

## A contribution to the taxonomic revision of the *Lotus angustissimus*-complex (Leguminosae, Loteae)

Tatiana E. Kramina

*Summary:* Based on the examination of more than 380 herbarium specimens and morphometric studies of 46 morphological characters in 143 specimens, a preliminary taxonomic revision of the *Lotus angustissimus* group (Leguminosae – Loteae) was conducted. Six species were recognized: *L. angustissimus* L., *L. subbiflorus* Lag., *L. castellanus* Boiss. et Reut., *L. parviflorus* Desf., *L. palustris* Willd. and *L. macrotrichus* Boiss. They can be distinguished by a complex of morphological characters, including style length, keel beak length, number of flowers per head and number of seeds per pod, as well as pod pubescence. The distribution range of the studied taxa is given. Results obtained are discussed in connection with recent molecular data. A possibility of hybridization among the studied taxa, especially between *L. castellanus* and *L. palustris* and between *L. angustissimus* and *L. subbiflorus*, cannot be excluded.

*Keywords:* *Lotus*, Leguminosae, Mediterranean, morphology, taxonomy, biogeography

Species close to *Lotus angustissimus* L. or included in the *L. angustissimus*-complex or species group are distributed predominantly in the Mediterranean region, with some of them extending into non Mediterranean parts of western and eastern Europe, eastern Africa and western and central Asia. Several members of the complex, especially *L. angustissimus* L. and *L. subbiflorus* Lag., are widely-used as crop plants in many countries throughout the world, and have naturalised there.

*Lotus angustissimus* L. is one of the first species described in the study group (LINNAEUS 1753). In the protologue, LINNAEUS noted that it is characterized by linear, straight and usually paired legumes, upright stems, and alternate peduncles. Subsequent investigators mentioned an annual life form, patent pubescence, 1–3-flowered heads and some other characters as important diagnostic features of this species (SERINGE 1825; BOISSIER 1872). In her revision of the *L. angustissimus* group, HEYN (1970 a, b) emphasized the significance of the following diagnostic characters: ‘keel bent from its middle, with a short, straight-tipped beak’ and legumes straight, 15–25 mm long. In many taxonomic revisions and regional floras this species is accepted in a traditional sense (WILLKOMM & LANGE 1880; BRAND 1898; BALL & CHRŤKOVÁ-ŽERTOVÁ 1968; HEYN 1970 a, b; CHRŤKOVÁ-ŽERTOVÁ 1984; AKEROYD 1986; GREUTER et al. 1989; WEI ZHI & HUANG YIZHI 1993; VALDÉS 2000). However, *L. angustissimus* is one of the most variable species in this complex. This is one of the reasons why at the end of the 18<sup>th</sup> and beginning of the 19<sup>th</sup> Century, several species closely related to *L. angustissimus* have been described: *L. angustifolius* Gouan, *L. ciliatus* Ten., *L. diffusus* Soland. ex Smith and *L. gracilis* Waldst. et Kit. Later, they all were subsumed as synonyms of *L. angustissimus* L. This species is also widespread. Its distribution area covers the major part of the Mediterranean region, including Europe, Southwest Asia, North Africa and Macaronesia. Authors of several recent publications mentioned that *L. angustissimus* was collected as an alien plant in some regions of Central and East Asia (KURBATSKY 1994; WEI ZHI & HUANG YIZHI 1993).

KUPRIANOVA (1937) described a new species, *Lotus praetermissus* Kuprian., related to *L. angustissimus* but differing from the latter in long rare patent pubescence, solitary erect stems with spreading branches, wider and shorter legumes (16–20 mm long, not 20–30 mm as in *L. angustissimus*), and dark brown seeds. The separation of this taxon at specific level was adopted by many authors of regional floras of the territories of the former USSR (KUPRIANOVA 1945; GROSSHEIM 1952; TULYAGANOVA 1981; MINIAEV & ULLE 1987; KURBATSKY 1994; YAKOVLEV et al. 1996). The opposite view was expressed by HEYN (1970 a, b) and later some other western European authors (GREUTER et al. 1989; LOCK 1989; LOCK & SIMPSON 1991) who did not support the segregation of this species.

In some publications *L. angustissimus* was confused with a number of other species. For example, BRAND (1898) wrote about the difficulties of delimitation of *L. angustissimus* and *L. hispidus*; ZOHARY (1987) united *L. angustissimus* with *L. palustris* Willd.

*Lotus parviflorus* Desf. was first described from Algeria by DESFONTAINES in 1799. Among the most important diagnostic features he noted were a rough-haired pubescence, obovate leaflets, subcordate ‘stipules’, polyanthous peduncles, and a calyx as long as the corolla. In the protologue he also mentioned the pod being equal in length to the calyx. The species is distributed in the western Mediterranean region and its segregation was supported by many authors of monographic treatments and important floristic works (BOISSIER 1872; WILLKOMM & LANGE 1880; BRAND 1898; BALL & CHRITKOVÁ-ŽERTOVÁ 1968; GREUTER et al. 1989; and others). HEYN (1970 b) improved the diagnosis adding significant features of the keel, i.e. keel narrow, bent from the base, with a long straight-tipped beak. However, our investigation of botanical literature sources of the 19<sup>th</sup> Century revealed a lack of uniform conception of *L. parviflorus* Desf. at that time. SERINGE (1825) included it in the genus *Dorycnium* Mill., although this idea was not supported by subsequent investigators. A further problem is that *L. parviflorus* was sometimes confused with *L. hispidus* auct.

The first mention of *Lotus hispidus* is apparently ascribed to DESFONTAINES, who listed it in “Tabl. Bot. Mus. Hist. Nat.” (1804:190). However, the author did not provide any diagnosis of this species, so this name is illegitimate. In 1805, the name *L. hispidus* appeared in the 3<sup>rd</sup> edition of “Flore française” by CANDOLLE (1805:556) and is followed by a diagnosis describing this species as branched annuals, about 1 dm high, with upper parts and calyces covered by a dense pubescence of long trichomes, peduncles slightly exceeding the covering leaves, and with the long-teethed calyx almost equal to the corolla. In this work CANDOLLE (1805) also mentioned that *L. hispidus* DC. was collected for the first time on Corsica by “Mr. Miot et Noisette”. According to this description, plants of *L. hispidus* are rather similar to *L. parviflorus* Desf. The characters listed above are common features of these two species.

Later, the name *L. hispidus* was cited in CANDOLLE’S “Prodromus” (1825). This publication was followed by the formation of a large herbarium collection, now kept in Geneve [G]. We closely examined the microfiches of ‘Herbier de Candolle: Prodromus’ from Geneve [G-DC] as well as a photocopy of the herbarium specimen collected on Corsica by Mr. Noisette, also stored in G-DC under the name of *Dorycnium parviflorum* Ser. On the studied herbarium sheet, the left plant collected by Mr. Noisette is named as *L. involucratus* ex Noisette. This name has not been published validly. According to its morphological characters, this plant closely match the diagnosis of *L. parviflorus*. It is apparently annual with about 6 flowers in a head, ripe legumes hardly exceeding calyces with only styles protruding, and it has a keel with a long right beak.

A contribution to the taxonomic revision of the *Lotus angustissimus*-complexTable 1: Diagnostic characters of the species of the *Lotus angustissimus*-group according to HEYN (1970b) and KUPRIANOVA (1937).

	<i>L. parviflorus</i> Desf. ( <i>L. hispidus</i> DC. in Lam. & DC.)	<i>L. subbiflorus</i> Lag. ( <i>L. suaveolens</i> Pers.)	<i>L. castellanus</i> Boiss. et Reut. ex Boiss.	<i>L. palustris</i> Willd.	<i>L. angustissimus</i> L.	<i>L. praetermissus</i> Kuprian.
Number of flowers in umbel	(3)4–6	1(3–4)	1–3(4)	(1)2–4(6)	1–2(3)	1–2
Relation between corolla and calyx length	Corolla $\pm$ equal to calyx	Corolla longer than calyx				
Keel beak shape	Long beak with straight tip		Long beak with incurved tip	Short beak with slightly incurved tip	Short beak with straight tip	
Life form	Annual	Annual or perennial	Annual or biennial	Perennial	Annual	
Fruit length in mm	Up to 4	(5)8–15		(12)15–23(30)		
Relation between fruit and calyx length	Fruit $\pm$ equal to calyx or up to 1.25 times as long as the calyx	Fruit 1.5–3 times as long as the calyx		Fruit 2–4 times as long as the calyx		
Indumentum density	High		Low	High or low		High

The right plant, determined as *L. parviflorus* Desf., was collected by Desfontaines from Barbari in 1807. It also corresponds to the main diagnostic features of *L. parviflorus*. Below these two plants there is a separate label with determinations made by De Candolle: “*Lotus hispidus* (Desf. {crossed out}) – fl. fr.” and “— *parviflorus* Desf. DC. ic.”. Therefore, the name *L. hispidus* DC. in “Flore française” (LAMARCK & CANDOLLE 1805) can be typified by Noisette’s specimen from Corsica.

However, the majority of specimens in De Candolle’s herbarium determined as *L. hispidus* Desf. – including those from Corsica, notwithstanding the presence of characters typical to *L. parviflorus* (tab. 1), still differ from the latter in legumes being 2–3 times longer than the calyx (in *L. parviflorus* they are not or hardly exceeding the calyx), in a smaller number of flowers in a head and in a corolla markedly exceeding the calyx. The application of the name *L. hispidus* for these specimens is not correct. In the literature concerning *Lotus* species belonging to the discussed group, authors proposed two names: *L. subbiflorus* Lag. (LAGASCA 1805; BALL & CHRŤKOVÁ-ŽERTOVÁ 1968, LAINZ 1973) and *L. suaveolens* Pers. (PERSOON 1807; SERINGE 1825; HEYN 1970 a, b; ARAMBARRI 2000).

LAGASCA (1805) described *L. subbiflorus* Lag. as rough-haired plants with spreading stems, 2–3-flowered peduncles, straight cylindrical pods, exceeding both calyx and corolla. SERINGE included it in the genus *Dorycnium* Mill. as he did with *L. parviflorus* Desf. and some other *Lotus* species possessing short pods (SERINGE 1825). WILLKOMM & LANGE (1880) did not seem to have a clear opinion about this taxon and supposed it to be a form of *L. hispidus*. BALL & CHRŤKOVÁ-ŽERTOVÁ

(1968) combined *L. subbiflorus* Lag. with *L. hispidus* Desf. ex DC. and *L. castellanus* Boiss. et Reut. The lectotype of *L. subbiflorus* Lag. was selected by Laínz in 1961: “*Lotus subbiflorus* Lagasca sp. nov. En Pravia. Julio. Lag-a legit.” (Separada del Pliego №66170) [MA 172170] (LAINZ 1973).

Below we publish a description of the type specimen of *Lotus subbiflorus* Lag. which we made from the herbarium specimen MA 172170 of the ‘Instituto Antonio Jose Cavanilles’ in Madrid [MA]: Vegetative parts of the plant (i.e. leaves, stems) and calyces covered by long perpendicularly spreading hairs. Umbels 1–2-flowered. Calyx with almost linear teeth which are longer than tube. Keel bent upward from near the base, with a long, narrow, straight-tipped beak. Pod 2–3 times longer than the calyx.

HEYN (1970 a, b) noted incorrectly that the specimen: “*L. subbiflorus* Lag. sp. nov. Pto de Sta Maria (Cadiz)“ [M] is the type of *L. subbiflorus* Lag. This is the result of HEYN’s misinterpretation of diagnostic features. She supposed that the plants of *L. subbiflorus* possess a long-beaked keel with an incurved tip. As a consequence, HEYN erroneously considered *L. castellanus* Boiss. et Reut. to be a synonym of *L. subbiflorus*. Later, this idea was correctly criticized by LAINZ (1973), who distinguishes *L. subbiflorus* Lag. (syn. *L. suaveolens* Pers.) from *L. castellanus* Boiss. et Reut. (syn. *L. subbiflorus* sensu Heyn, non Lag.).

In the 20<sup>th</sup> Century *L. subbiflorus* Lag. was noted as alien in countries situated far from its primary distribution area, e.g. in Australia, Japan (ASAI 1987), New Zealand, and others.

According to its protologue, *L. palustris* Willd. is characterized by heads with about 4 flowers, glabrous cylindrical pods, branched erect stems, which are rough-haired as well as the leaves (WILLDENOW 1802). Different points of view have been expressed on its relationships to other species of the section *Lotus*. Some authors (SERINGE 1825; BALL & CHRITKOVÁ-ŽERTOVÁ 1968) considered it to be rather close to *L. corniculatus* L.; BRAND (1898) and HEYN (1970 b) supposed it was closer to *L. angustissimus* L.; GREUTER et al. (1989) combined it together with *L. castellanus* Boiss. et Reut., and *L. hispidus* DC. to *L. palustris* agg. HEYN (1970 b) and ZOHARY (1987) noted a marked seasonal polymorphism in this species. HEYN (1970 b) emphasized the following features as characteristic of *L. palustris*: keel with a short, slightly incurved beak, and rather long pods (15–23 mm).

To date there is no agreement in the literature regarding limits of the *Lotus angustissimus*-group, its structure and species level taxonomy. Molecular data available (ALLAN et al. 2003; DEGTJAREVA et al. 2006) do not allow to resolve the relations of the studied taxa unambiguously. So the purposes of the present work are:

- to revise the diagnostic significance of characters;
- to search for new useful diagnostic features; and
- to distinguish and delimit the studied species to form a basis for new molecular investigations.

## Materials and methods

More than 380 herbarium specimens from BM, G, K, LE, LW, LWS, MHA, MW, NSW, US, and W were studied. 143 of them were selected for morphometric research, i.e.: *Lotus angustissimus* s.l. (including *L. angustissimus* s.str. (18 specimens), *L. praetermissus* (16 specimens), *L. subbiflorus* (34 specimens), *L. castellanus* (24 specimens), *L. parviflorus* (12 specimens), *L. palustris* (38 specimens), *L. macrotrichus* (1 specimen).

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

46 morphological characters were measured in all specimens:

1 PL	— Peduncle length in cm;	23 LHD	— Leaf hair density, grades from 1 to 9;
2 RL	— Leaf rachis length in mm;	24 PHD	— Peduncle hair density, grades from 1 to 9;
3 RTL	— Leaf rachis tip length in mm;	25 SHD	— Stem hair density, grades from 1 to 9;
4 TLL	— Terminal leaflet length in mm;	26 KBL	— Keel beak length in mm;
5 TLW	— Terminal leaflet width in mm;	27 KL	— Keel length in mm;
6 TLL2	— Terminal leaflet length up to the position of maximum width in mm;	28 NF	— Number of flowers in umbel;
7 TLP	— Terminal leaflet petiole length in mm;	29 FL	— Flower length in mm;
8 LLL	— Lateral leaflet length in mm;	30 CL	— Calyx length in mm;
9 LLW	— Lateral leaflet width in mm;	31 CTE	— Calyx teeth length in mm;
10 LLL2	— Lateral leaflet length up to the position of maximum width in mm;	32 CTU	— Calyx tube length in mm;
11 LLP	— Lateral leaflet petiole length in mm;	33 SL	— Style length in mm;
12 BLL	— Basal leaflet length in mm;	34 NS	— Number of seeds in pod;
13 BLW	— Basal leaflet width in mm;	35 FRL	— Fruit length in mm;
14 BLL2	— Basal leaflet length up to the position of maximum width in mm;	36 FRW	— Fruit width in mm;
15 BLP	— Basal leaflet petiole length in mm;	37 TLI1	— Terminal leaflet index 1=4/5;
16 CHL	— Calyx hair length in mm;	38 TLI2	— Terminal leaflet index 2=6/4;
17 LHL	— Leaf hair length in mm;	39 LLI1	— Lateral leaflet index 1=8/9;
18 PSHL	— Peduncle short hair length in mm;	40 LLI2	— Lateral leaflet index 2=10/8;
19 PLHL	— Peduncle long hair length in mm;	41 BLI1	— Basal leaflet index 1=12/13;
20 SSSL	— Stem short hair length in mm;	42 BLI2	— Basal leaflet index 2=14/12;
21 SLHL	— Stem long hair length in mm;	43 KI	— Keel index =26/27;
22 CHD	— Calyx hair density, grades from 1 to 9;	44 CI	— Calyx index =31/32;
		45 FRCI	— Fruit-calyx index =35/30;
		46 FLCI	— Flower-calyx index =29/30.

In some specimens fruit-characters (characters № 35, № 36, and № 45) were not measured because ripe fruits were absent. Any characters describing the incurvation of the keel were excluded from the analysis due to obvious difficulties in its measurement and variation of incurvation degree in different stages of flower development.

**Statistical analysis:** All statistical procedures and analyses were conducted by using the software STATISTICA version 6 from StatSoft, Inc. 2001 ([www.statsoft.com](http://www.statsoft.com)).

**Univariate statistics:** The mean, standard error of mean, min and max values were calculated for each character of each studied species. For most significant taxonomic characters categorized plots of means and 95% confidence intervals were constructed. Comparison of means of several groups was made using Unequal N HSD (=modified Tukey's test for unequal groups) criteria.

