619. LOTUS MACULATUS

Leguminosae – Papilionoidae

Plant in Peril 30

Nicholas Hind

Summary. The name '*Lotus maculatus* Breitf.' is shown not to have been validly published when Breitfeld first provided her description in 1973. The species, a critically endangered endemic of Tenerife in the Canary Islands, is described here, and the holotype selected. The plant is illustrated in colour, provided with line drawings of dissections, described in detail, and aspects of its relationships, cultivation and biology discussed.

The genus *Lotus* L. (Leguminosae: Papilionoideae: Loteae), colloquially known as the BIRD'S-FOOT-TREFOILS (based on the appearance of the elongated pods spreading stiffly from the stem bearing the inflorescence, like a bird's foot), is a taxonomically difficult genus of between 100 and 180 species, depending upon the treatment (Brand, 1898; Polhill, 1981; Mabberley, 1997; Sokoloff & Lock, 2005). Kunkel (1974) described the genus as largely homogeneous except, that is, for a small group of species from Macaronesia. As viewed by Brand (1898), Callen (1959) and Monod (1980), the Canary Island species were recognised by their erect, and forked or toothed style, a feature not found elsewhere in the genus, except that is for *Lotus creticus* L.

Bramwell & Bramwell (2001) covered the 19 species of the genus native to the Canary Islands, noting that 15 of them, members of *Lotus* subgen. *Pedrosia* (Lowe) Brand, can be relatively difficult to identify. Two of the other four (*L. berthelotii* Masf. and '*L. maculatus* Breitf.') Kunkel transferred to the genus *Heinekenia* Webb ex Christ (Kunkel, 1974: 9–10). However, *Heinekenia* is no longer recognized and, to these two, two other species were added, the four now constituting *Lotus* subgen. *Rhyncholotus* Monod (Monod, 1980; Perez de Paz, 1990): *L. berthelotii* (Tenerife), *L. eremeticus* A.Santos (La Palma), *L. pyranthus* P. Pérez (La Palma) and the species that is the subject of this plate, from Tenerife.

The plant illustrated here is the second species of *Lotus* subgen. *Rhyncholotus* to be illustrated in *Curtis's Botanical Magazine*; *Lotus berthelotii* was described by Hooker (1884) as *L. peliorhynchus* Hook. f. During research for the present plate, *L. maculatus*, a problem was found with

Plate 619 *Lotus maculatus* CHRISTABEL KING

the original description. Unfortunately, Breitfeld (1973: 30) not only mentioned that flowering material was seen and collected on 15th March 1971, but also that flowering and fruiting specimens were seen and collected on 8th September 1971. Whilst she certainly used the word 'holotype', no distinction was made as to which material was actually used as the 'holotype' collection and since the material belongs to more than one gathering it cannot be accepted as a type. Breitfeld's name was not validly published under Art. 37.2 of the *International Code of Botanical Nomenclature* (McNeill *et al.*, 2006), hence the new species that we are proposing below. This maintains Breitfeld's authorship, but the species is validly published here, some 35 years after Breitfeld's original article.

One interesting feature of the Macaronesian species in subgenus *Rhyncholotus* is the possession of a number of floral traits, a syndrome, that suggests ornithophily, the visiting and potential pollination of flowers by birds. Such flowers typically present a pollination syndrome simplistically consisting of red-orange-yellow corollas/flowers, often abundant and dilute nectar and a lack of scent (Faegri & van der Pijl, 1971), although personal experience in the New World tropics would indicate that hummingbirds, for example, are no readers of text books. Valido *et al.* (2004) have usefully summarized a number of examples of ornithophilous flowers in the Canary Islands, citing examples of genera in diverse families such the Boraginaceae (*Echium* L.), Campanulaceae (*Canarina* L, *Musschia* Dumort.), Malvaceae (*Lavatera* L.), Scrophulariaceae (*Isoplexis* (Lindl.) J.C.Loudon), and *Lotus*. Valido *et al.* (2004) pointed out, however, that two aspects of these taxa are rather interesting: these ornithophilous-flowered taxa are present in the Macaronesian archipelago but absent in nearby NW Africa and Europe, especially the Mediterranean and, that in Macaronesia there are no specialist nectar-feeding birds to be found, just opportunist passerine species visiting flowers for nectar. In summarising the phylogenetic information (Allan *et al.* 2004), combined with their own studies, Valido *et al.* (2004: 1949) proposed that ornithophily could have either a mainland or a Macaronesian origin, with the closest relatives of the Macaronesian *Lotus* spp. as insect-pollinated Moroccan species, of Mediterranean origin. However, the origin of ornithophily in *Lotus* still remains obscure, especially since there is at present no evidence of the past presence of specialist nectar-drinking birds on the Canarian archipelago.

