root-like hairs, with small translucent sheathing bracts, producing either flowers or a single leaf and 1–3 lateral stolons c. 1 mm thick and up to c. 5 cm long; new tubers are formed at the ends of the stolons. *Leaf* appearing at the tip of the stem (sterile plant) or from lateral buds following flowering (fertile plant), pseudopetiolate; pseudopetiole erect, 1.5–4 cm long, 0.7–1.8 mm in diameter, bright green, sulcate, sheathed by 1 or 2 membranous cataphylls 1.2–1.6 cm long, which are sometimes deciduous; leaf blade slightly plicate, horizontal, cordate to polygonal, with 7 main veins diverging palmately, 3.2–9.0 cm long, 2.9–9.0 cm wide, cordate at base, uniformly green, glossy on both surfaces, leaf lobes short, usually rounded, apical lobe sometimes acute; margin entire. *Inflorescence* terminal, whitish-brown; with 0–2 lateral inflorescences emerging at nodes below ground; above-ground parts of the inflorescence unbranched, 1-flowered, 6–9 cm tall, 0.8–1.7 mm in diameter, pale brownish green, spotted with pink, bearing 1–2 pale, pink-spotted sheathing sterile bracts 0.8–2 cm long; floral bract encloses the pedicel at base, 3.5–4.5 mm long, 1.5 mm wide, acute. *Flower* resupinate, erect in bud, becoming horizontal over a period of one day, and over two days gradually nodding; only slightly opening at the apex (rarely opening more widely for 2–3 days), 18–25.5 mm long, sepals pale green-brown covered in purple spots, petals white to pale yellow-brown with purple spots, labellum pale pink, covered throughout in bright violet spots, with a light green central line on the disk, column white with conspicuous purple spots; scent not detected; pedicel and ovary 3.7–11 mm long (elongating over time). *Sepals* narrowly elliptic,

acute, 3-veined; dorsal sepal 14–15.5 mm long, c. 1.8 mm wide; lateral sepals slightly oblique, 14–15.5 mm long, 1.8–2.0 mm wide. *Petals* narrowly elliptic, 12–13.8 mm long, 2–2.4 mm wide, acute, 3-veined. *Lip* trilobed, narrowly oblong, 12–13.8 mm long, not saccate or swollen at the base, basal disk 4.5–5 mm long, 2.2–3 mm wide at its widest, margins rolled upwards at the base and embracing the column, sides less strongly incurved towards the apex; lateral lobes acute, 0.9–1.1 mm long, appressed to the column; mid-lobe narrowly oblong, 7–7.5 mm long, 2–2.5 mm wide, flat at the base but with sides rolled or folded up towards the apex, margin entire but slightly irregularly rounded-dentate and with short papillae, apically obtuse, truncate or shallowly emarginate; upper surface shortly papillose throughout; the violet spots are formed by clusters on coloured papillae. *Column* clavate, 4.5–4.7 mm long, c. 1 mm in diameter at the base, dilating to c. 1.4 mm at the apex, ventral side covered in short hairs, with a pronounced, irregularly lobed clinandrium, c. 1.4 mm long at the dorsal side (covering most of the anther, and surrounding the anther cap); stigma pillow-shaped, c. 1.2 mm wide; anther cap oblong, c. 1.4 mm long and 1.1 mm wide, concave at the apex; pollinia 1.1–1.2 mm long, reaching the stigma at anthesis, not easily removed from the stigma; rostellum absent. *Capsule* ovoid to fusiform, dehiscent almost round after seeds have been released, drooping, dehiscent, 9–10 mm long, c. 4.2 mm wide, perianth on capsule persistent even after dehiscence. *Seeds* up to c. 10,000 in each pod, fusiform, terete, curved, c. 0.9 mm long, c. 0.15 mm wide, transparent, whitish, with a minute orange-yellow embryo in the centre (adapted from Niissalo et al., 2020, augmented with further observations and measurements). Figure 4.

NOTE: The fruits develop fast. From the day that the flower turns from upright to horizontal (which can be considered the equivalent of anthesis), it takes 21–28 days until the fruit splits. Most flowers produce a capsule without any external stimulus.

DISTRIBUTION. Endemic to Singapore. This species occurs in Bukit Timah Nature Reserve (BTNR, where it is more widespread than assessed by Niissalo et al., 2020), Bukit Batok Nature Park (BBNP), Rifle Range Nature Park (RRNP) and Tengah Forest. So far only a small number of plants have been found in the largest forest reserve in Singapore, Central Catchment Nature Reserve (CCNR).

HABITAT & ECOLOGY. Almost all the known plants occur in secondary tropical forest in leaf litter. Often, they are found on slopes in clay soil amongst clumps of introduced *Dracaena fragrans*. Sometimes they occur amongst the roots of large figs (*Ficus* spp.). The few plants known from CCNR occur in Nee Soon Freshwater Swamp Forest, in wet soil in relatively undisturbed forest.

FLOWERING & FRUITING TIME. Individual plants have cycles of growth and blooming, but vegetative, flowering and fruiting plants can all be found at any time of the year in the biggest populations. We have observed one to two growth cycles in an individual per year. Sometimes, especially after several weeks of drought, populations become almost entirely dormant before flowering (as observed by Niissalo et al., 2020), but it is also common to see clumps with leaves, flowers and fruits simultaneously.