**Multivariate analysis:** Discriminant analysis was conducted using 143 specimens. The following numbers were attached to specimens according to species they belong to:

- 1 — *Lotus praetermissus* Kuprian., Turkish specimens of *L. angustissimus* L. s. l., and *L. macrotrichus* Boiss. (20 specimens); these specimens were united in one group because they were rather close in morphology and geographical distribution;
- 2 — *Lotus angustissimus* (15 specimens);

- 3 — *Lotus subbiflorus* (34 specimens);  
 4 — *Lotus castellanus* (24 specimens);  
 5 — *Lotus parviflorus* (12 specimens);  
 6 — *Lotus palustris* (38 specimens).

We used two variants of step-wise discriminant analysis:

- a) with  $F_{\text{to enter}}=4.0$ ,  $F_{\text{to remove}}=3.9$ ;  
 b) with  $F_{\text{to enter}}=1.0$ ,  $F_{\text{to remove}}=0.0$ .

43 characters were initially included in the analysis, and after the step-wise procedure some of them were selected for final analysis.

## Results

### Univariate statistics

Comparison of character means in *L. angustissimus* and *L. praetermissus* using Unequal N HSD criteria showed the lack of significant differences between means of these two species in key diagnostic characters: style length, flower length, calyx and its tube and teeth length, number of flowers per umbel, and some others (fig. 1, tab. 2). The main significant difference between these two species was revealed in characters of leaf dimension and indumentum pattern although these characters are very variable. The wide amplitude of the variability is probably due to the diversity of climatic and other abiotic and biotic factors of localities where these plants grow. Differences between *L. angustissimus* and *L. praetermissus* in the characters 'number of seeds' and 'fruit to calyx index' needs to be checked using more representative material.

*Lotus palustris* differs from other studied species in leaf characters and calyx length having the largest linear dimensions of them (fig. 1 a, b; tab. 2).

*Lotus parviflorus* is characterized by maximal hair length on the calyx (fig. 1 h), and in *L. castellanus* we found the minimal hair density on peduncles.

*Lotus castellanus* and *L. palustris* differ from the others in hair length on calyces and leaves; they have minimal values for these characters. *L. castellanus* also significantly differs from other studied species in its hair density on the peduncles and stems. It has the lowest hair density among all members of the group.

Keel beak length and style length are strongly correlated (the Pearson's coefficient of linear correlation  $r=0.89$ ). The minimal values of these characters are observed in *L. angustissimus* and *L. praetermissus*, the maximal ones in *L. castellanus*. Three other species have intermediate values (fig. 1 c, d). Strong correlation was also found between fruit length and number of seeds ( $r=0.79$ ). Studied species form the following sequence according to the values of these two characters (from minimal values to maximal ones):

*L. parviflorus* → *L. castellanus* and *L. subbiflorus* → *L. palustris* → *L. angustissimus* and *L. praetermissus* (fig. 1 e, f).

*Lotus parviflorus* differs from the other studied species also in the number of flowers per partial inflorescence (fig. 1 g).

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

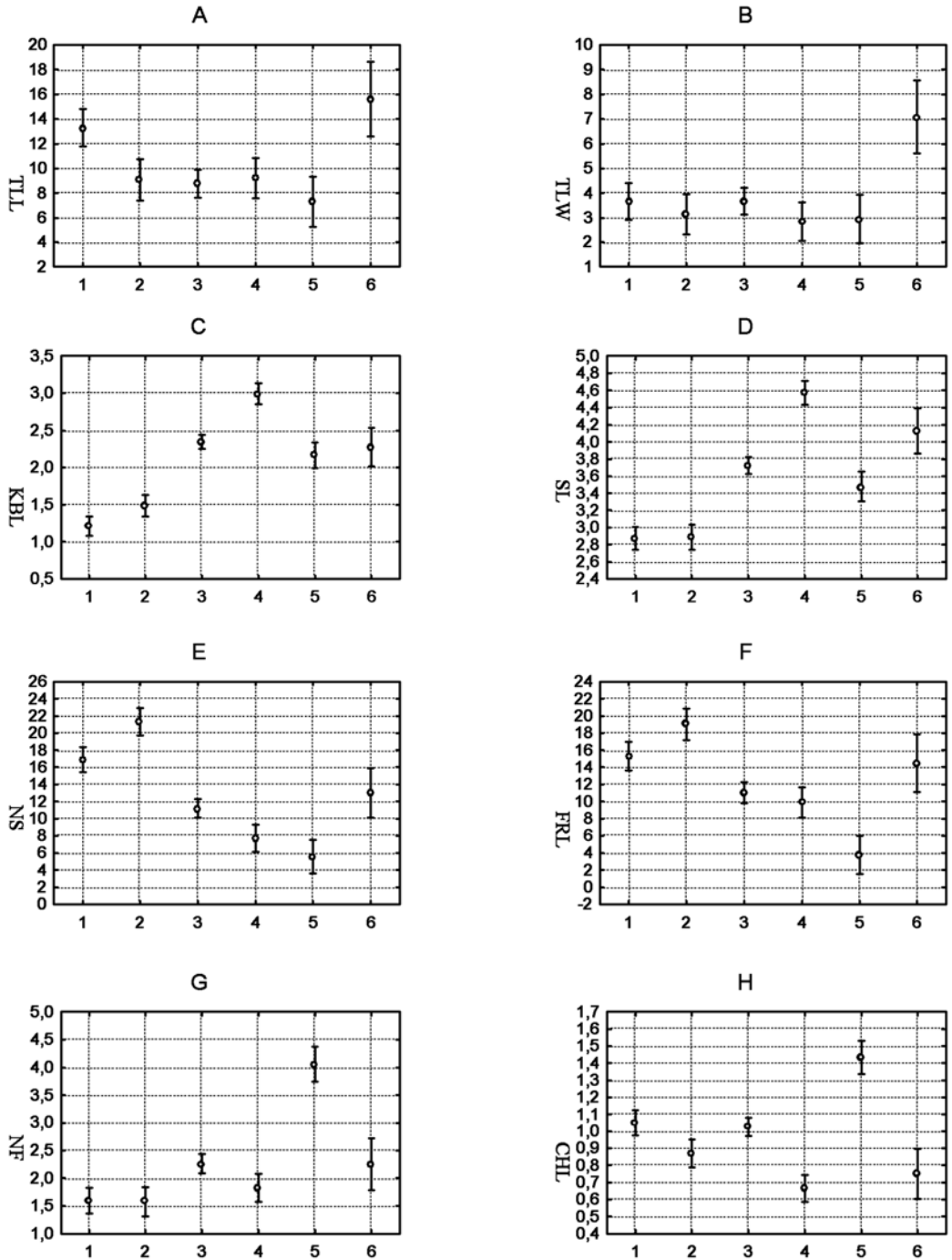


Figure 1: Categorized plots of means with 95% confidence intervals.

OX – species: 1 – *Lotus praetermissus* Kuprian. and Turkish specimens of *L. angustissimus* L. s.l., 2 – *L. angustissimus* L., 3 – *L. subbiflorus* Lag., 4 – *L. castellanus* Boiss. et Reut., 5 – *L. parviflorus* Desf., 6 – *L. palustris* Willd.

OY – characters: A – TLL, B – TLW, C – KBL, D – SL, E – NS, F – FRL, G – NF, H – CHL.

Table 2: Means (M), standard errors of means (m), min and max values of studied characters for 5 species. 11 characters marked in bold were selected for discriminant analysis (first variant).

	<i>Lotus angustissimus</i> n=34			<i>Lotus subbiiflorus</i> n=34			<i>Lotus castellanus</i> n=24			<i>Lotus parviflorus</i> n=12			<i>Lotus palustris</i> n=37		
	M ± m	Min-Max		M ± m	Min-Max		M ± m	Min-Max		M ± m	Min-Max		M ± m	Min-Max	
	1	2		3	4		5	6		7	8		9	10	
Peduncle length in cm	1.42±0.15	0.5–4.0		1.77±0.14	0.5–3.8		1.43±0.19	0.6–3.4		1.81±0.15	1.1–2.7		3.52±0.59	1.1–9.1	
Rachis length in mm	4.17±0.27	2.1–9.6		5.09±0.45	1.0–13.2		3.56±0.28	1.7–7.4		3.46±0.27	2.2–5.5		6.64±0.49	2.0–15.0	
Rachis tip length in mm	0.71±0.06	0.2–1.5		0.70±0.08	0.2–2.2		0.70±0.07	0.3–1.5		0.39±0.06	0.2–1.0		1.08±0.12	0.3–4.0	
<b>Terminal leaflet length in mm</b>	<b>11.01±0.61</b>	<b>5.3–17.2</b>		<b>9.86±0.69</b>	<b>3.8–19.8</b>		<b>9.50±0.64</b>	<b>4.8–17.1</b>		<b>7.25±0.44</b>	<b>5.0–10.0</b>		<b>15.68±0.76</b>	<b>7.6–28.0</b>	
Terminal leaflet width in mm	3.50±0.23	2.0–8.6		4.21±0.32	1.2–10.0		3.42±0.39	1.4–9.2		2.93±0.20	1.9–4.1		6.51±0.40	3.5–15.0	
Terminal leaflet length up to the position of maximum width in mm	6.84±0.38	3.6–11.9		6.92±0.50	2.2–13.8		6.21±0.46	2.3–12.3		4.63±0.36	3.1–7.3		10.05±0.43	5.5–17.0	
Terminal leaflet petiole length in mm	0.43±0.02	0.2–0.8		0.44±0.03	0.2–0.9		0.48±0.02	0.3–0.7		0.29±0.03	0.2–0.6		0.65±0.04	0.3–1.2	
Lateral leaflet length in mm	10.44±0.55	4.9–16.5		9.56±0.70	3.5–19.7		8.00±0.69	4.1–18.0		6.96±0.38	5.4–9.5		14.11±0.77	7.0–27.0	
Lateral leaflet width in mm	3.04±0.18	1.9–5.9		3.62±0.25	1.1–7.2		2.62±0.37	1.2–8.4		2.56±0.17	1.4–3.7		5.68±0.36	2.5–12.5	
Lateral leaflet length up to the position of maximum width in mm	5.64±0.38	1.4–11.4		6.24±0.52	2.3–15.7		4.73±0.42	1.9–10.7		3.73±0.36	2.6–6.3		8.27±0.42	5.0–15.0	
Lateral leaflet petiole length in mm	0.43±0.02	0.2–0.6		0.37±0.02	0.2–0.7		0.47±0.04	0.2–0.9		0.30±0.03	0.2–0.6		0.64±0.04	0.3–1.2	
Basal leaflet length in mm	8.64±0.45	4.3–13.4		7.98±0.56	3.0–15.7		5.63±0.51	3.0–12.7		5.83±0.44	4.1–9.2		10.52±0.58	6.0–22.0	
Basal leaflet width in mm	4.22±0.27	1.8–7.8		4.55±0.33	1.8–9.9		2.55±0.41	0.9–8.9		3.51±0.21	2.5–5.0		6.39±0.37	3.2–12.5	
Basal leaflet length up to the position of maximum width in mm	2.19±0.13	1.3–3.7		2.30±0.17	1.0–5.3		1.66±0.12	0.7–3.3		1.30±0.12	0.8–2.3		2.65±0.24	1.1–10.0	
<b>Basal leaflet petiole length in mm</b>	<b>0.46±0.02</b>	<b>0.3–0.8</b>		<b>0.41±0.02</b>	<b>0.2–0.7</b>		<b>0.57±0.06</b>	<b>0.2–1.2</b>		<b>0.28±0.02</b>	<b>0.2–0.4</b>		<b>0.76±0.04</b>	<b>0.4–1.5</b>	
<b>Calyx hair length in mm</b>	<b>0.94±0.04</b>	<b>0.2–1.3</b>		<b>1.04±0.03</b>	<b>0.7–1.3</b>		<b>0.66±0.02</b>	<b>0.4–0.8</b>		<b>1.40±0.03</b>	<b>1.2–1.6</b>		<b>0.71±0.02</b>	<b>0.0–1.0</b>	
Leaf hair length in mm	0.95±0.04	0.2–1.3		0.99±0.03	0.7–1.3		0.57±0.03	0.3–0.8		1.19±0.03	1.0–1.3		0.73±0.03	0.0–1.1	
Peduncle short hair length in mm	0.29±0.01	0.0–0.3		0.30±0.01	0.2–0.4		0.20±0.004	0.2–0.3		0.31±0.01	0.2–0.4		0.26±0.01	0.2–0.3	
Peduncle long hair length in mm	1.09±0.05	0.0–1.6		1.39±0.05	0.9–2.2		0.73±0.03	0.5–1.0		1.58±0.07	1.3–2.2		0.91±0.02	0.6–1.2	
Stem short hair length in mm	0.29±0.01	0.0–0.3		0.31±0.01	0.2–0.4		0.21±0.01	0.2–0.3		0.31±0.01	0.3–0.4		0.27±0.01	0.2–0.4	



A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

Table 2 (continuation):

	1	2	3	4	5	6	7	8	9	10
<b>Stem long hair length in mm</b>	<b>1.12±0.05</b>	<b>0.0–1.5</b>	<b>1.42±0.05</b>	<b>0.9–2.0</b>	<b>0.80±0.04</b>	<b>0.5–1.1</b>	<b>1.41±0.04</b>	<b>1.2–1.6</b>	<b>1.00±0.03</b>	<b>0.6–1.3</b>
Calyx hair density in grades	8.44±0.24	2–9	8.97±0.03	8–9	8.33±0.21	5–9	9.00±0.00	9–9	8.73±0.22	1–9
Leaf hair density in grades	7.53±0.22	2–9	8.18±0.14	7–9	8.04±0.21	5–9	8.58±0.19	7–9	8.51±0.25	1–9
<b>Peduncle hair density, grades</b>	<b>7.94±0.27</b>	<b>1–9</b>	<b>8.32±0.16</b>	<b>6–9</b>	<b>5.92±0.28</b>	<b>3–8</b>	<b>8.83±0.11</b>	<b>8–9</b>	<b>8.49±0.22</b>	<b>2–9</b>
Stem hair density in grades	6.47±0.21	1–8	6.79±0.16	5–8	5.04±0.33	2–7	7.08±0.26	6–8	7.00±0.25	2–9
Keel beak length in mm	1.35±0.06	0.5–1.9	2.36±0.04	1.9–2.9	2.75±0.09	1.7–3.3	2.13±0.06	1.8–2.5	2.26±0.06	1.6–3.3
Keel length in mm	3.73±0.07	2.8–4.4	4.33±0.07	3.2–5.0	5.11±0.07	4.5–5.8	3.80±0.08	3.4–4.3	4.78±0.08	3.9–5.7
<b>Number of flowers in umbel</b>	<b>1.59±0.04</b>	<b>1–2</b>	<b>2.38±0.09</b>	<b>1.5–4</b>	<b>1.85±0.09</b>	<b>1.5–3.0</b>	<b>4.25±0.29</b>	<b>2.5–6.0</b>	<b>2.43±0.10</b>	<b>1.5–4</b>
Flower length in mm	6.40±0.14	4.4–8.4	6.91±0.13	5.0–8.3	7.34±0.18	6.1–9.6	5.61±0.13	4.8–6.1	7.58±0.14	6.0–9.5
Calyx length in mm	4.71±0.12	3.4–5.9	4.86±0.14	3.1–7.3	5.02±0.14	3.9–6.9	4.83±0.15	4.2–6.0	5.78±0.13	4.5–7.9
Calyx teeth length in mm	2.58±0.08	1.6–3.6	2.91±0.09	1.8–4.1	2.88±0.11	2.1–3.9	3.33±0.08	3.0–3.9	3.49±0.10	2.5–4.9
Calyx tube length in mm	2.09±0.06	1.2–3.1	1.93±0.04	1.3–2.6	2.15±0.07	1.3–2.8	1.51±0.03	1.3–1.7	2.29±0.05	1.7–3.4
<b>Style length in mm</b>	<b>2.88±0.04</b>	<b>2.3–3.3</b>	<b>3.72±0.06</b>	<b>2.9–4.4</b>	<b>4.43±0.07</b>	<b>3.8–4.9</b>	<b>3.51±0.06</b>	<b>3.2–3.9</b>	<b>4.17±0.07</b>	<b>3.2–5.1</b>
<b>Number of seeds in pod</b>	<b>19.35±0.65</b>	<b>12–28</b>	<b>11.73±0.53</b>	<b>6–19</b>	<b>8.30±0.85</b>	<b>5–19</b>	<b>6.25±0.89</b>	<b>4–14</b>	<b>12.78±0.48</b>	<b>7–21</b>
Fruit length in mm	17.10±0.85	5–28	11.35±0.43	6–18	10.42±0.75	5.8–18.0	3.78±0.35	2–6	16.48±0.67	9–25
Fruit width in mm	1.45±0.08	0.9–2.4	1.58±0.07	1.0–2.3	1.37±0.06	1.0–2.0	1.36±0.21	1.1–2.3	1.79±0.06	0.8–2.4
<b>Terminal leaflet index 1</b>	<b>3.24±0.13</b>	<b>1.9–4.8</b>	<b>2.38±0.07</b>	<b>1.6–3.2</b>	<b>3.13±0.20</b>	<b>1.9–5.8</b>	<b>2.52±0.11</b>	<b>1.9–3.4</b>	<b>2.47±0.05</b>	<b>1.8–3.2</b>
Terminal leaflet index 2	0.63±0.01	0.5–0.8	0.70±0.01	0.6–0.8	0.65±0.01	0.5–0.8	0.64±0.02	0.5–0.7	0.65±0.01	0.5–0.7
Lateral leaflet index 1	3.50±0.11	2.3–5.3	2.67±0.07	1.8–3.4	3.46±0.20	2.1–5.2	2.81±0.18	2.1–4.4	2.57±0.07	1.4–3.6
Lateral leaflet index 2	0.54±0.02	0.3–0.9	0.65±0.01	0.5–0.8	0.59±0.02	0.4–0.8	0.53±0.03	0.4–0.7	0.60±0.01	0.4–0.8
Basal leaflet index 1	2.14±0.08	1.4–3.5	1.79±0.06	1.4–3.3	2.66±0.21	1.3–5.7	1.66±0.07	1.4–2.1	1.67±0.04	1.2–2.1
Basal leaflet index 2	0.26±0.01	0.2–0.4	0.29±0.01	0.2–0.5	0.31±0.02	0.2–0.5	0.22±0.01	0.2–0.3	0.25±0.01	0.1–0.5
<b>Keel index</b>	<b>0.36±0.01</b>	<b>0.13–0.52</b>	<b>0.55±0.01</b>	<b>0.46–0.69</b>	<b>0.54±0.01</b>	<b>0.38–0.61</b>	<b>0.56±0.01</b>	<b>0.49–0.67</b>	<b>0.47±0.01</b>	<b>0.28–0.62</b>
Calyx index	1.26±0.05	0.65–2.17	1.51±0.04	0.18–2.06	1.38±0.08	0.88–2.62	2.21±0.05	1.94–2.50	1.53±0.04	1.04–2.06
Fruit-calyx index	3.98±0.25	1.76–9.14	2.39±0.08	1.56–3.42	2.05±0.13	1.07–3.26	0.79±0.07	0.51–1.14	2.89±0.11	1.58–4.51
<b>Flower-calyx index</b>	<b>1.37±0.03</b>	<b>1.14–1.71</b>	<b>1.44±0.03</b>	<b>1.05–1.68</b>	<b>1.48±0.03</b>	<b>1.16–1.88</b>	<b>1.17±0.03</b>	<b>1.00–1.36</b>	<b>1.32±0.02</b>	<b>0.98–1.49</b>