CULTIVATION. *Lotus berthelotii* has a relatively long history of cultivation, and although far from common, is listed by several nurseries in the current *RHS Plant Finder* (Lord *et al.*, 2007). *Lotus maculatus* however, appears to have been in cultivation for perhaps less than 35 years, and apparently there are only two nurseries listed which stock it.

Growing either of the species, or the hybrids, is fairly straightforward. Plants of hybrid origin have been successfully grown outside in the author's garden in Reading, unprotected for four years in hanging baskets (on south- as well as west- facing walls) and a plant trough (on a north facing party wall, but getting late afternoon sun). The plants are grown in what can only be described as an exhausted John Innes No. 3 loam-based compost (originally made up with some added peat and grit). They are, usually, regularly watered throughout the main growing season and, very rarely, fed with a general all-purpose fertiliser. Other ideal growing conditions would be in rock walls in landscape glasshouses, or in the open if you are fortunate enough to have frost-free conditions. In 2008 the plans by the Decorative Nursery in Kew are for the bulked stock of both species and the hybrid to be used as bedding plants.

In cultivation, plants of both the species and hybrids are usually showing signs of bud in (mid-February–) the March–April period, carrying on flowering well into July, with sporadic flowers appearing into August. Old flowering stems, together with those affected by drought, usually become leafless and woody and as a result are obvious and can be pruned out to maintain a neat-looking plant. During good growing seasons some judicious pruning may be necessary to keep the plants in hanging baskets manageable, if only to stop long stems catching on plants growing below. My young plants have never been pinched out as they branch freely forming hanging curtains of stems of their own accord, usually within the first year, but certainly after two years. Breitfeld (1973) recorded stems usually around 1m and up to 2.5 m amongst rocks; in the hybrids the stems can also grow up to 1.25 m long in hanging baskets.

Although *Lotus maculatus* is considered to be frost sensitive and *L. bertholotii* is considered borderline hardy, little damage has ever been seen on the hybrids in the author's garden throughout the hardest frosts of the last three winters. Damage is restricted to leaves on

the exposed upper parts of the stems as they hang over the edge of the hanging baskets and troughs the plants are in. If penetrating frosts are of short duration, re-growth will quickly cover up the frosted stems, otherwise a fleece covering should keep off the worst of the frost. The greatest problem in some areas is the often dry winter-spring period when drought is the biggest worry.