CONSERVATION STATUS. This species is nationally listed as Endangered (EN; Middleton et al., 2024). The threat level is lower than previously assessed by Niissalo et al. (2020) and Lindsay et al. (2022; CR), as the number of localities and the number of individuals has become better understood. Only one historical location in Stagmount has been lost, but the populations in BBNP, CCNR and Tengah Forest are all relatively close to that locality. The largest population is close to a public footpath. So far, there is no evidence of poaching. The amount of seemingly suitable habitat is extensive in Singapore. Several new localities

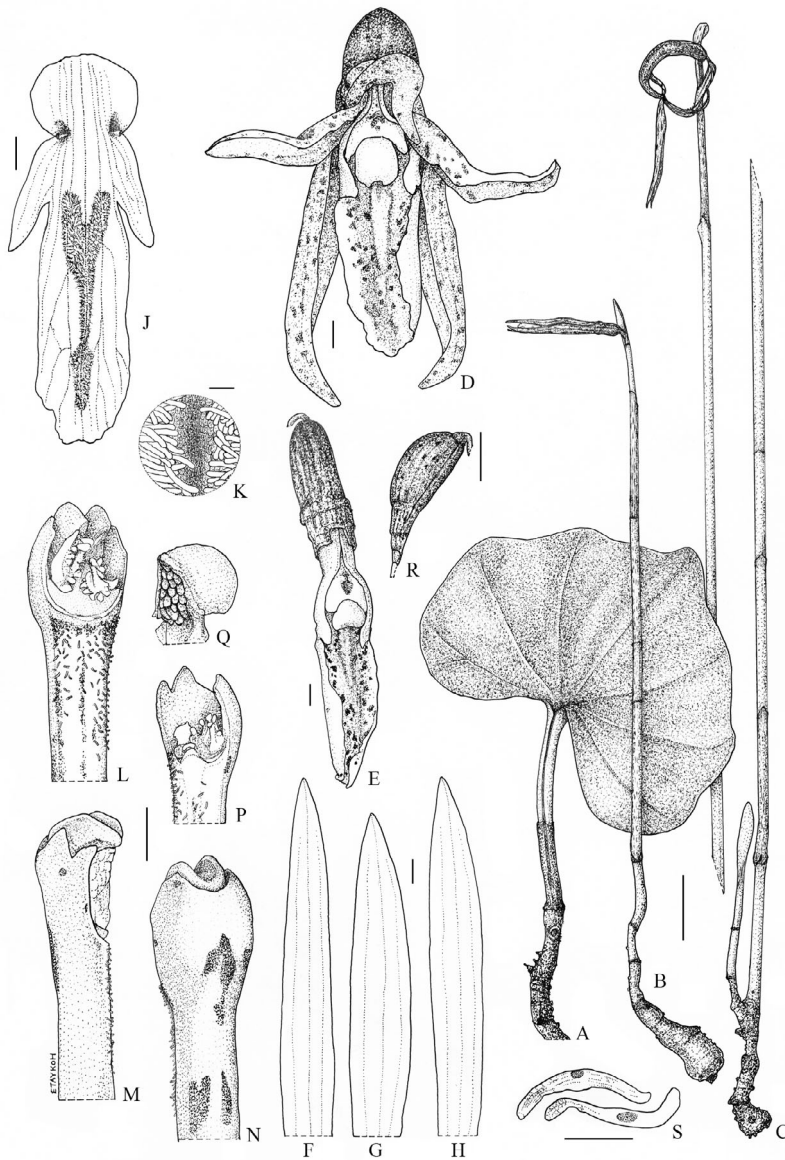


FIGURE 4 *Nervilia singaporensis* Niissalo. A) leafy shoot; B) inflorescence; C) infructescence with a lateral inflorescence; D) manually opened flower, front view; E) flower with sepals and petals removed; F) dorsal sepal; G) petal; H) lateral sepal; I) labellum pressed out; J) details of papillae in the depression in the central ridge of the labellum; L) column, bottom view; M) column, side view; N) column, oblique top view; P) column with anther cap removed, oblique front view; Q) anther cap with incomplete pollinia still attached, side view; R) ripe capsule prior to dehiscence; S) seeds. Scale bars: A–C, 10 mm; D–J & L–Q, 1 mm; K, 0.2 mm; R–S, 0.5 mm. Drawn by Evonne Tay-Koh from M.A. Niissalo SING 2019–1365. Reproduced from Niissalo et al. (2020).

have been found since the initial rediscovery in 2019. The initial global conservation assessment proposal for this species (Niissalo et al., 2020) was misled in some regards. As this species is almost exclusively found in secondary forests, habitat fragmentation and edge effects are of less concern than initially estimated. One of the subpopulations (Tengah Forest) has been scheduled for development; however, the number of plants there is not known; only

one plant has been collected, and the effect on the total population size may be negligible. The total number of mature individuals (< 250 plants), extent of occurrence (8.844 km²) and area of occupancy (16 km²)—the latter two calculated using <https://geocat.iucnredlist.org/>—are larger than initially assessed. Our revised proposal for the global conservation assessment is EN (D; IUCN Standards and Petitions Subcommittee, 2024).

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