## Discriminant analysis

During the step-wise procedure with parameters  $F_{\text{to enter}}=4.0$ ,  $F_{\text{to remove}}=3.9$ , 11 characters were selected (exactly: №4, 15, 16, 21, 24, 28, 33, 34, 37, 43, and 46) which proved to be the most valuable for species delimitation (see tab. 2, characters marked in bold). The analysis showed good discrimination quality (the criteria Wilk's Lambda=0.002). Centroids of all groups were significantly different from each other, and the groups №1 and №2 were the closest. The correctness of specimen determination was about 94%. Seven mistakes were made in delimitation between *L. angustissimus* and *L. praetermissus*, and two mistakes in delimitation between *L. castellanus* and *L. palustris*. According to the results obtained, the specimen of *L. macrotrichus* was placed in *L. angustissimus*, and the specimen *Majorov s.n.*, 1999 in *L. palustris*.

In the canonical analysis 5 roots were selected, but only the first two of them made a significant contribution to species delimitation. Their eigenvalues were equal to 9.0 and 7.1, correspondingly. These eigenvalues indicate that alongside the first and second root between-group variability is significantly larger than within-group variability. NS and SL characters had the highest standardized coefficients for root 1 (equal to 0.88 and -0.68, respectively), CHL and NF had the highest ones for root 2 (equal to -0.83 and -0.78, correspondingly).

Scatterplot of specimens in the surface of first and second axes explains 85% of total between-group variability and shows the best species discrimination (fig. 2A). The species №3 (*L. subbiflorus*) and №5 (*L. parviflorus*) are well delimited. Clouds of the species №1 (= *L. angustissimus*) and №2 (= *L. praetermissus*) significantly overlap and almost coincide. Clouds of the species №4 (*L. castellanus*) and №5 (*L. palustris*) partly overlap. Along the first axis, which makes the major contribution in group discrimination, clouds of the species are located according to the following order: *L. castellanus*+*L. palustris*+*L. parviflorus*→*L. subbiflorus*→*L. angustissimus*+*L. praetermissus*. In this chain a tendency towards the shortening of the style and the keel beak can be observed. Along the second axis, *L. parviflorus* is most different from other taxa, due to the maximal number of flowers per head and the longest hairs on calyces as compared to other studied species. The

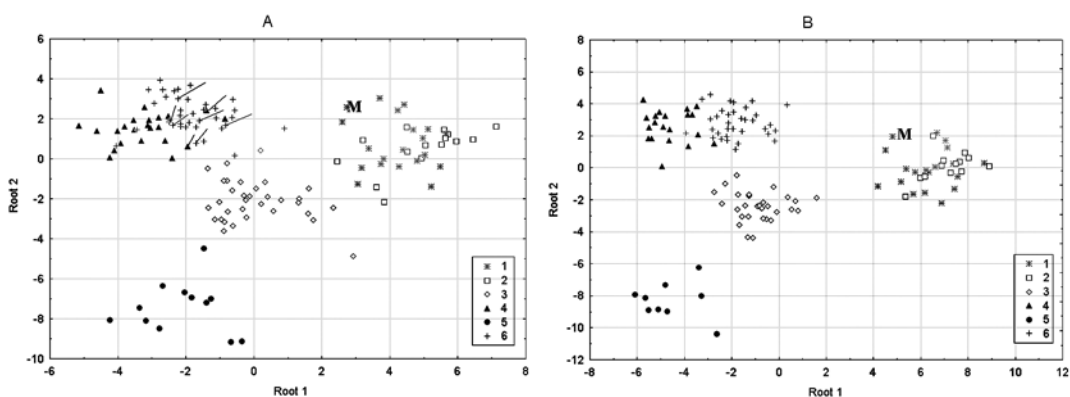


Figure 2: Scatterplots of studied specimens in the surface of first and second canonical variables. A – The results of discriminant analysis with 11 characters. B – The results of discriminant analysis with 33 characters.

Species markers: 1 – *Lotus praetermissus* Kuprian. and Turkish specimens of *L. angustissimus* L. s.l., 2 – *L. angustissimus* L., 3 – *L. subbiflorus* Lag., 4 – *L. castellanus* Boiss. et Reut., 5 – *L. parviflorus* Desf., 6 – *L. palustris* Willd., M – *L. macrotrichus* Boiss. In fig. 2A specimens of *L. palustris* Willd. and *L. castellanus* Boiss. et Reut. with intermediate morphological characters mentioned in discussion are marked with arrows.

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

specimen of *L. macrotrichus* (lettered by M) is situated at the periphery of the combined cloud of *L. angustissimus* and *L. praetermissus*. The specimen 'Majorov s.n. 1999' appeared in the area of overlapping *L. castellanus* and *L. palustris* clouds.

The second variant of step-wise discriminant analysis was performed with parameters  $F_{\text{to enter}}=1.0$  and  $F_{\text{to remove}}=0.0$ , that allowed to include much more characters in the analysis. 33 characters were included, in particular, № 4–6, 14–17, 19–22, 24–29, 31–33, and 34–46. Supposing, many characters have high standardized coefficients associated with three first axes, a reasonable interpretation of axes can hardly be made. A scatterplot of all studied specimens in the surface of first and second axes explaining about 82% of total between-group variability, is shown in fig. 2, B. The general pattern of the plot (especially, location of clouds) is similar to that obtained in the analysis with 11 included characters. But as compared to the previous results, all studied species are better distinguished. We see four groups of points separated by gaps. Specimens of *L. parviflorus* and *L. subbiflorus* form single-species clouds. *L. angustissimus* and *L. praetermissus* are mixed in a common cloud, and the clouds of *L. castellanus* and *L. palustris* slightly overlap.

## Discussion

The analysis of nrITS1-2 sequences of the species studied in the present paper revealed that they do not form a monophyletic group, but cluster within 3 clades (DEGTJAREVA et al. 2006). *Lotus palustris* was included in the *Lotus corniculatus*-group according to the concept of BALL & CHRITKOVÁ-ŽERTOVÁ (1968) and to former molecular studies of *Lotus* (ALLAN et al. 2003). It should be noted that DEGTJAREVA et al. (2006) analyzed the same nrITS sequence as ALLAN et al. (2003). Other species of the complex studied were subdivided into two groups:

- a) *L. castellanus* + *L. angustissimus* + *L. praetermissus*,
- b) *L. parviflorus* + *L. subbiflorus* (in this clade *L. conimbricensis* Brot. was also included).

Morphological results obtained in the present study confirmed significant differences between *L. castellanus* and *L. subbiflorus*. In addition to the keel shape revealed by HEYN (1970a, b), a valuable character delimiting these two species is the pubescence of the pod: present in *L. castellanus* and absent in *L. subbiflorus*.

*Lotus praetermissus* and *L. angustissimus* are very close in the majority of morphological characters but they do not form a clade on trees obtained from molecular and combined analyses (DEGTJAREVA et al. 2006). This contradiction may be explained only after conducting additional molecular analyses using more accessions of these species and different DNA markers. In the present study we retain the concept of a joint species *L. angustissimus* (incl. *L. praetermissus*).

In the material studied we found several specimens combining characters of *L. subbiflorus* and *L. angustissimus*. They occur together very often with typical representatives of both species. Plants with intermediate morphological characters usually have styles 3.1–3.6 mm long (that is typical for *L. subbiflorus*) but longer and narrower (15–22 × 1.4–1.6 mm) many-seeded (number of seeds per pod usually varies from 15 to 22) pods. The latter character is common for *L. angustissimus*. Keel shape is of intermediate pattern. Taking into account the position of the typical species on molecular trees (DEGTJAREVA et al. 2006), i.e. in different clades, intermediate plants can be considered as specimens of hybrid origin, *L. subbiflorus* Lag. × *L. angustissimus* L. However, this assumption should be tested by adequate methods.

Specimens with combined morphological characters were revealed in France (*Sieber s.n.* [K], *Aellen s.n.* [K]), Greece (*Barelay 1415* [K]), and Italy (*unknown collector s.n.* [K], *Parlatore s.n.* [K], *Todaro s.n.* [K], *Rigo 272* [K]).

According to our results, *L. parviflorus* is the most distinct species of the group. Only *L. subbiflorus* is somewhat close to it. They share many morphological characters such as keel shape and length, style length, leaflet shape and some others, as well as the majority of the distribution area. This is in agreement with the results of molecular analyses. In addition, *L. parviflorus* possesses its own unique characters, delimiting it from *L. subbiflorus*. These are a very short pod not exceeding the calyx, more dense 3–6-flowered heads, and longer calyx teeth.

Delimitation of *L. castellanus* and *L. palustris* caused many problems, especially after we had added in the analysis more material from the Eastern Mediterranean and Africa. These two species are the only representatives of the group possessing a keel beak with an incurved tip. According to HEYN (1970b), *L. castellanus* is distributed in SW Europe, and *L. palustris* in the Eastern Mediterranean. Keel beak length and the degree of its incurvation suggested by HEYN (l.c.) for discrimination of these species, do not allow a distinction to be made between them. The dimensions of the vegetative organs and pods, as well as density and length of hairs on the calyces, stems, and leaves are also overlapping between the species. We revealed that all specimens of *L. castellanus* have pubescence alongside the ventral suture of the pod, whereas most pods of *L. palustris* are glabrous. This feature may serve as a good diagnostic character but we found several specimens with more or less developed hairs on pods in the Eastern Mediterranean.

Specimens of *L. palustris* with slightly pubescent pods were found in Greece (*Spruner s.n.* [K], *De Heldreich 1024* [K]), Cyprus (*Syngrassides 19* [K], *Kennedy 568* [K]), Turkey (*Hilzmet Pasha 64* [K]), Syria (*Sintenis 1437* [K], *Haradjian 2665* [K]), and Lebanon (*unknown collector s.n.* [K]). According to the large number of herbarium specimens studied, they occur together with specimens lacking pubescence on pods.

In the material from Turkey we found a very interesting specimen collected by Majorov in Antalya, near Tekirova village (*Majorov s.n.* [MW]). This plant is similar in habit to *L. castellanus* Boiss. et Reut. but has totally glabrous fruits. Its diagnostic characters place it in an intermediate position between *L. subbiflorus* Lag. and *L. palustris* Willd. According to the results of the discriminant analysis, it should be placed in *L. palustris*. However, in the analysis of nrITS this specimen grouped with specimens of *L. castellanus*. This situation needs a special study because we cannot exclude a possibility of hybridization in our species complex.

We revealed two specimens of *L. castellanus* from Italy, Sardinia (*Reverchon 269* [K]), and several specimens of this species from Algeria (*Lefebvre s.n.* [W 344125]), and Morocco (*Gandoger s.n.* [LE], *Schousboe 41* [W 344123], *Lindberg 1551* [K]). All these collections show that the character 'pubescence of the pod' is really not very stable. It does not permit the delimitation of the two mentioned species unambiguously. Additionally, they are probably not well isolated from each other geographically.

## Conclusions

The results of the present research show a preliminary conclusion that within the study group, six species can be recognized, i.e. *L. angustissimus*, *L. subbiflorus*, *L. castellanus*, *L. parviflorus*, *L.*

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

*palustris*, and *L. macrotrichus*. They can be distinguished by a complex of morphological characters. The most effective of them are: style length, keel beak length, number of flowers per head, and number of seeds per pod, as well as pod pubescence. Taking into account morphological data obtained and previous molecular results, we cannot exclude a possibility of hybridization among these taxa, especially between *L. castellanus* and *L. palustris* and between *L. angustissimus* and *L. subbiflorus*.

Key to species of the *Lotus angustissimus*-complex

- 1 Style length 2.3–3.0(3.3) mm. Keel with straight short beak (not more than 0.5 of the keel length above the point of upward flexure). Fruit 9–28 mm long, with 12–28 seeds, 2 to 5 times longer than the calyx ..... (1) *L. angustissimus* L. (= *L. praetermissus* Kuprian.)
- Style length (2.9)3.0–6.5 mm. Keel with either an incurved beak, or with a straight long beak (more than 0.5 of the keel length above the point of upward flexure) ..... 2
- 2 Keel beak with straight tip ..... 3
- Keel beak with incurved tip ..... 5
- 3 Flowers 10 mm long or more, the three upper leaflets of the compound leaf rhombic-ovate, apex attenuate, acuminate, pods 24–50 mm long ..... (6) *L. macrotrichus* Boiss.
- Flowers 5–8.5 mm long, the three upper leaflets of the compound leaf elliptic, obovate or oblanceolate, apex acute or rounded, not attenuate, pods 3–15(18) mm long ..... 4
- 4 Umbels 3–6-flowered. Fruit not exceeding the calyx, valves not contorting during dehiscence. Calyx teeth usually twice (or more) the length of the tube ..... (5) *L. parviflorus* Desf.
- Umbels 1–3(4)-flowered. Fruit 1.5–3 times as long as the calyx. Calyx teeth usually less than twice as long as the tube ..... (2) *L. subbiflorus* Lag.
- 5 Ovary and pod pubescent alongside the ventral suture. Upper leaflets index (length to width ratio) 2 to 5.8. Stems usually sparsely or moderately pubescent. Annuals or biennials (rarely perennials) ..... (3) *L. castellanus* Boiss. et Reuter
- Ovary and pod glabrous, sometimes with few trichomes. Upper leaflets index 1.5–3. Stems usually densely pubescent. Perennials ..... (4) *L. palustris* Willd.

**(1) *Lotus angustissimus* L.** 1753, Sp. Pl.: 774; Seringe in DC., 1825, Prodr. 2: 213; Willkomm et Lange, 1880, Prodr. Fl. Hisp. 3: 346; Brand, 1898, Bot. Jahrb. Syst. 25: 215; Kuprianova, 1945, Fl. URSS, 11: 296; Ball et Chrtková-Žertová, 1968, Fl. Europ. 2: 175; Heyn, 1970, Isr. J. Bot. 19: 271–292; Heyn, 1970, Fl. of Turkey 3: 518–531; Chrtková-Žertová, 1984, in Rechinger, Fl. Iranica 2: 237–342; Zohary, 1987, Fl. Palaestina 2: 91; Miniaev et Ulle, 1987, Fl. Partis Europaeae URSS, 6: 108; Greuter et al. 1989, Med-Checklist 4: 128; Lock, 1989, Legumes of Africa: 342; Lock et Simpson, 1991, Legumes of West Asia: 172; Valdes, 2000, Flora Iberica, 7(2): 795; Wei Zhi & Huang Yizhi, 1993, Flora Reip. Popul. Sinicae 42: 227. — Protologue: “...in G.[allia] Narbonensi”. — Lectotypus (HEYN 1970, Isr. J. Bot. 19: 287): Hortus Siccus Cliffortianus, no. 5 [BM!]

*Lotus angustifolius* Gouan, 1762, Hort.: 394. — Protologue: “Habitat à Gramont, Mauguio, à la Source du Lés”. — Type n.v.

*Lotus armeniacus* Kit Tan et Sorger, 1986, Pl. Syst. Evol. 154(1/2): 116. — Types: Turkey, A9, prov of Kars: 25 km from Tuzluca to Kagizman, saline steppe south of Aras river, 1000 m s.m., 20 VIII 1984, Sorger & Kit Tan 84-69-3 (holotype: Herb. F.Sorger); NE Anatolia. A8 Trabzon: marshy field at river mouth, 5 VIII 1957, sea level. Davis & Hedge, D. 32016 (paratype: [E], isoparatype: [K!]); B9 Agri: 5 km W. of Taslicay, wet meadows N. of Murat river, 1500 m s. m., 8 VIII 1983, Sorger 83-45-14 (paratype: Herb. F.Sorger, photo [E]).