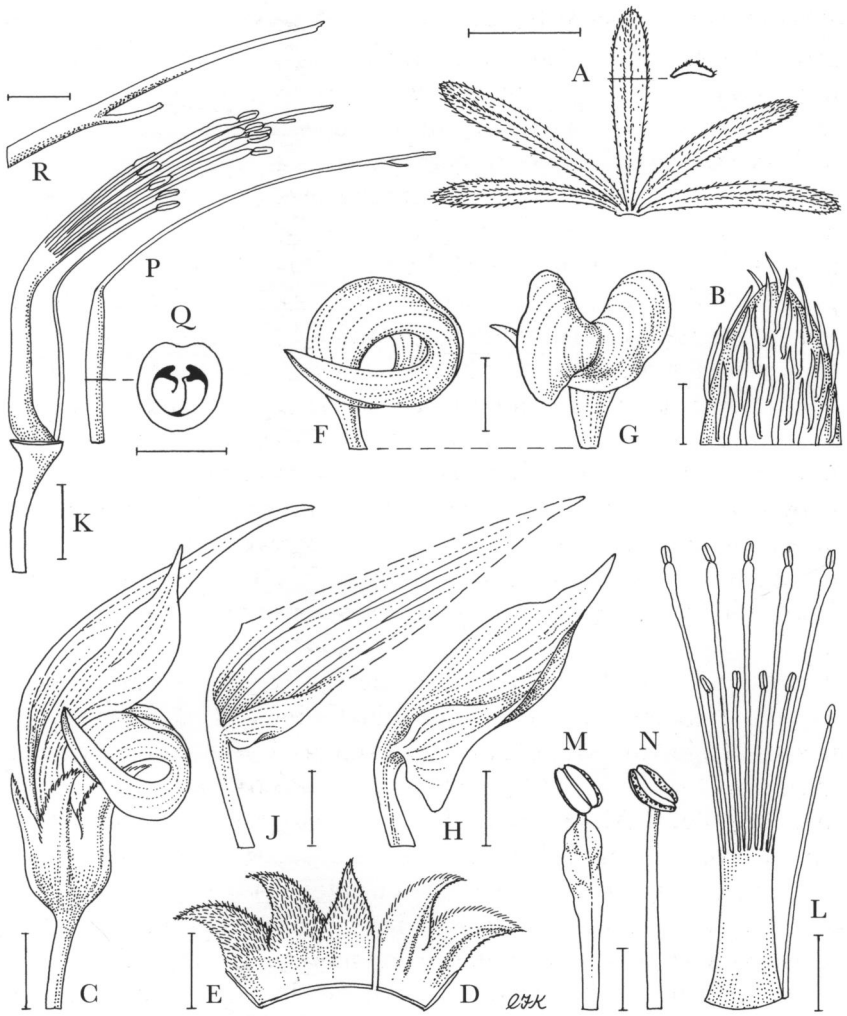
For the author drought is the thing that both the species and hybrids are most prone to, especially if the weather is either dry for too long in the early spring, or too hot and dry during the summer. It is usually the leaves that show signs of stress with the leaf-clusters closing up. If caught quickly by drenching, few problems ensue. However, if left too long there is rapid leaf-loss from the upper parts of the stems and the longer stems go bald very quickly. Re-growth is usually quite quick from the base, and occasionally the terminal buds manage to survive, but all too often whole branches can be lost from near the base. Plants have been lost only through drought, not from winter frosts. Ideally they should never be allowed to dry out and really require constantly moist, but not wet, conditions.

HYBRIDS. Hybrids of *Lotus maculatus* tend to fall into two distinctive groups; those named 'Amazon Sunset' and 'Gold Flash', 'Golden Treasure' or 'Yellow Flash' have coral and apricot, orange, red-orange or gold-coloured mixes, but always with the brownish strip in the middle of the standard and the brownish tip of the tubular keel. The base of the keel, margins of the standard and the wing petals are various shades of yellow through to orange or reddish. The other group, often called 'Red Flash', tend to have completely red petals but still with the dark mid-band of the standard and the dark tip of the keel – from the *L. maculatus* parent. The data sheet for the original stock of *L. maculatus*, accessioned into Kew in 1987 as the cultivar 'Golden Treasure' (but subsequently determined as the true species), was apparently given an Award of Merit at an RHS show in July 1988. However, it was only as recently as 2002 that both *L. berthelotii* '(deep red-flowered)' and the hybrid '*L. berthelotii* × *maculatus*' received Awards of Garden Merit (RHS AGM listing 2004). In that listing the hardiness rating for both was given as 1–3. In Brickell (2003) *Lotus berthelotii* is marked as borderline half hardy; *Lotus maculatus* is noted as frost tender with plants liable to damage if temperatures fall below 5°C, but is recorded as being tolerant down to about –3.8°C. However, plants of *L. berthelotii* × *maculatus* have been

successfully grown outside in the author's garden in Reading, unprotected for the last three winters, with rain, frost and, fortunately, little snow, thrown at them, in hanging baskets and a wall trough. In 2006 several of the plants were in flower before Chelsea week in May and in full bloom in early June.

PROPAGATION. Owens' (1985) studies on *Lotus berthelotii* growing at Kew provided evidence that in that species seed set is very low, at least from self-pollination, suggesting self-incompatibility. Owens proposed that the stock studied at Kew was from a single clone; whether the other accession is from another clone is unknown. The situation in *L. maculatus* is potentially worse, not least because of the critically small natural population that now exists, and because it too is self-incompatible. Seed production is exceedingly uncommon in cultivation, so effectively the only method of propagation is by cuttings. Soft stem, or stem-tip, cuttings (c. 10 cm long) are taken (either early in January or during the summer), treated with hormone rooting powder, and stuck in 75 mm square pots in a 50:50 mix of coarse grit: coir medium; the pots then are placed under a propagator lid over gentle heat. Rooting is almost assured, with at least 80% (often well over 90%) success rate. Rooted cuttings are then planted on individually into 10 cm square pots, in a 1:3 Perlite: John Innes No. 3 loam-based compost, or equivalent, mix, and kept on capillary matting (for ease of watering) until established. Established plants can then either be planted out, as summer bedding, or in hanging baskets or troughs, depending upon whether ground cover or hanging curtains are wanted.