?*Lotus ciliatus* Ten., 1811–1815, Prodr. Fl. Nap.: XLIV. — from description only. {The specimen ‘*Lotus ciliatus*, Tenore, Sep. 1824’ [K!] belongs to *Lotus parviflorus* Desf.}

*Lotus corbieri* Rouy, 1899, Rouy et Fouc., Fl. France 5: 152. — Protologue: “Manche, falaise de Carteret (Corbière in herb. Rouy)”. — Type n.v.

*Lotus diffusus* Sol. ex Smith, 1800, Fl. Br. 2: 794. — Protologue: “Amongst the rocks near Hastings” (syntype: [BM!]).

*Lotus glaberrimus* Schur, 1866, Enum. Pl. Trans.: 160. — Protologue: “Auf Salzthon: Bei Salzburg; auf der Heuwiese bei Klausenburg; bei Kolos in der Mésoség; bei Marós-Uyvár”. — Type n.v.

*Lotus gracilis* Waldst. et Kit. ex Willd., 1802, Sp. Pl. 3: 1389; 1807, Pl. rar. 3: 254, 229. — Type n.v.

*Lotus levieri* Heldr., 1876, Nuov. Giorn. Bot. Ital. 7: 297. — Protologue: “in agris siccis post messem inter pagum Altopascio (pr. Lucca) et lacum Sibolla”. — Lectotype (designated here): *E.Levier* Fl. Etrusc. exs., ad vias et margines agrorum inter lacum Sibolla et pagum Altopascio (Lucca), 7 Jul. 1875 [K!].

*Lotus praetermissus* Kuprian., 1937, Bot. mat. (Leningrad) 7: 37; Kuprianova, 1945, Fl. URSS 11: 296; Tulyaganova, 1981, Opredelitel’ rasteniy Sredney Azii 6: 48–50; Miniaev et Ulle, 1987, Fl. Partis Europaeae URSS 6: 108; Wei Zhi et Huang Yizhi, 1993, Flora Reip. Popul. Sinicae 42: 227. — Protologue: “... Prope Starobelsk in arenis. 1.VII.1904. Schirajewsky” (holotype: [LE!]).

*Lotus thessalus* Hayek, 1926, Repert. Spec. Nov. Regni Veg. Beih. 30(1): 881. — Protologue: “In pratis. The[ssalia]”. — Type n.v.

Illustrations: figure 3.

Annual or perennial herbaceous plants with taproots. Shoots thin, erect, ascending or prostrate. Main shoot usually well developed, 7–45 cm long, branching in its upper half (*L. angustissimus* var. *praetermissus*) or at the base and in the upper part, or along its whole length. Lateral shoots of the first order usually as long as the main shoot, 2–57 cm long. Plants pubescent, hair density varies from low to high. Hairs thin, deflected, usually of two types on the stem, i.e. short, curved hairs 0.1–0.5 mm long, and long, straight, almost perpendicularly deflected ones 0.7–2.5 mm long. On leaves and calyces hair length gradually varies within the limits of 0.3–2.0 mm. Leaf rachis 2–10 mm long, usually shorter than leaflets. Upper lateral leaflets inserted 0.2–1.5 mm below the rachis top, usually not symmetrically. Three upper leaflets 5–17 × 2–9 mm, elliptic, narrow-elliptic, obovate or oblong, sometimes almost rhombic (the lateral ones slightly oblique). Two basal leaflets 4–13 × 1.5–8 mm, oblique-broadly-obovate, oblique-obovate, or oblique-lanceolate.

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

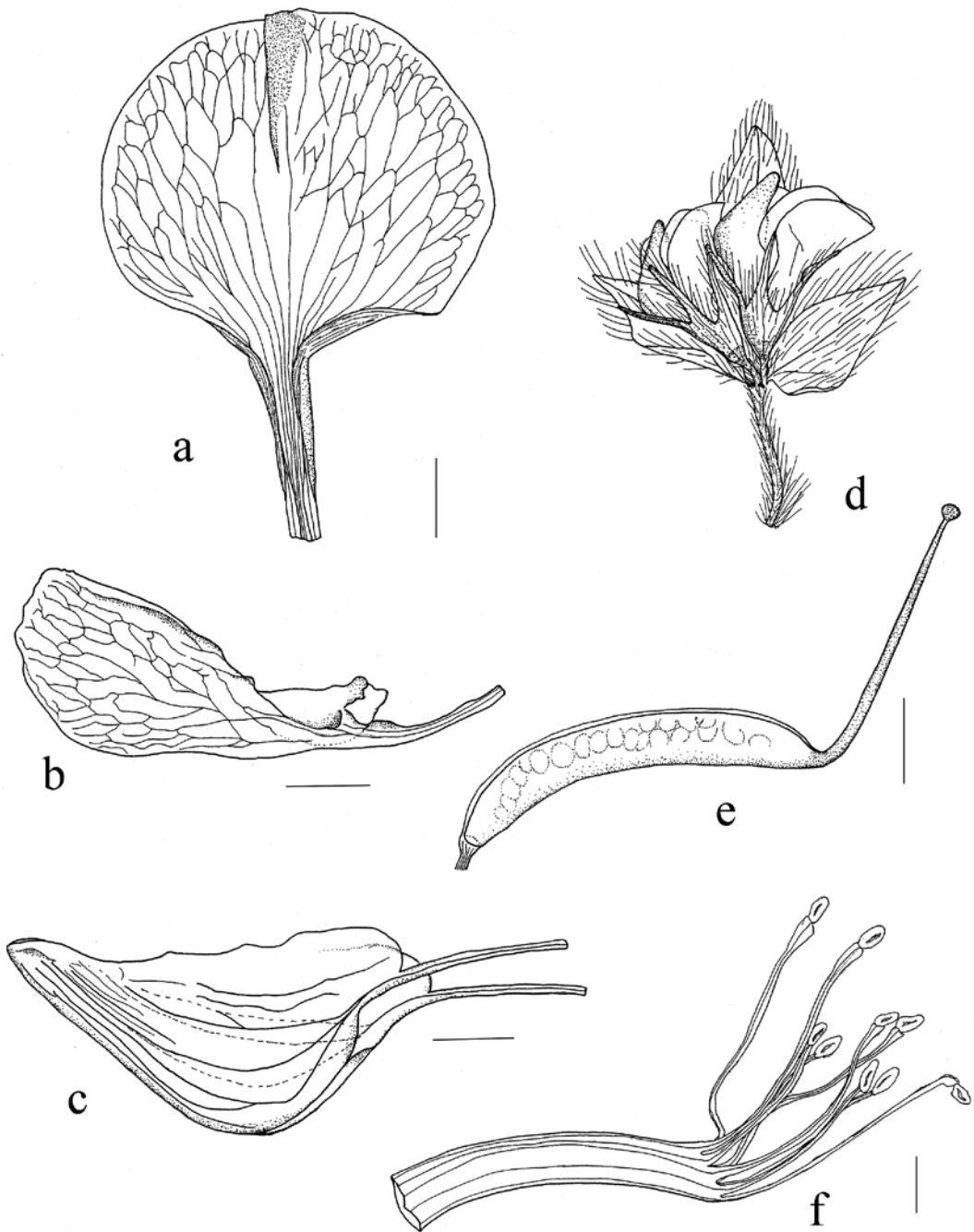


Figure 3: Characters of *Lotus angustissimus* L. (incl. *L. praetermissus* Kuprian.): a – standard, b – wing, c – keel, d – partial inflorescence, e – gynoecium, f – androecium. Bar = 1 mm.

All leaflets with acute apex, on short petiolules (0.2–0.8 mm long). Stipules as very small black or purple glands at the base of leaf rachis. Umbels on very thin (1–1.5 mm in diameter) and rather short (0.5–3(4) cm long) axillary peduncles, plus-minus as long as subtending leaves in flowering and elongating a little in fruiting. Pseudobract on a peduncle with (1)2–3 elliptic or oblong, at the apex acute leaflets on a short (0.1–0.6 mm long) rachis. Flowers in depauperated 1–2(3)-flowered

umbels. Flowers 4.5–8.5 mm long. Calyx almost actinomorphic, its teeth narrow, almost linear with triangular base, usually exceeding conic tube (1.2–2 times), rarely equal to tube or slightly shorter than it. Corolla yellow, 1.1–1.7 times longer than the calyx. Standard with round limb, claw clearly delimited from the blade. Standard is plus-minus equal to wings and keel. Keel bent from the middle at right angle (its length above the point of upward flexure 2.8–4.4 mm), with a short, straight-tipped beak 0.5–1.9 mm long, which constitutes 12–51% of the keel length above the point of upward flexure. Style 2.3–3.3 mm long. Fruits thin, straight, cylindrical or slightly compressed, blackish-brown to light-brown, glabrous, usually glossy, often raised in seed places, 5–28 × 0.9–2.4 mm, 2–9 times longer than the calyx, with 12–28 seeds. Seed almost spheroid, spheroid-disciform or spheroid-ovate-disciform, from the lateral-side view almost rounded or ovate, from the hilum-side view ovate; smooth, dull or semiglossy, yellow, sometimes with rose or purple tinge, brown, yellowish-brown or reddish-brown (sorrel), self-colored or pointed or mottled with blackish-purple spots or dots of various density, 0.9–1.2 × 0.9–1.1 × 0.7–0.9 mm. Radicular lobe inconspicuous or slightly discernible. Hilar rim yellow or reddish-brown, self-colored, slightly darker or lighter than the other seed surface. Raphe oblong-obovate or triangular, darker than the other seed surface. Lens conspicuous as small protuberance. Micropyle small, triangular.

2n = 12, 24 (HEYN 1970b; GRANT 1995).

Open places, steppes, different kinds of meadows, forest margins, ravines and caves, banks of streams and lakes, on sandy, sandy-argillaceous, clay, clay flint, or sometimes alkaline soils. Also on roadsides, along railway lines, near populated localities, on waste grounds, garbage dumps, and pastures.

**Geographical distribution** [data taken from literature are marked with double asterisk]: **Europe:** (\*\*)Albania, Austria, Bulgaria, France (incl. Corsica), Greece (incl. Crete and East Aegean Islands), (\*\*)Spain (incl. Balearic Islands), Hungary, Italy (incl. Sardinia and Sicily), former Yugoslavia (Croatia, Macedonia, Serbia, Montenegro, Slovenia), Portugal, Romania, Russia (European part: Tver', Moscow, Samara, Saratov, Orenburg, Rostov, Volgograd, Voronezh prov., Kalmykiya, Bashkiriya), (\*\*)Turkey (European part), Ukraine (Ternopol', Donetzk, Dnepropetrovsk, Lugansk, Zaporozhskaya, Poltava Khar'kov, Kherson prov., Crimea), United Kingdom; **Asia:** Azerbaijan, Cyprus, Georgia, (\*\*)Jordan, Iran, Israel, Kazakhstan, Lebanon, Russia (Asiatic part: Ural, Siberia: Orenburg, Omsk prov., Altai; Caucasus: Krasnodar, Kuban. prov.), (\*\*)Syria, Turkey; **Africa:** Algeria, Azores (Portug.), Canary Islands (Spain), Egypt, Madeira (Portug.), Morocco. **Introduced:** (\*\*)China, South Africa, Australia, Russia (Siberia).

SELECTED MATERIAL EXAMINED [specimens selected for morphometric research are marked with asterisk]: EUROPE: **RUSSIA (EUROPEAN PART): Tver prov.** (alien): 1.5 km SE from Kalinin railway station, *A.A.Notov s.n.*, 3 Oct. 1988 \*[MW]; **Moscow prov.** (alien): Zvenigorod distr., near B.Vyasyomy village, *V.Alekhin s.n.*, Aug. 1921 \*[MW 155563]; Bronnitsy distr., near Bykovo railway station, *V.Milovanov s.n.*, 30 Jul. 1923 [MW 155562]; **Voronezh prov.:** near Varvarino farm, *S.Krasovskaya 550*, 1 Aug. 1938 \*[MW 89217]; near Varvarinka, *S.V.Golitzin s.n.*, 28 Jun. 1948 [MW]; Khopersky nature reserve, 10 km NNE from Novokhopersk town, *N.Tzvelev 644*, 18 Jun. 1979 [LE]; **Samara prov.:** Novo-Uzenskyi distr.: *V.Bogdan 710*, 10 Aug. 1899 [LE], *V.Bogdan s.n.*, 13 Aug. 1894 [LE], near Walujka, *V.Bogdan s.n.*, 28 Jul. 1894 [LE], 10 Aug. 1899, [LW, \*MW 155567]; Nikoayevskyy distr.: Baronsk, *D.Yanishbensky s.n.*, 17 & 18 Jul. 1900 [LE], 18 Aug. 1915 [LE]; Pokrovskaya Sloboda vill., *D.Yanishbensky s.n.*, 13 Jul. 1900 [LE], 29 Aug. 1912 [LE]; Dyakovskaya cottage, *D.Yanishbensky s.n.*, 21 Jul. 1903 [LE]; **Volgograd prov.:** headstream of Golubaya river, *P.Smirnov s.n.*, 21 & 27 Jun. 1939 \*[MW, LE]; Sarepta, *Claus s.n.*, 1846 [LE]; *Becker s.n.* [MW 155569],



A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

1851, 1857 [LE]; *Mis. A.Becker s.n.*, 1864 [LE]; *Eversmann s.n.* [\*MW 155568], *Gremyachensky s.n.* [MW 89219]; Tinguta, Yergeni, *Paczoski s.n.*, 30 May 1890 [LE]; Elʹton, Ulugan, *D.Yanishensky s.n.*, 28 May 1915 [LE]; Davydovka, *B.A.Keller s.n.* [LE]; Moguta firth, *D.Yanishensky s.n.*, 18 Sep. 1927 [LE]; Ilovinskaya st., *D.Litvinov s.n.*, 6 Oct. 1883 [LE]; Eruslan river valley, near St. Poltavka vill., *A.Vazinger 353*, 14 Aug. 1932 [LE]; Dividing range of Eruslan and Kamyshevakh rivers, near Pobeda farm, *A.Vazinger 285*, 22 Jul. 1932 [LE]; Kletskyy distr., near Kletskyy, *L.Kalashnikov s.n.*, 22 Aug. 1922 [LE]; Kamyshin distr.: *Litvinov s.n.* [MW 155565], near Kamyshin town, *Mis. Zinger 84*, Jun. 1883 [LE]; near Alexandrovka village, *Litvinov 3884*, 16 Jul. 1883 [MW 155566]; Stalingradskoye reservoir, 25 km S from Bykovy farms, *V.Ekzertzev s.n.*, 10 Sep. 1960 [\*MW]; Krasnoarmeysky distr.: 4 km E from Tinguta station, *Ju.Alekseev s.n.*, 7 Aug. 1964 [\*MW]; Uryupink distr., Khoper river floodplain, *Alyushin 427*, 21 Aug. 1931 [LE]; Ustʹ-Medveditzkyy distr.: Ustʹ-Medveditza, at Don river, *Dr. R.Pabo s.n.*, 4 Jun. 1854 [LE]; near Ustʹ-Khoperskaya, *S.Gorshkova and N.Chernogryazskaya s.n.*, 26 Feb. 1916 [LE]; **Saratov prov.**: Saratov surroundings, near Goryuchka river, *M.G.Popov s.n.*, 1 Aug. 1918 [LE]; Yelshanka, *D.Yanishensky s.n.*, Sep. 1915 [LE]; **Kalmykiya**: Ergeninsky drainage divide, *A.Yakshina s.n.*, 19 Jun. 1950 [\*MW]; **Rostov prov.**: surroundings of Taganrog and Novocherkassk, *I.F.Kramakov 219*, 1875–88 [MW 89218]; Salʹsk distr., between Zapadny and Gugninsky farms and Gugninskaya village, *N.Ivanova and S.Naumova 82*, 25 Jul. 1925 [MW 155576]; Taganrog distr., Rovenʹki village, *E.Lavrenko 16*, 26 Jul. 1925 [LE]; Valley of Sal river, near Zolotarevskyy farm, *S.G.Gorshkova 614-a*, 3 Sep. 1928 [LE]; Salʹskyy okrug: Zapadnye horsefarms, *N.D.Bondareva 267*, 1926 [LE]; Zapadnoy farm, *N.Ivanova and S.Naumova 82*, 25 Jul. 1927 [LE]; Between Efanov and Dodonov farms, *Unknown 703*, 19 Aug. 1927 [LE]; Miusskoye forest division, *G.A.Stepunin 72 (66)*, 1911 [LE]; **Orenburg prov.**: approximately Orenburg, *unknown s.n.* [LE]; Ilel distr., near Alekseevka vill., *A.Borisova s.n.*, 15 Aug. 1928 [LE]; **Bashkiriya**: Zilairskyy kanton, between Kinderle and Valitovo, *N.Ivanova 870*, 9 Aug. 1930 [LE]; **UKRAINE: Ternopolʹ prov.**: Kremenetz, [*unknown collector*] [LW 073536]; **Donetzk prov.**: Volodarsky distr.: Kamennyye mogily nature reserve, *Panova s.n.*, 17 Apr. 1957 [LE]; *Lazebna s.n.*, 28 Jun. 1966 [LWS]; Amvrosievsky distr., B.Meshkovo, *O.Dubovik s.n.*, 21 Aug. 1961 [LE]; Artemovka, *O.Dubovik s.n.*, 6 Aug. 1961 [LE]; Blagodatnoje, *O.Dubovik s.n.*, 5 Aug. 1961 [LE]; Makeyevka distr.: Zuyevka village, *D.Stetzenko 25*, 18 Jul. 1932 [LE]; Andreyevka farm, *D.Stetzenko 22*, 5 Aug. 1932 [LE]; 3 km from Makeyevka village, *E.Karnaukh 17*, 5 Jul. 1932 [LE]; Novaya Zarya village, *Oleksii 24* [LE]; near Yasenevka village, *L.M. 23*, 6 Sept. 1932 [LE]; Girnik, *D.Stetzenko 21*, 26 Jul. 1932 [LE]; Gorlovka distr., Donbass, W from Yuzhnyy mine, *M.Oleksiyenko 26*, 3 Jul. 1932 [LE]; Baykar station, *M.Oleksiyenko 27*, 6 Jul. 1932 [LE]; Artemovskyy (Bakmutskyy) distr., Luganskaya village, *E.Lavrenko 2*, surroundings of Nikitovka village, *E.Lavrenko 29*, 26 Aug. 1925 [LE]; **Dnepropetrovsk prov.**: *Fon-Graff s.n.*, 1851 [LE]; Novomoskovsk distr.: near Kocherezhka vill., *Ju.Alekseyev s.n.*, 26 Jun. 1982 [\*MW]; Near Panʹkovka vill., *G.Bogomazov s.n.* [LE]; Novomoskovsk cottage, *P.Kozhevnikov 35*, 14 Jul. 1929 [LE]; Pavlograd distr., *F.Graff 39, 240* [LE]; Nikopol distr., opposit Kapulivka vill., *M.Kuksin 4*, 1 Oct. 1931 [LE]; **Lugansk prov.**: Kolpakov station of Donetzk railway, *L.Sokolova s.n.*, 25 Jul. 1927 [LE]; Ivanovskyy distr., NE from Krasnyy Luch town, *G.Grosset s.n.*, 10 Jul. 1957 [MW]; Antrazit, *O.Dubovik s.n.*, 29 Jun. 1962 [LE]; Krasnodon distr., Provalʹskaya step, *O.Dubovik s.n.*, 28 Jun. 1962 [LE]; Olʹkhova[ya] st., *N.Pidopliczka s.n.*, 17 Jul. 1925 [LE]; **Zaporozhskaya prov.**: flooded areas between Dubki and Alexandrowsk [=Zaporozhʹye], *Dementʹyev s.n.*, 19 Aug. 1896 [LE]; pr. urbem Alexandrowsk [=Zaporozhʹye], *L.Gruner s.n.*, 1865 [LE, MW 155577]; near Skelʹka vill., *Marchuk s.n.*, 12 Jul. 1951 [LW 073654, 073655]; Distr. Zaporizhzhja, NE from Vodyanoye vill., *Kozlov 8*, 23 Aug. 1930 [LE]; Zherebetz, *K.Ivanov s.n.*, 1869 [LE]; **Poltava prov.**: Kremenchug, *Bieberstein s.n.*, 1824 [LE], *Rogonicz s.n.* [LE], *Tscherniaiew s.n.* [\*MW 155573, 155571]; near Krukov town, *Rogonicz s.n.*, 3 Jul. 1857 [LE]; Kobelyakskyy distr., near Orlik vill., *N.Zinger s.n.*, 26 Jun. 1898 [LE]; **Kharʹkov prov.**: pr[ope] u[rbem] Starobjelsk, *Schirajewsky s.n.*, 23 Jul. 1905 [\*MW 155572]; near the town, *Schirajewsky s.n.*, 1 Jul. 1904 [LE]; Kupyansk distr.: Kabanʹye st., *M.Kotov s.n.*, 10 Jun. 1915 [LE]; Popovka farm, *M.Klokov 12*, 27 Jun. 1941 [LE]; Kremennaya, *M.Klokov 37, 147*, 17 Jun. 1919 [LE]; SSE from Kupyansk town, *M.Klokov 11*, 1 Aug. 1914 [LE]; Izyum, *Chernyaev 3, 21*, 1818 [LE]; *G.Schirjaeff 5*, 6 Jul. 1871 [LE]; Isyum distr., Bogorodichnoye,

*G.Schirjaeff* 6, 11 Jul. 1914 [LE]; Svyatogorsk, *Chernyaev s.n.*, 30 Jul. 1838 [LE]; Bogoroditzkoye, *G.Schirjaeff* 18, 398, 11 Jul. 1914 [LE]; Starobel'sk distr., near Voronov farm, *M.Klokov* 10, 12 Jun. 1919 [LE]; near Starobel'sk, *I.I.Shirayevskyy* 9, 1 Jul. 1904 [LE]; **Kherson prov.**: Near Kherson, *I.Paczoski s.n.*, 20 Jun. 1912 [LE]; Askaniya-Nova, *I.Paczoski s.n.*, 8 Aug. 1906 [LE]; *K.Zalesskyy s.n.*, 17 Jul. 1914 [MW 155570]; *S.A.Dzhenanovskyy s.n.*, 13-14 Jun. and 11 Aug. 1922 [LE]; *A.Poretzky s.n.*, 3 Jun. 1926 [LE]; *O.A.Baklushinskaya s.n.*, 20 Jun. 1928 [MW 155575]; *T.N.Rybakova s.n.*, 20 Jun. 1928 [MW 155574]; *Dogsom s.n.*, 16 Jul. 1964 [\*MW]; S from Bukhteyeva, Aleshkovskiy sands, *A.Poretzky s.n.*, 9 Jul. 1926 [LE]; 15-18 km E from Novaya Mayachka vill., *N.N.Tzeyelev et al.* 1630, 5 Jun. 1984 [MW]; Koziy mys vill., *M.Kuksin* 41, 28 Jul. 1930 [LE]; Melitopol' distr., near Aygamoshi vill., *N.Shostenko et al.* 5, 57, 27 Jul. 1928 [LE]; Chapli, in the end of Old Reserved Steppe, *N.Osadehyy* 43, 6 Jul. 1928 [LE]; Melitopol surroundings, Zabigaylov steppe depression, *O.Yanat s.n.*, 13 Aug. 1910 [LE]; Dneprovsk distr., Kostogryzova vill., *E.Ispolator* 15, 42, 19 Jul. 1900 [LE]; bank of Dnepr river, near Zaborinka farm, *A.Poretzky s.n.*, 3 Jul. 1926 [LE]; Near Belozherka, *I.Paczoski s.n.*, 19 Aug. 1906 [LE]; 4 Jul. 1910 [LE]; Ivanovka near Borisovo, *I.Paczoski s.n.*, 16 and 19 Jun. 1901 [LE]; Kryukov, *I.Paczoski s.n.*, 28 Jun. 1913 [LE]; **Krymskaya prov.**: Tauria borealis, *N.C.Sredinskyy* 144, 1868 [LE]; Slope of Magobi mountain, *M.Rapoport* 23, 22 Oct. 1958 [MW]; **BULGARIA**: M. Rhodope Orientalis, pr. urb. Zlatograd, *N.Stojanov et al. s.n.*, 23 Jul. 1954 [MW]; Malka Agalina ad Pontum, *N.Vihodcversky s.n.*, 19 May 1968 [MHA]; pr. Slivno, *J.Wagner* 34, 21 Jul. 1893 [BM]; **CROATIA**: Meeresstrand bei Medolino, *J.Frey n.s.n.*, 4 Jun. 1876 [\*NSW 512805]; **FRANCE**: Iles d'Ityerès, *Forestier s.n.* [\*NSW 513497]; Falaise de Tarteret, *E.Lebel s.n.*, May-Jun. 1845-49 [LE]; Cherbourg, *A. Le Jolis s.n.*, 22 Jul. 1859 [LE], Aug. 1862 [MW 260911]; Bayonne, *D.Deslongchamps s.n.*, 1806 [LE]; **GREECE**: Insula Icuria, *F.Guiol* 188, Jun. 1900 [BM]; **HUNGARY**: Hungaria austr., Vadaszerdo et Csoka-erdo Temesvarii, *Borbas s.n.* [MW]; ad pagum Apátim, *J.Prodan s.n.*, 1 Jun. 1910 [\*NSW 512681]; **ITALY**: in Esturiae maritimis, *unknown collector s.n.*, 1854 (Herbarium R. Musei Florentini) [\*NSW 512677]; In vineis insule St. Antioco, *U.I.Müller s.n.*, May [LE]; Sicilia: *A.F.Lang s.n.* [LE]; Prov. di Messina, mnt. Sori, loco dicto Barrila, *G.Zodda s.n.*, Jun. 1906 [MW]; Liguria occid., Varazze, *L.G.Gresino s.n.*, 18 Jun. 1908 [LE]; **MONTENEGRO**: Cattaro, *Th.Pichler s.n.*, 3 Jul. 1868 [K]; 4 Jun. 1885 [K]; Roguša, *Huter s.n.*, 19 May 1867 [K]; Čeluga, *A.Baldacci* 67, 1898 [K]; **PORTUGAL**: Mouquim, *A.Fernandes et al.* 12403, 8 Jun. 1973 [MHA]; **ROMANIA**: Banatus, distr. Severin: pr. pag.Costeii, *G.Bujorean s.n.*, 1 Aug. 1941 [MW, MHA]; montis Olimp, supra pagum Orșova, *E.I.Nyárády* 1272, 30 May 1923 [NSW 512578]; **UNITED KINGDOM**: Surrey, Womersh, *E.C.Wallace s.n.*, 22 Aug. 1935 [MW]; near Gosport Stands, *G.E.Kilderlee s.n.*, Jul. 1848 [NSW 513095]; **ASIA**: **AZERBAIJAN**: Between Lenkoran' town and Gamushevan vill., *N.Shepchinkyy* 65, 6 Jun. 1931 [LE 43508]; Near Nizhniye Nyuady vill., *N.Shepchinkyy* 167, 11 Jun. 1931 [LE 43507]; Talysh, Lencoran', *A.Lomakin s.n.*, 28 May 1894 [\*NSW 512577]; **CYPRUS**: prope Prodromo, *Sintenis et Rigo* 819, 30 Jun. ?? [BM]; **GEORGIA**: **Abkhaziya**: Tzentral'nyye Laty vill., *Sorokina s.n.*, 13 Jul. 1951 [LE]; Surroundings of Sukhumi, *A.P.Ivanov s.n.*, 23 Apr. 1888 [LE 43506]; **Kakhetiya**: near Lagodekhi, *Grinevskyy s.n.*, 19 Jun. 1900 [LE 43505]; **Adzhariya**: Near Shuakhevi vill., *T.A.Ostroumova et al.* 307, 29 Jul. 1987 [MW]; **ISRAEL**: Sharon Plain, Netanya, *C.Heyn s.n.*, 29 Apr. 1964 [MHA]; **IRAN**: prope Enseli, *J.Bornmüller* 6614, 24 Apr. 1902 [BM]; Guilan, Lahijan, *N.Lindsay* 797, May 1936 [BM]; **KAZAKHSTAN**: **Ural'sk prov.**: Ural'sk distr., Karabinskaya school, *A.Kubysov* 210, 4 Aug. 1895 [\*MW 155564]; Chigrinsk. distr., valley of Peschanka river, *Ada Schmidt* 185, 22 Jun. 1925 [LE]; **Aktyubinsk prov.**: Mugodzhary mountains, W from Alabas st., *A.K.Skvortzov s.n.*, 21-22 Jun. 1987 [MHA]; Temirskyy distr., Emba horse farm, Tas-Bulat-tau, *N.Sokolova s.n.*, 1 Jul. 1934 [MHA]; **Kustanay prov.**, Naurzumskyy state nature reserve: Tersekskyy pine forest, *A.Shreter s.n.*, 24 Jun. 1940 [MHA]; **Semipalatinsk prov.**: Ust'-Bukhtarminskoye vill., *M.Tomin s.n.*, 18 Jul. 1910 [LE]; Karakalinsk distr., Tyvo-Tas mountain, *S.E.Kucherovskaya* 411, 7 Jul. 1914 [\*NSW 512579]; **Vostochno-Kazakhstanskaya prov.**: left bank of Irtysh river, *E.Doyarenko s.n.*, 25 Jul. 1937 [MW]; **LEBANON**: Ain Zahalta, *Postian. s.n.*, 1881 [BM]; *J.Bornmüller* 11693, 13-20 Jun. 1910 [BM]; **RUSSIA (CAUCASUS)**: **Krasnodar prov.**: Sochi, Matzesta, *V.Miller s.n.*, 5 Jun. 1907 [MW 43504]; Khosta, *Krasil'nikov s.n.*, 1914 [MW 43503]; **Kubanskaya prov.**: *F.I.Poltoratzky s.n.*, 1888-90 [MW 43502]; **RUSSIA**

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

**(URAL, SIBERIA):** Ural, *Ledebour s.n.* [LE]; **Orenburg prov.:** Guberlinsk, *Al.Bunge s.n.* [LE]; near Guberlya station, at Guberlya river, *Fedchenko and Goncharov* 26, 23 Jul. 1927 [LE]; Orsk distr.: near Orsk, *Antonov s.n.*, 1852 [LE]; Pokrovskoye-Karagay, *D.Litvinov s.n.*, 22 and 23 Jul. 1895 [LE]; **Altay:** *Ledebour s.n.*, 1826 [LE]; *Meyer s.n.* [LE]; prope Buchtarminsk, *Al...[uncertain] s.n.*, 26 Jun. 18?? [LE]; **Omsk prov.:** Kurgan distr., Zverinogolovskyy okr., Mochalova vill., *N.A.Iranova* 2876, 30 Jun. 1929 [LE]; **TURKEY:** Trebizond, *E.K.Balls B 1568*, 5 Jul. 1934 [BM]; NE Anatolia. A8 Trabzon: marshy field at river mouth, *Davis & Hedge D. 32016*, 5 Aug. 1957 [K]; Antalya: Manavgat – Kara point, *Davis & O.Polunin* 25829, 10 Apr. 1956 [BM]; **AFRICA: ALGERIA:** Djurdjura, between Ouadhia and junction with Tizi Ouzou – M'Chedallah road, *unknown collector s.n.*, 21 Jun. 1975 [BM]; **PORTUGAL: Madeira:** *N.H.Mason s.n.*, 1856 [W 1972]; Chestnut woods about the Jardim, *R.T.Love* 598, 9 Jul. 1829 [LE]; **Azores:** *Hewett C.Watson s.n.*, 1842 [\*NSW 513096]; **SOUTH AFRICA (introduced):** Cape Peninsula, Wynberg Hill, *T.M.Satler* 2886, 27 Nov. 1932 [BM]. **AUSTRALIA AND OCEANIA (introduced): AUSTRALIA: New South Wales:** Dyer's Crossing via Taree, *S.R.Abbot s.n.*, 16 Oct. 1967 [\*NSW 98234]; Dyer's Crossing via Nabiack, *S.R.Abbot s.n.*, 23 Aug. 1967 [\*NSW 98232]; Sydney: Royal Botanic Gardens, *K.L.Wilson 892 & J.Se[...]*, 10 Jan. 1975 [\*NSW 512728]; Mosman, *J.Thompson* 717, 3 Dec. 1970 [\*NSW 512716]; Rookwood Cemetery, *E.Jugz s.n.*, 11 Nov. 1961 [\*NSW 512726]; **Norfolk Island:** *B.M.Watehouse* 5510, 14 Oct. 1999 [\*NSW 512788]; **Tasmania:** Midland distr., Cressy house, *R.S.Smith* 94684, 17 Apr. 1965 [BM]; **NEW ZEALAND:** North Island, Waitemata County, Mayrangi Bay, *E.B.Bangerter* 5135, 31 Dec. 1973 [\*NSW 512576].

**(2) *Lotus subbiflorus* Lag.** 1805, Varied. Ci. Lit. Artes (Madrid) 2(4): 213; Willkomm et Lange, 1880, Prodr. Fl. Hisp. 3: 348; Ball et Chrtková-Žertová, 1968, Fl. Europ. 2: 175 (sensu lato, incl. *L. castellanus* Boiss. et Reut.); Heyn, 1970, Isr. J. Bot. 19: 271–292 (sensu Heyn, non sensu orig. Lagasca); Láinz, 1973, Candollea 28: 13–14; Lock, 1989, Legumes of Africa: 348. — Holotype: “En Pravia. Julio. Lagasca” [M 66170, photo!].

*Lotus angustissimus* L. var. *brachycarpus* Pau, 1930. — Type: Iter Maroccanum, In arenosis subhumidis c. Malalien, C.Pau 350, 27 Jun. 1930 (isotype – [K!]).

*Lotus angustissimus* L. subsp. *suaveolens* (Pers.) O.Bolos et Vigo, 1974, in Bull. Inst. Catalana Hist. Nat. Secc. Bot. 38(1): 70.

*Lotus approximatus* Clav., in Act. Linn. Soc. Bord. 38: 528. — Protologue: “Saint-Christophe-de-Double (Deloynes)”. — Type n.v.

?*Lotus diffusus* Sebast. et Maur., Fl. Rom. prod.: 257.

?*Lotus divaricatus* Soland. ex Buch, 1816, in Abh. Acad. Berl.: 198. — Type: Madeira: Solander [BM]?

*Lotus filiformis* Poir., 1813, Enc. Suppl. 3: 504. — Protologue: “... dans les provinces méridionales de la France”. — Type n.v.