PESTS AND DISEASES. In hanging baskets and wall-mounted troughs there is little problem from snails and slugs, although a watch does have to be kept just to ensure nothing untoward finds its way onto overhanging branches. The greatest problem is from aphids, greenfly sometimes taking a liking to the young flower buds. A proprietary aphid-killer is recommended when any problem is noticed, although a strong spray will knock off most without damaging the plants unduly. Red spider mite could be a problem during the driest part of the season although the author has never experienced this as a major problem provided the plants are kept well-watered; a drip-watering system can be very useful. Carnation Tortrix moth (*Cacoecimorpha pronubana* Hubner) larvae can also be a problem. Treatment, by applying a biological larvicide, such as the bacterium *Bacillus thuringiensis*, or the newer



Lotus maculatus. A, leaf, also showing a cross section through one of the leaflets; B, leaf apex in detail showing 'decumbent' hairs; C, flower; D, calyx, exterior view of two sepals; E, calyx, interior view of three sepals; F, standard petal from beneath; G, standard petal from above; H, wing petal; J, keel sectioned and viewed from inside; K, gynoecium and androecium, showing position of separate stamen; L, stamen bundle opened out; M, anther and upper portion of longer stamen; N, anther and upper portion of shorter stamen; P, style and ovary; Q, section through immature ovary; R, apical portion of style showing fork. Scale bars: A, C–K, N = 5 mm; L, M, P, Q = 1 mm; B = 0.5 mm. Drawn by Christabel King from material grown at K.

Spinosad® (derived from an actinomycete fungus), can control this problem before it gets out of hand. Vine weevil grubs do not appear to be a problem with this particular plant, or its hybrids.

Lotus maculatus Breitf., sp. nov. Type: Spain – Canary Islands – Tenerife: The holotype collection is selected here as the flowering material made on 15th March 1971, *q.v.* Holotype: LPA.

Lotus maculatus Breitf., Cuad. Bot. Canaria 17: 27 (1973), nom. non rite public. [Original type citation: Spain: Canary Islands: 'Habitat in aere humido in fissuris rupium basalticarum in partibus vix accessibilibus regione septentrionale Teneriffae insulae suo unico loco ... et postea 1971 die 15 Martii in plena floratione vidi et legi, idem ipse anno die 8 Septembri cum floribus et fructus legi.' [*Breitfeld* s.n.]. 'Holotype LPA; isotype: Herb. Breitfeld' (according to Breitfeld, 1973: 30).

Heinekenia maculata (Breitf.) G.Kunkel, Cuad. Bot. Canaria 22: 10 (1974).

The validating Latin description was provided by Breitfeld in Cuad. Bot. Canaria 17: 27 (1973).

DESCRIPTION. Herbaceous stemmed, woody-based, pendulous subshrub. *Stems* to 1.5 m or up to c. 2.5 m amongst rocks (although much shorter, c. 30 cm, in cultivation), solid, glabrescent, usually silk grey-green, often pinkish during summer, lower internodes 35–45 mm, side branches 3.5–4.5 cm (5–20 cm long in hybrids), stipules minute. *Leaves* imparipinnate, with 5 leaflets, leaflets 10–25 mm long, x c. 1 mm wide, narrowly subulate to linear, convex above and concave beneath, margins entire, apex obtuse to rounded, surfaces usually moderately pubescent but appearing greyish, hairs appressed and antrorse, uniseriate, multicellular. *Inflorescences* terminal on short axillary vegetative side shoots or on short axillary flowering shoots on side shoots. *Inflorescences* of (1–) 2–4 (–6) flowers, pedicel 5–10 mm long, moderately to densely pubescent; *calyx* campanulate, c. 5.5 mm diam., curved but slightly zygomorphic, upper pair of sepals c. 8 mm long, laterals c. 4 mm long (brown to blackish subcuticular pigmentation appearing when dried or when placed in spirit), inner surface densely short-pubescent, outer surface sparsely to moderately pubescent, margins densely ciliate to barbate. *Flowers* yellow tending towards orange at tips of petals, but with a conspicuous dark band in middle of standard; wings clawed, main limb ovate or broadly lanceolate, distinctly auriculate above claw, c. 20 mm long and c. 6 mm at widest and upper margin curled over and saccate, very sparsely pubescent over venation outside, otherwise glabrous, claw c. 5 mm long and somewhat fleshy; standard c. 25 mm long, strongly recurved back over calyx and usually to one side, petal dark green outside (according to Breitfeld, 1973) and with a dark brownish stripe along length above midrib inside, sparsely pubescent along venation outside, otherwise glabrous, broadly-lanceolate and often recurved to one side back over calyx, conduplicate and keeled towards apex, apex acute; keel ovate, c. 30 mm long, long-beaked, beak turned upwards, brown to burnt umber towards apex; *stamens* diadelphous, 5 longer stamens with filaments c. 18 mm long and broadened and flattened beneath anther, 4 shorter stamens with filaments c. 12 mm long and cylindrical beneath anther, filaments fused into basal tube, free stamen lying above anther cylinder and style, filament cylindrical; *style* exceeding stamens, curved upwards, with sub-apical spur above long stamens. *Fruits* (largely taken from Breitfeld, 1973: 30) c. 3–4 cm long,