*Lotus hispidus* Desf., 1804, Tab. ed. 1: 190; Ball, 1878, Willkomm et Lange, 1880, Prodr. Fl. Hisp. 3: 346; Journ. Linn. Soc.: 424; Brand, 1898, Bot. Jahrb. Syst. 25: 216; Rouy, 1899, Flore de France 5: 153; Larsen et Žertová, 1969, Feddes Repert. 80(4/6): 305–314. — nom. inval., nom. nud. Valdes, Page 796.

?*Lotus odoratus* Sims, Bot. Mag. t.1233.

*Lotus pilosissimus* Poir., Encyc. Suppl. 3: 504. — Type n.v.

?*Lotus stagnalis* Batt., Flor. Alg.: 244.

*Lotus suaveolens* Pers., 1807, Syn. Pl. 2: 354; Seringe in DC., 1825, Prodr. 2: 213; Heyn, 1970, Fl. of Turkey 3: 518–531. Heyn, 1970, Isr. J. Bot. 19: 271–292. — Type: “*Lotus suaveolens* Syn. plant. Cultas in HB Parisiense” [L, photo!].

?*Lotus unibracteatus* Viv., Fl. Lib. Spec.: 48.

Illustrations: figure 4.

Annual, biennial or perennial herbaceous plants with taproots. Shoots ascending or prostrate. Main shoot as long as lateral shoots of first order (4–88 cm), branching along its whole length, rarely in its basal and upper parts. Vegetative parts of plant, calyces and pedicels covered with dense, deflected indumentum of thin hairs. On calyces and leaves hairs 0.2–2.0 mm long, on stems hairs of two types: short curved hairs 0.1–0.5 mm long, and long straight perpendicularly deflected hairs 0.6–3.0 mm long. Leaf rachis 1–13.2 mm long, usually slightly shorter than leaflets. Upper lateral leaflets inserted 0.2–2.2 mm below the rachis top, usually nonsymmetrically. Three upper leaflets 3.5–20.0 × 1.1–10.0 mm, obovate to oblanceolate (the lateral ones slightly oblique). Basal leaflets 3–16 × 1.8–10 mm, oblique-ovate to oblique-lanceolate, sometimes oblique-elliptical. All leaflets on short petiolules 0.2–0.9 mm long. Stipules as very small black or purple glands at the base of leaf rachis. Peduncles 0.5–3.8 cm long, plus-minus as long as subtending leaves, in fruits a little elongating (up to 4.0–5.5 cm). Pseudobract on a peduncle with (1)2–3 elliptical or oblong leaflets 2.7–12.5 × 0.7–6.7 mm, on a short rachis (0.1–0.7 mm long) or practically without any one. Umbels (1)2–4-flowered. Flowers 5.0–8.5 mm long. Calyx almost actinomorphic or slightly zygomorphic, teeth 1.2–2.1 times longer than tube, narrow, lanceolate, gradually contracting upwards, slightly bent towards the standard. Two upper teeth a little bit larger and shorter than others, the lower tooth the longest and narrowest. Corolla 1.1–1.7 times longer than calyx, light-yellow. Standard equal to or exceeding the keel, the latter exceeding the wings. Standard blade ovate, not clearly delimited from shorter claw. Wing limb oblong-obpyriform, truncate at the apex. Keel bent upward from near the base, with long straight-tipped beak. Keel length above the point of upward flexure 3.2–5.0 mm, beak length 1.9–2.9 mm (i.e. 46–69% from keel length from the point of upward flexure). Style 2.9–4.5 mm long. Fruits straight, cylindrical or slightly compressed, dark- or light-brown, glabrous, 6–23 × 1.0–2.3 mm, 1.5–3.5 times longer than calyx, with 6–18(23) seeds. Seeds almost disciform, from the lateral-side view almost rounded or ovate (oblique-ovate), from the hilum-side view elliptical or oblong, smooth, dull, from reddish-brown (sorrel) to light-brown, with purple dots of median density, 0.9–1.1 × 0.8–1.0 × 0.5–0.7 mm. Radicular lobe inconspicuous or slightly discernible. Hilum rounded, slightly recessed or situating at the level of seed surface, with small rim aril. Hilar rim dark-brown, self-colored, without dots and points, darker than other seed surface. Raphe oblong or ovate, also darker than other seed surface. Lens small protuberance, surrounded by dark spot. Micropyle small, triangular.

2n = 24 (HEYN 1970b, as *L. suaveolens* Pers.), (?)12 (GRANT 1995).

Open places, different kinds of meadows, sea coasts (littorals, coastal sandy and loamy soils, rocks), stream banks, roadsides, hills.

**Geographical distribution: Europe:** France (incl. Corsica), Greece (incl. Crete), Italy (incl. Sardinia and Sicily), Portugal, Spain, United Kingdom (SW); **Asia:** Israel, (\*\*)Turkey (Western Anatolia, single locality); **Africa:** (\*\*)Algeria, Azores (Portug.), Canary Islands (Spain), (\*\*)Libya, Madeira (Portug.), Morocco, (\*\*)South Africa, Tunisia. **Introduced:** Australia, (\*\*)Japan, New Zealand, (\*\*)Zimbabwe.

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

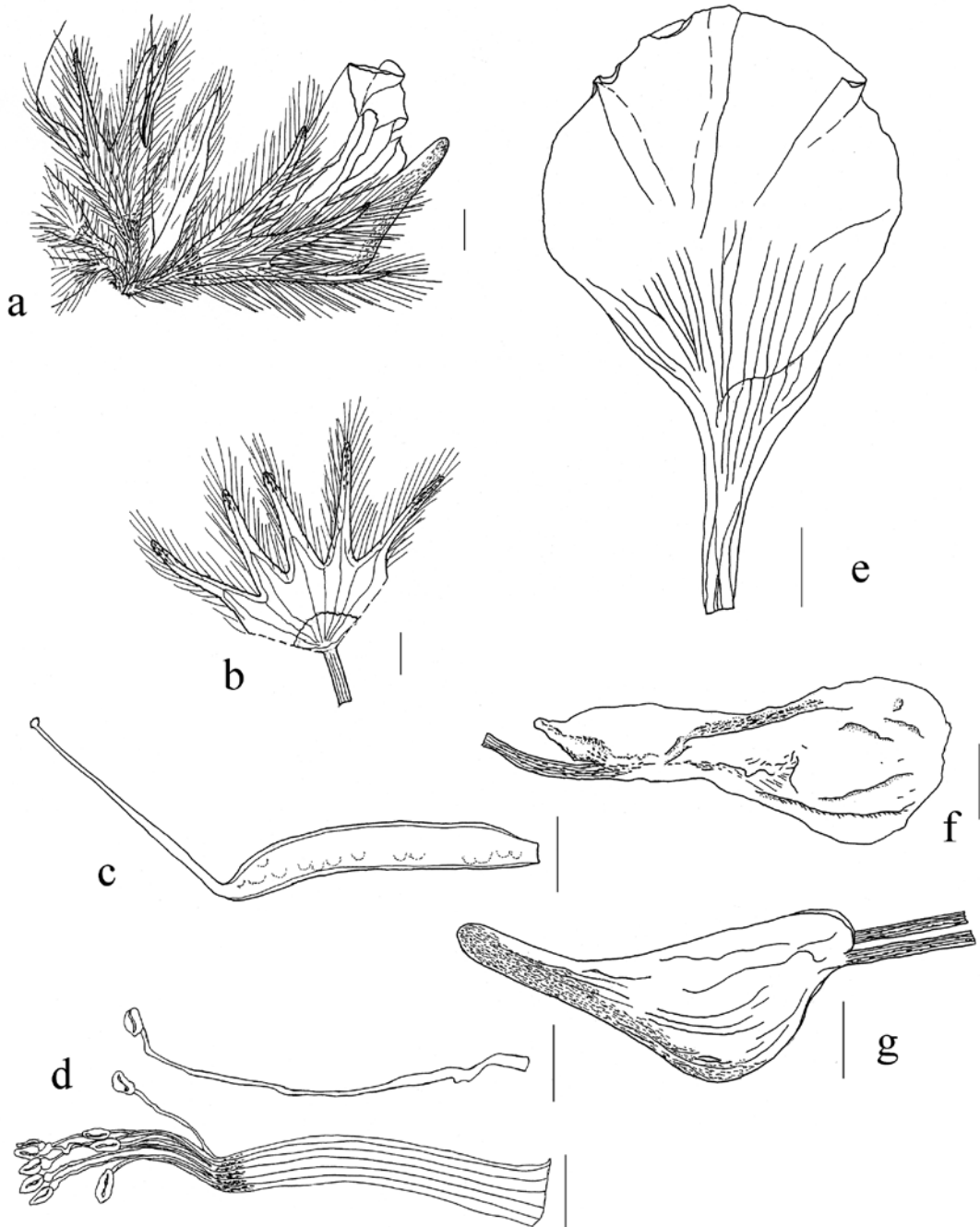


Figure 4: Characters of *Lotus subbiflorus* Lag.: a – partial inflorescence; b – calyx, c – gynoecium, d – androecium, e – standard, f – wing, g – keel. Bar = 1 mm.

SELECTED MATERIAL EXAMINED (fig. 5): **EUROPE: FRANCE: Dep. Îles-de-France:** Les Pecqueux, [uncertain] s.n. [\*NSW 513498]; Gallia meridionali, comm. Steven, 1822 [LE]; **Dep. Aquitaine:** Bayonne, D.Deslongchamps s.n., 1806 [LE]; Bordeaux, unknown collector s.n. [LE]; Entre Roquefort et Villeneuve, unknown collector s.n., 19 Jul. 1823 [LE]; Salies de Béarn, Moulléfarine s.n., 17 Aug. 1889 [\*NSW 513492]; Arès, A.J.Neyraut s.n., 9 Jun. 1901 [\*NSW 513482]; Près Dax, Bonnet s.n., 23 Jul. 1880 [K]; Layrac, Ch. Arnaud

& *E. Garroute 2816*, 10 Jul. 1877 [K]; **Dep. Basse-Normandie**: Granville, *A. Le Jolis s.n.*, Jul. 1860 [\*MW 260909]; Environs de Cherbourg, *Des Erangs s.n.*, Sep. 1828 [LE]; Anderville, Carteret, *E. Lebel s.n.*, Jun–Jul. 1846–47 [LE]; Île de Chausey, *D. Brehier s.n.*, 13 Aug. 1862 [LE]; **Dep. Bretagne**: Côtes-du-Nord: *E. Le Maout s.n.* [\*LE]; Penmarch, *Finistère s.n.*, Jun. 1854 [K]; **Dep. Centre**: entre Allogny et le Rein-du-Bois (Cher) *A. Déséglise & A. Jullien-Crosnier s.n.*, 29 Jul. 1854 [LE]; entre la Selle St. Denis et la Bronse Loir et Cher, *P. Hariot s.n.*, 31 May 1874 [K]; La Ferte-Imbault, *Segret 6106*, 24 Sep. 1930 [BM]; **Dep. Corsica**: Forêt d'Aitone bei Evisa, *P. Aellen 176*, 25 Jul. 1932 [LE]; Trockener Hügel bei Evisa, *P. Aellen 180*, 25 Jul. 1932 [LE]; Solenzara, *P. Aellen 179*, 16 Jul. 1932 [K]; Ajaccio, *Salzmann s.n.*, Sep. 1822 [K]; **Dep. Midi-Pyrénées**: Toulouse, *Decandolle s.n.*, 1807 [LE]; *Laperrouse s.n.*, 1808 [LE]; *Schrader s.n.* [LE]; *Cro... s.n.*, 1868 [LE]; **Dep. Pays de la Loire**: Pays de Retz, *Desvaux s.n.*, 1813 [K]; **Dep. Provence-Alpes-Côte d'Azur**: Graveson près de Saint-Martin, au sud d'Avignon, *G. Dutartre no. 14195*, 20 Jun. 1988 [MHA]; Draguignan, *D. Gay s.n.*, Dec. 1821 [LE]; Îles d'Hyères, *Forestier s.n.* [\*NSW 513497], *du Lovout s.n.*, Jun. 1841 [K]; **GREECE**: **Crete**: Distr. Sitia, inter Piskokephalo et Maronia, *K.H. Rechingen 12700*, 8 May 1942 [K]; **ITALY**: **Prov. Campania**: Napoli, *Neyn, Herbellertens s.n.* s.dat. [LE]; Isle d'Ischia, *unknown collector s.n.*, 1855 [K]; **Prov. Latina**: Lazio, Pianura Pontina, *M. Iberite 15222*, 15 Jun. 1991 [\*MHA]; **Prov. Sardinia**, *unknown collector s.n.* s.dat. [LE]; Santa Teresa Gallura par Tempio, *E. Reverchon s.n.*, 1881 [K]; **Prov. Sicilia**: Palermo, *Parlatore s.n.*, 1841 [LE]; Ficuzza, *E. et A. Huet du Pavillon 67*, 1 Jun. 1856 [LE]; **Prov. Toscana**: Pisa, *Henry van Heurck s.n.*, 1870 [K]; **PORTUGAL**: **Prov. Évora (Alto Alentejo)**: Monsaraz, margem do Guadiana, Moinho do Gato, *Malato-Beliz et al. 6432*, 23 May 1968 [MHA]; **Prov. ??**: Santa Anna in Castanetis, *Fr. Hall s.n.*, 14 Jun. 1828 [LE]; **Prov. Algarve**: Faro prox. Da Arábia, *Bento Rainha 1777*, 10 May 1949 [\*NSW 513483]; **Prov. Aveiro**: Entre Pampilhosa et Luso, *M. Ferreira 148*, Jun. 1886 [BM]; **SPAIN**: **Prov. Badajoz**: Granja de Torrehermosa, *A. Segura Zubizarreta 34566*, 17 May 1987 [\*MHA]; **Catalogne**: *Requien s.n.*, Jun. 1827 [LE]; **Prov. Asturias**: Grado, *Durieu s.n.*, 24 Jun. 1835 [LE]; Canga, de Tineo, *Durieu s.n.*, Jul. 1835 [LE]; **Prov. Cadis**: suprâ Algeciras, *Boissier et Reuter s.n.*, 1849 [LE]; **Prov. Cantabria**: Santander, *Ed. Leroy 5621*, 1925 [W 22798]; **Prov. Extremadura**: Berlanga, *J. Daccou 1028*, May 1883 [LE]; **Prov. Huelva**: Sierra Morena, S of Santa Olalla, *N.Y. Sandwith 6356*, 12 Jun. 1964 [\*NSW 513486]; **Balearic Islands**: Menorca, Binisarmena, *Willkomm 23*, 28 Mar. 1873 [LE]; **UNITED KINGDOM**: **Channel Islands**: Guernsey, Vale Church, *J. Boswell-Syme s.n.*, Jun. 1853 [MW]; St. Catherine's Bay, *F.J. Hanbury s.n.*, 5 Jul. 1884 [\*MW]; Alderney, *A. Bruce Jackson 98*, 2 Jun. 1933 [K]; Sark, *unknown collector s.n.*, 3 Jul. 1876 [\*NSW 513479], *F. & E. Ballard 459*, 19 Jul. 1930 [K]; **Jersey**: St. Breladés, *Jas. W. White s.n.*, 2 Jun. 1896 [MW]; *K. Louis-Arsène s.n.*, 8 Jun. 1926 [LE]; **Isles of Scilly**: Tresco, *F.J. Hanbury s.n.*, 13 Jul. 1923 [\*MW]; Saint Mary's, *A.G. Gregor s.n.*, 22 Jun. 1989 [\*NSW 513478]; W. Curnow s.n., Jul. 1878 [W 17994]; **Hampshire**: Southbourne, *B.L. Burt 1025*, 31 May 1944 [K]; **Cornwall**: Breage near Helston, *J. Cunnack s.n.*, Aug. 1875 [\*NSW 513484]; St.-Sampsons, *Quemys s.n.*, 5 Jul. 1876 [\*NSW 513496]; near Polperro, *Relotone s.n.*, 14 Jul. 1934 [K]; **Devon**: SW of East Portlemouth, *T.A. Sprague s.n.*, 29 Jul. 1931 [K]; between Croyde Bay and Baggy Point, *S. Ross-Craig et al. 989*, 25 Jun. 1940 [K]; **Dorset**: Near Arne, Poole Harbour, *W.C. Worsdell s.n.*, 14 Jul. 1937 [K]; Christchurch, *H. Fisher s.n.*, Jul. 1885 [LE]; *D.M. Heath s.n.*, Jul. 1920 [K]; **West Cornwall**: Lamorna Cove in the neighbourhood of Penzance, *Charles Bailey s.n.*, 7 Oct. 1886 [\*NSW 513485, \*NSW 513487]; **Exeter County**: Budleigh Salterton, *Deron s.n.*, 30 Jun. 1848 [\*NSW 513480]; **ASIA**: **ISRAEL**: Sharon Plain, Kefar Vitkin, near banks of Alexander River, *M. Zobary and N. Fienbrun s.n.*, 7 Apr. 1939 [\*MHA]; **AFRICA**: **TUNISIA**: Korbous, *C.J. Pittard 683*, May 1910 [\*NSW 513481]; **MOROCCO**: Chaouiâ: Camp Boulhaut, *C.J. Pittard s.n.*, 15 May 1912 [\*NSW 513489]; Dj. Habibi, *M. Gandoger s.n.*, 1910–1911 [W 6901]; **Prov. Kenitra**: 10 km NE Kenitra, *W. Lippert 23193*, 3 Mai 1987 [W 04997]; **Prov. Tanger-Tetouan**: in arenosis subhumidis c. Malalien, *C. Pau 350*, 27 Jun. 1930 [K]; **PORTUGAL**: **Azores**: *Hochobeller s.n.*, May, Jun. 1838 [LE]; ins. Terceira, *C. Hochst 85*, May 1838 [LE]; **Madeira**: *Webb s.n.*, Jul. 1835 [LE]; Machico, *E. Port 6731*, 4 May 1870 [\*LE]; *J. Bornmüller 524*, 2 May 1900 [LE, W]; Nibeiro de S. Juan, *G. Mandon s.n.*, Apr.–Jun. 1865–1866 [LE]; **AUSTRALIA AND OCEANIA**: **AUSTRALIA**: **Victoria**: Apollo Bay, *Battrill s.n.*, 12 Mar. 1957 [\*NSW 512768]; **New South Wales**: Dyer's Crossing, S of Taree, *A. Lee s.n.*, 5

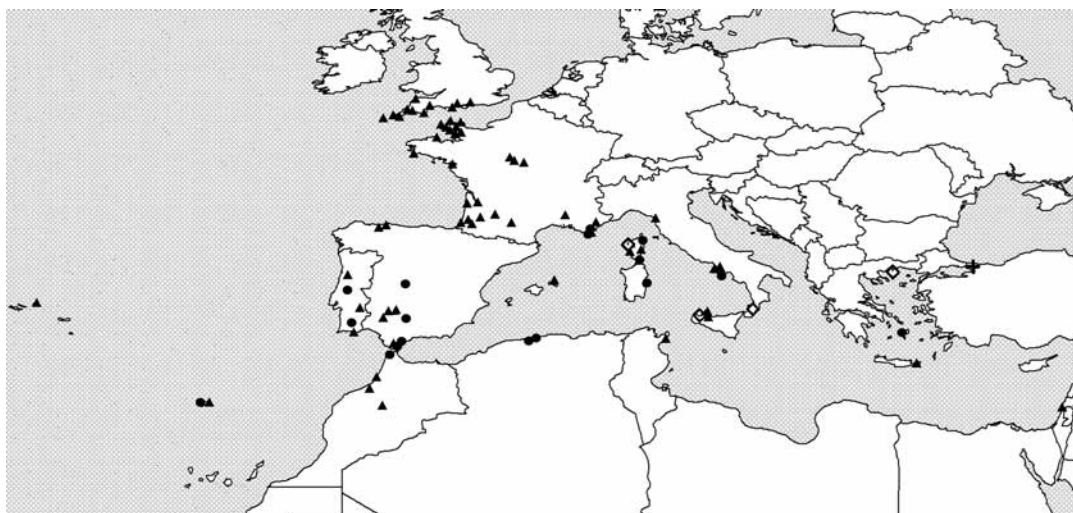
A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

Figure 5: Geographical distribution of *Lotus subbiflorus* Lag. (filled triangles), *L. parviflorus* Desf. (filled circles), specimens with combined characters of *L. angustissimus* L. and *L. subbiflorus* Lag. (open rhombs), and *L. macrotrichus* Boiss. (cross).

Nov. 1969 [\*LE]; Jamberoo Mountain Road, 3.25 km due E of Robertson, *P.G.Kodala 163 et al.*, 15 Mar. 1992 [\*NSW 253468]; Near Terece, *J.B.Noonan s.n.*, 2 Jan. 1970 [\*NSW 513227]; Leura, *unknown collector s.n.*, 14 Dec. 1934 [\*NSW 248110]; Mosman (George Heights Oval), *J.Thompson s.n.*, 3 Jan. 1971 [\*NSW 248142]; Kiah (or Towamba); *S.Jacobs 2857*, 27 Nov. 1976 [\*NSW 248141]; Central Tilba, *Bellert s.n.*, 22 Dec. 1964 [\*NSW 98229]; Kuring-gai Creek, *G.Thompson s.n.*, 21 Nov. 1971 [\*NSW 248099]; **NEW ZEALAND:** North Island, Waitemata County, Mairangi Bay, Montrose Terrace, *E.B.Bangerter 5129*, 16 Dec. 1973 [\*NSW 513177]; Tikitere, *E.McBarron 6641*, Nov. 1956 [\*NSW 513161].

***Lotus subbiflorus* Lag. × *Lotus angustissimus* L.**

(specimens with combined characters of *L. subbiflorus* and *L. angustissimus*)

**FRANCE:** Corsica, *Sieber s.n.* [K]; Trockener Hügel bei Evisa, *P.Aellen s.n.*, 23 Jul. 1932 [K]; **GREECE:** Thasos: Makryammos, 2.5 km SE of Limenas, *C. Barelay 1415*, 15 May 1969 [K]; **ITALY:** Sicilia, *unknown collector s.n.* [K]; *Parlatore s.n.*, 1847 [K]; Palermo, *Todaro s.n.*, 1847 [K]; Calabria, prov. Reggio, Gerace, *G.Rigo 272*, 6 Jun. 1898 [K].

Illustrations: figure 5 (map).

Plants with a combination of characters usually have styles longer than 3 mm (which is common in *L. subbiflorus*) but longer and narrower pods (15–22 × 1.4–1.6 mm) with many (up to 22) seeds what is characteristic for *L. angustissimus*. Keel shape is of intermediate pattern.

**(3) *Lotus castellanus* Boiss. et Reut.** 1849(8?), *Diagn. pl. nov.* 2: 34; Boissier et Reuter, 1852, *Pugillus Pl. Nov. Afr. Austr. Hisp. Austr.*: 38; Willkomm et Lange, 1880, *Prodr. Fl. Hisp.* 3: 347; Brand, 1898, *Bot. Jahrb. Syst.* 25: 217; Larsen et Žertová, 1969, *Feddes Repert.* 80(4/6): 305–314; Lainz, 1973, *Candollea* 28: 13–14; Greuter et al. 1989, *Med-Checklist* 4: 132; Lock, 1989, *Legumes of Africa*: 343; Valdes, 2000, *Flora Iberica* 7(2): 795. — Protologue: “... Spain: Montes de Toledo”. — Type: [Spain:] In arvis humidis prope San Pablo, Toletanorum, Jul. 1841, Reuter (holotype: [G, photo!], isotype: [K!]).

*Lotus angustissimus* L. var. *major* Boiss.ex Brand 1898, Bot. Jahrb. Syst. 25: 217. — nom. prov.

?*Lotus clausonis* Pomel, 1875, Nouv. Mat. Fl. Atl.: 182.

?*Lotus hispidus* Desf. ssp. *clausonis* (Pomel) Batt., 1889, Fl. Alg. Dicots.: 244.

*Lotus subbiflorus* Lag. 1805, Varied. Ci. Lit. Artes (Madrid) 2(4): 213 sensu Heyn, 1970, Isr. J. Bot. 19: 271–292, non sensu orig. Lagasca.

*Lotus subbiflorus* Lag. ssp. *castellanus* P.W.Ball, 1968, Feddes Repert. 79: 41; Ball et Chrtková-Žertová, 1968, Fl. Europ. 2: 175.

*Dorycnium subbiflorum* (Lag.) Ser., in DC., 1825, Prodr. 2: 209.

Illustrations: figure 6.

Annual, biennial or perennial herbaceous plants with taproots. Shoots ascending or erect. Main shoot 20–70 cm long, usually highly branching along its whole length. Lateral shoots of first order usually as long as the main one, 14–80 cm long, also branching. Plants pubescent. Calyces and leaves densely covered with straight, deflected hairs 0.1–1.4 mm long, stems and peduncles less densely covered with short, curved hairs 0.1–0.3 mm long, and long, straight, highly deflected hairs 0.5–1.3 mm long. Leaf rachis 1.7–5.2 mm long, 2–3 times shorter than the terminal leaflet. Upper lateral leaflets inserted 0.4–1.5 mm below the rachis top, usually nonsymmetrically. Three upper leaflets 4.0–13.0 × 1.2–4.2 mm, oblanceolate, obovate-oblanceolate, elliptic, or almost linear, the lateral ones slightly oblique. Leaflets of basal pair 3.0–7.0 × 0.9–2.8 mm, oblique-ovate, oblique-lanceolate, or oblique-ovate-elliptical, often early falling off. All leaflets with acute apex, on short petiolules 0.2–1 mm long. Stipules as small black or purple glands at the rachis base. Peduncles in flowering 0.6–3.7 cm, in fruits elongating up to 5–6 cm. Pseudobract on peduncle with 1–3 elliptical, oblong, or linear leaflets 2.9–7.3 × 0.5–2.5 mm on short rachis 0.1–0.7 mm or practically without any one. Umbels 1–3(4)-flowered. Flowers 6.0–9.2 mm long. Calyx 3.8–6.5 mm long, slightly zygomorphous, its teeth of different length and width. The lower tooth is of maximum length, which is gradually decreasing towards the upper teeth. The teeth width, on the contrary, decreases from upper teeth towards the lower one. All teeth tips are curved upward, towards the standard. Each calyx tooth with short apical awl part, about 1/8 of the whole tooth length. Calyx teeth about as long as or 1.3–2.0(2.5) times longer than the conic or conic-campanulate tube. Corolla 1.2–1.6 times longer than calyx, yellow, turning red after drying. Standard exceeds the keel or equal to it, the latter is longer than wings. Standard with rounded or ovate blade, clearly delimited from the shorter claw. Keel bent upward from near the base, long-beaked with incurved tip. Keel length above the point of upward flexure 4.5–5.8 mm, beak length 2.5–3.3 mm (i.e. 53–61% from keel length from the point of upward flexure). Style 3.6–5.0 mm long. Fruits 6–12(15) × 1.0–1.7 mm, brown or dark-brown, straight, cylindrical, 1.2–3.3 times longer than calyx; containing 4–12(19) seeds. Fruits are hairy with semi-appressed or deflected trichomes 0.1–0.3 mm long alongside the ventral suture, as well as ovaries. Seeds spheroid-disciform, from the lateral-side view almost rounded, from the hilum-side view elliptical, smooth, dull, of various tones of brown colour (i.e. reddish-, light-, yellowish- or greenish-brown), self-coloured or with rare brownish-purple spots, 0.9–1.2 × 1.0–1.1 × 0.6–0.8 mm. Radicular lobe inconspicuous. Hilum rounded, slightly recessed or situating at the level of seed surface, with small rim aril. Hilar rim yellow- or reddish-brown, self-coloured, without dots and points, darker or lighter than other



A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

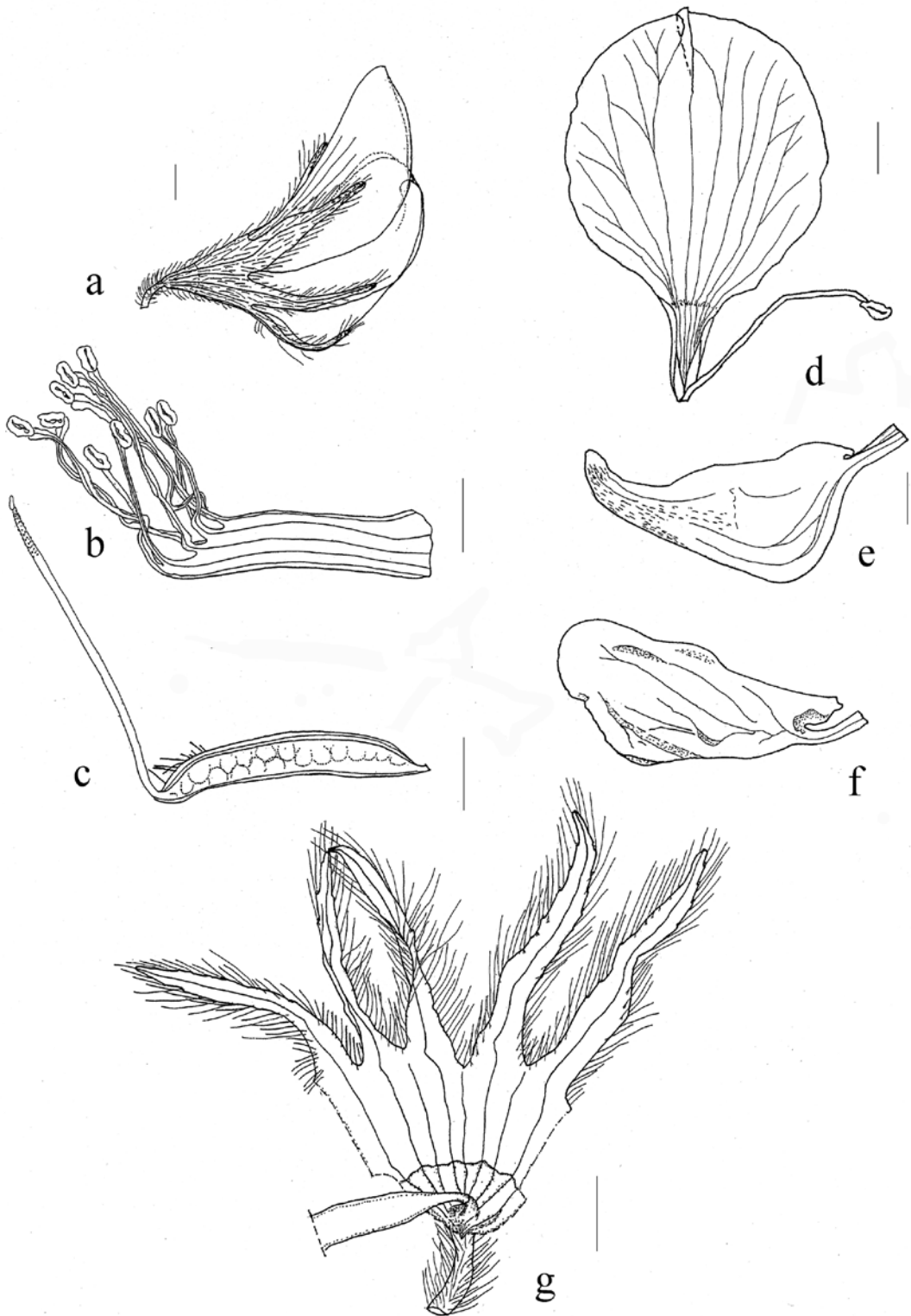


Figure 6: Characters of *Lotus castellanus* Boiss. et Reut.: a – flower, b – androecium (nine connate stamens), c – gynoecium, d – standard with free stamen, e – keel, f – wing, g – calyx.

seed surface. Raphe ovate or almost rounded, darker than other seed surface. Lens as a small protuberance, surrounded by a small dark spot. Micropyle small, triangular or wide-triangular.

$2n = 12$  (HEYN 1970b, as *L. subbiflorus* Lag.).

Coastal beaches, meadows, stream banks, dry slopes, mountain foots (on altitudes not more than 700 m s.m.), wet places and marshes, roadsides, weedy places, field edges. On gravelly, granitic or limestone rocks, sandy soils.