narrow, cylindrical, terete, linear, glabrous, constricted between seeds, 2-valved, many seeded; seeds spherical or ovoid, dark brown, shiny, becoming a marbled black.

DISTRIBUTION. Spain – Canary Islands: apparently extremely rare on the northeast coast of Tenerife, near El Sauzal, in the Anaga region. Eight plants (apparently reduced from 12 in 1985) that were recorded by Hernández (1993) on Roque de Tierra, a 'fonolitic islet' just off the northeast coast of Tenerife, have all disappeared (cf. Gómez & Coello, 2004).

ECOLOGY. Halophytic lithophyte on basalt cliffs, along with other xerophytic floristic elements in the association *Frankenio-Astydamietum latifoliae.*

HABITAT. At the base of basalt cliffs with conglomerate outcrops, c. 20–30 (–50) m above sea level.

FLOWERING TIME. (December–) February to May (–August) in the wild, although often with some flowers throughout the year – usually fruiting from February through to August; May to August or September in cultivation, especially amongst the hybrids, although under glass buds can start forming as early as the beginning of February.

CHROMOSOME NUMBER. 2n = 28 (Gómez & Coello, 2004). This count was also recorded for *L. maculatus* × *berthelotii* grown at the Royal Botanic Gardens, Kew (Cyt. No. 86-287), originally from the Instituto Canario de Investigaciones Agrarians from a cross made by Ana Calero in Valle Guerra in the Canary Islands.

CONSERVATION STATUS. When described by Breitfeld (1973), the observed population was restricted to some 30 plants. Walters & Gillett (1998) listed the species as E (Endangered) but, more importantly, the last assessment (Gómez & Coello, 2004) recorded the species as CR (Critical) – CR B2ab (iii, iv); C2a(i); D. Critically there are only two localities where the species is known – the whole population of the species reduced to just ten individuals in an area of less than 500 m^2. The greatest threat to the species is from man. The true species is, however, widely cultivated, and is maintained in the Jardín Botanico Canario 'Viera y Clavijo' in Gran Canaria, and a large stock at the Royal Botanic Gardens, Kew. The hybrids are widely known in cultivation.

VERNACULAR NAMES. PICO DE PALOMA (Spanish), PARROT'S BEAK.

Breitfeld (1973: 27) described the indumentum of the leaves of this species as 'tenuiter villoso (sub lente)' (= lightly villous, with long weak hairs, under a lens), suggesting they were capillary. However, it is quite clear that under a lens, and certainly under a binocular dissecting microscope, these hairs (albeit 0.3 mm long) consist of a large spear-shaped apical uniseriate, multicellular portion which is appressed to the leaf surface and with a short base consisting of few cells issuing from a pad-like epidermal cell. Mader & Podlech (1989) referred to them as long 'breit abgeflachte haare', literally 'wide flat-hairs', which are common in several of the Moroccan species.

The pollen type is described as 'subtype IIIb' – 3-zonocolporate, elliptical, rectangular-elliptical or circular in equatorial outline and circular or more or less triangular angulaperturate in polar outline (Díez & Ferguson, 1994). This is a common type in Old World species of the genus and, as Díez & Ferguson

pointed out, no differences can be distinguished between the four subgenera currently recognised.

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