**Geographical distribution:** **Europe:** France, Italy, Portugal, Spain; **Africa:** Algeria, Morocco.

MATERIAL EXAMINED (fig. 7): **EUROPE: FRANCE: Dep. Pays de la Loire (Vandée):** prope Landeronde, *Ch.Portarlier* 2627, 6 Jul. 1883 [\*LE, K]; **PORTUGAL: Prov. Alto Alentejo:** Elvas, *F.Vintemes & F.Antemes* 853, 8 Jul. 1970 [\*MHA]; **Prov. Baixo Alentejo:** Mértola Minas de Sao Domingos, *Bento V. Rainha* 6127, 31 May 1963 [\*MHA]; Estrada Castelo Branco a Malpica, *A.Queiroz et al.* 11764, 6 Jul. 1971 [\*MHA]; **Prov. Braga:** Guimaraesh, *LeTaür (?) s.n.* [\*K]; **Prov. Beira Litoral:** Leiria, Monte Real, *Bento V. Rainha* 6203, 19 Aug. 1964 [W 03573]; Barrinha de Esmoriz, *Malato-Belitz et Guerra* 13585, 12 Jul. 1977 [\*MW]; **Prov. Évora:** Evoramonte près Estremoz, *J. Daveau s.n.*, Jul. 1881 [\*LE, K]; **Prov. Faro:** near Faro, *Wiln s.n.*, May 1847 [\*K]; à Monchique, *E.Bourgeau* 1783, 15 Jun. 1853 [\*LE]; Vendas-Novas, *R. et A. Fernandes* 2929, 15 Sep. 1948 [K]; **ITALY: Sardinia,** near Tempio, *E. Reverchon* 269, 19 Jun. et 22 Jul. 1882 [\*K]; 19 Jul. ?? [\*K]; **SPAIN: Prov. Andalucía:** Algeciras, *Schott s.n.* [W]; *E.Reverchon* 88, 4 Jul. 1887 [K]; au Coto à Puerto Santa Maria, *E.Bourgeau s.n.*, 7 Jun. 1849 [\*LE]; Waterfall valley, *A.H.Wolley-Dod* 2246, 25 Jun. 1913 [\*K]; Guadacorte, *A.H.Wolley-Dod* 2235, 17 Jun. 1913 [K]; Grazalema, *N.Y.Sandwith* 6346, 11 Jun. 1946 [K]; between Villanueva de Cordoba and Torrecampo, *N.Y.Sandwith* 6127, 7 Jun. 1963 [K]; **Prov. Ávila:** Mombeltran, loco dicto “Los Pozos de Felipe”, *A. Segura Zubizarreta* 38.109, 38.111, 1 Jul. 1990 [\*MHA]; Candeleda, *Lacaita* 364/27, 27 Jul. 1927 [K]; **Prov. Castilla-La Manacha:** Toledo, Hinojosa del Monte, *A. Segura Zubizarreta* 15.112, 15 Jul. 1977 [\*LE]; Prope San Pablo, *Reuter s.n.*, Jul, 1841

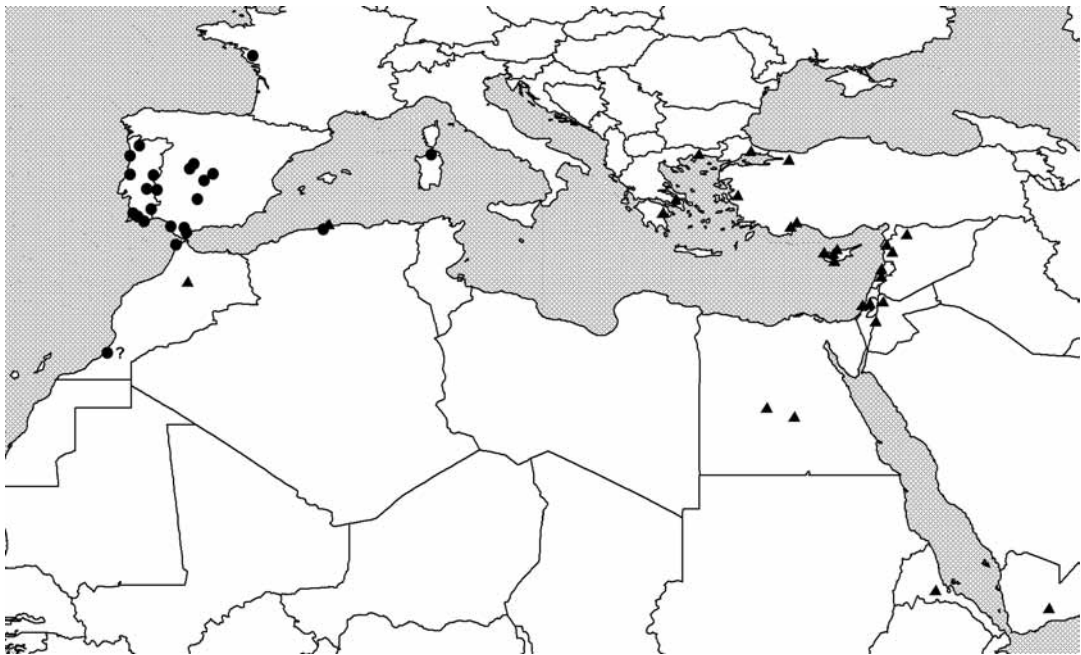


Figure 7: Geographical distribution of *Lotus castellanus* Boiss. et Reut. (filled circles) and *L. palustris* Willd. (filled triangles).

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

[K, ISOTYPE); **AFRICA: ALGERIA:** Prov. Alger, Mazafran, *J. Lefebvre s.n.*, 26–27 Jun. 1862 [W 344125]; **MOROCCO:** Güeret, *M. Gandoger s.n.*, Apr. 1908 [\*LE]; pr. Tanger, mnt. Djebel Kebir, *Schousboe 41*, Mai-Aug. [W 344123]; *H. Lindberg 1551*, 15 Jul. 1926 [\*K].

**(4) *Lotus palustris* Willd.** 1802, Sp. Pl. 3: 1394; Seringe in DC., 1825, Prodr. 2: 214; Brand, 1898, Bot. Jahrb. Syst. 25: 217; Kuprianova, 1945, Fl. URSS, 11: 296; Ball et Chrtková-Žertová, 1968, Fl. Europ. 2: 175; Heyn, 1970, Isr. J. Bot. 19: 271–292; Heyn, 1970, Fl. of Turkey 3: 518–531; Greuter et al. 1989, Med-Checklist 4: 133; Lock, 1989, Legumes of Africa: 347; Lock et Simpson, 1991, Legumes of West Asia: 174. — Type: “Habitat in Crete” Willdenow [B – Willd. 14274 – photo!].

*Lotus angustissimus* L. ssp. *palustris* (Willd.) Ponert, 1972–1973, Feddes Repert. 83(9/10): 640.

?*Lotus clausonis* Pomel., 1875, Nouv. mat. Fl. Atl.: 182.

?*Lotus hispidus* Sprun. et Heldr. ex Nym., 1878, Consp.: 183.

*Lotus hispidus* Desf. var. *vidalii* Pau, 1928, in Font-Quer. It. Marocc.: no. 213. — Type: Morocco: pr. Xauen, in herbosis, Font-Quer., It. Marocc. 1928 (holotype: [G], isotype: [BM!]);

*Lotus lamprocarpus* Boiss., 1849, Diagn. pl. nov. 2: 33; Ball, 1878, Journ. Linn. Soc.: 424. — Type: Greece: Phalarum, Spruner (holotype: [G – Boiss.], isotype: [K!]).

?*Lotus longicaulis* Welw. ex Nym., 1878, Consp.: 183.

?*Lotus palustris* Willd. var. *glaberrimus* Ascherson et Schweinf., 1879, Bot. Ver. Brandenb. 21: 66. — Type: Egypt, Tienah, Schweinfurth 160, 27.3.1874 [G – Boiss.].

*Lotus palustris* Willd. var. *villosissimus* Lindb. f. — Type: Cyprus, Distr. Nicosia, pag. Galata, Lindberg s.n., Iter, 23.6.1939 [K!].

*Lotus vidalii* (Pau) Sennen ex Pau, 1932, Cavanillesia 5: 176.

Illustrations: figure 8.

Perennial herbaceous plants with taproots. Shoots prostrate or ascending, long (30–110 cm long), usually highly branched along their whole length and forming a lot of paracladia and serial buds. Plants densely or more diffusely covered with deflected thin hairs. Hairs on calyces and leaves 0.1–1.8 mm long. On stems and peduncles hairs of two types: short, curved hairs 0.1–0.3 mm and long, perpendicularly deflected hairs 0.5–2.0 mm. This species is characterized by a seasonal polymorphism appearing in the length of shoots, the size of leaflets and pods and indumentum pattern (HEYN 1970). Leaf rachis 5–15 mm long, about 2 times shorter than upper leaflets. Upper lateral leaflets inserted 0.6–4.0 mm below the rachis top, usually nonsymmetrically. Three upper leaflets 10–28 × 3.7–15 mm, obovate or obovate-oblongate, the lateral ones slightly oblique. Lower lateral leaflets oblique-ovate, 6–22 × 4.3–12.5 mm. All leaflets on discernible petiolules 0.3–1.3 mm long. Stipules as black or blackish-red small glands, in many specimens non-discernible due to dense indumentum. Flowers in 1–4(5)-flowered umbels on axillary peduncles, 1–3 times longer than subtending leaves. Pseudobract on peduncle with 2–3(5) elliptical or, rarely, obovate leaflets 4–15 × 1.8–5.6 mm on a short rachis (0.1–0.9 mm), or rarely practically without any one. Flowers 6–10 mm long. Calyx 4.7–7.9 mm long, almost actinomorphic, rarely slightly zygomorphic (i.e. the teeth of unequal width and incurved upwards). Calyx teeth 1.3–1.8 times

T. E. KRAMINA

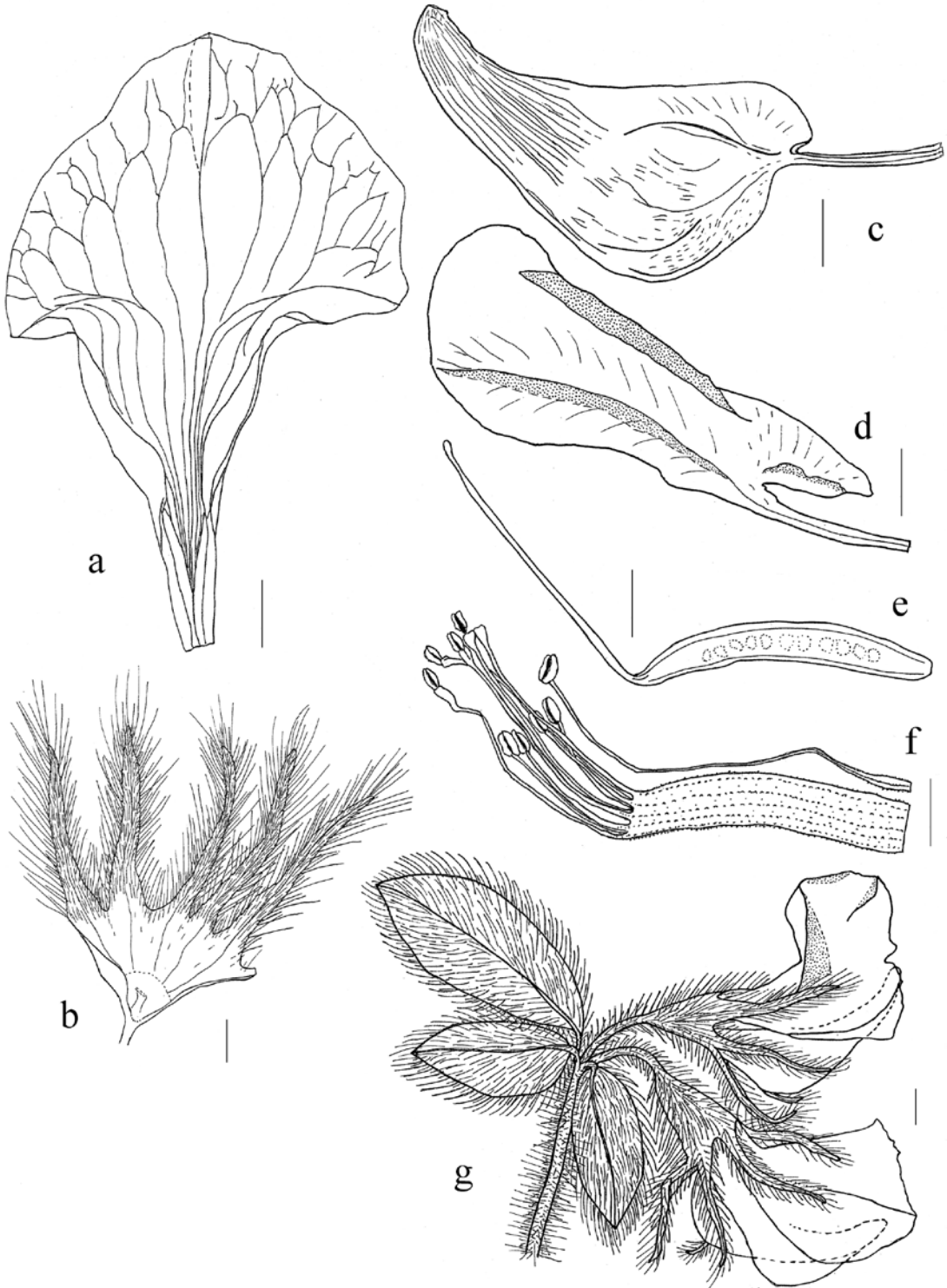


Figure 8: Characters of *Lotus palustris* Willd.: a – standard, b – calyx, c – keel, d – wing, e – gynoecium, f – androecium, g – partial inflorescence.

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

longer than the conic tube, rarely almost equal to the latter. Awl parts of teeth usually short, 1/3–1/8 of their length, rarely till 2/3–3/4. Corolla yellow, sometimes with purple lines on keel and standard, turning reddish-brown on drying. Standard equal to or exceeding the keel. Standard limb obovate or obovate-rhombic. Keel longer than wings, bent upward from near the base (its length above the point of upward flexure 4.1–5.7 mm), with a beak 1.8–3.3 mm long (40–62% from the keel length above the point of upward flexure). Keel beak with slightly incurved tip. Style 3.5–5.1 mm long. Fruits straight, cylindrical or slightly compressed, dark- or blackish-brown, glabrous or sometimes with few trichomes, 8–27 × 1.2–2.4 mm, with 9–21 seeds. Seeds almost spheroid, spheroid-disciform, or spheroid-ovate-disciform, both from the lateral-side view and from the hilum-side view almost rounded or ovate, smooth, semiglossy, yellow or light-brown, self-coloured or with solitary purple dots, 1.1–1.2 × 1.0–1.2 × 0.8–1.0 mm. Radicular lobe discernible. Hilum rounded, slightly recessed, with small rim aril. Hilar rim greenish-light-brown or light-brown, self-coloured, darker than the other seed surface. Raphe triangular, also darker than the other seed surface, reddish-brown. Lens small protuberance, sometimes surrounded by a small dark spot. Micropyle small, triangular.

2n = 12, 14, 24 (HEYN 1970b; GRANT 1995).

Wet and swampy meadows, stream banks, marshes.

**Geographical distribution:** **Europe:** (\*\*)Albania (S), Greece (incl. Crete and East Aegean Islands), (\*\*?)Italy (Sardinia), (\*\*?)Portugal, (\*\*?)Spain, Turkey (European part); **Asia:** Cyprus, Iordania, Israel, Lebanon, Syria, Turkey, West Bank, (\*\*)Yemen (S); **Africa:** (\*\*)Algeria, Egypt, Eritrea, (\*\*)Ethiopia, (\*\*)Libya, Morocco, (\*\*)Tunisia.

**MATERIAL EXAMINED** (fig. 7): **EUROPE: GREECE: Thráki:** *H.G.Tedd 1068*, 18 Oct. 1933 [\*K]; Moussafacei, *H.G.Tedd 1068*, 18 Oct. 1932 [\*K]; near Vafaúka (=Boyajilár), *H.G.Tedd 2093*, 16 Oct. 1933 [\*K]; **Argolis:** Nauplia [=Náfplion], prope Tyrinthon, *T.G.Orphanides 582*, 13(25) Jul. 1856 [\*LE, \*K]; **Attica:** Phaleri, *Spruner s.n.* [\*K]; *De Heldreich 16*, May–Jun. 1851 [\*LE, \*K]; *De Heldreich 361*, Jul. 1868 [\*K]; *De Heldreich 1024*, 17 Jul. 1889 [\*LE, \*K]; **Crete:** *A.Baldacci 115*, 16 Jul. 1893 [\*K]; **TURKEY (European part): Prov. Istanbul:** Silivri to Tekirdag, *Davis et Coode D.39198*, 12 Aug. 1962 [\*K]; **ASIA: CYPRUS: Distr. Kyrenia:** Myrtou, *A.Syngrasides 198*, 12 Jun. 1932 [\*K]; **Distr. Nicosia:** Galata, *H.Lindberg s.n.*, 23 Jun. 1939 [\*K]; **Distr. Paphos:** Polis, *M.Haradjian 799*, 1–7 Jun. 1913 [K]; Prodromos, *G.E.Mberlen 521*, 5 Sep. 1955 [K]; *E.C.Casey 1208*, 12 Jul. 1951 [K]; **Dist. Limassol:** Platres, *E.W.Kennedy 568*, 15 Jun. 1932 [K]; Akrotiri, [...erton] 693, 4 May 1967 [K]; **IODANIA:** SE Coast, Dead Sea, *J.B.Gillette 15790*, 23 Apr. 1963 [\*K]; Between Ajlun' and Wadi Zerka, *P.H.Davis 3778*, 3 Jul. 1941 [K]; **ISRAEL:** Philistean Plain, env. of Palmahim, *M.Zobary & I.Admursky s.n.*, 22 Jun. 1958 [\*LE, \*MHA, K]; Jaffa, *J.Bornmüller 482*, 11 May 1897 [\*LE, K]; **LEBANON:** Ain Zahalta, *J. et F.Bornmüller s.n.*, 26 Oct. 1910 [\*LE]; mont Lebanoro, *unknown collector s.n.*, Aug. 1911 [\*K]; Beskinta, *H.F.Mooney 4544*, 11 Jul. 1952 [\*K]; **SYRIA:** Aleppo, *P.Sintenis 1437*, 27 Aug. 1888 [\*K]; Monts Nusairy [=Nusairiyeh Range]: env. of Massiaf, *Manoog Haradjian 3379*, Jun. 1910 [LE, K, W 19817]; 15 miles E from Ladikiya, *Manoog Haradjian 2656*, 1–15 May 1909 [W 18501]; Mont Amanus, Kusliji Dag, *Manoog Haradjian 2665*, Aug. 1908 [\*K]; **TURKEY:** Iter trojanum, Seiliny, *P.Sintenis s.n.*, 1883 [\*LE, K]; In provinciae Haimana Anatoliae, *Dr. Wiedemann s.n.*, 1834 [\*LE]; **Prov. Antalya:** Antalya, *D.E.S.Truman 254*, 26 Jun. 1958 [K]; Between Lara and Antalya, *T.A.Tengvall 501*, 3 May 1936 [K]; coast of Mediterranean sea, 70–80 km S from Antalya town, near Tekirova village, *J.R.Majorov s.n.*, 17 Oct. 1999 [\*MW]; **Prov. Sakarya (Adapazari):** Arifiye, *Davis et Coode D.36263*, 17 Jul. 1962 [\*K]; **Prov. Izmir:** *Hilzmet Pasha 64*, 1943 [K]; **WEST BANK (PALAESTINA):** Philistean Plain, Wadi Rubin, *M.Zobary s.n.*, 14 Jul. 1926 [\*MHA]; Hula Plain, W of Gonen, *M.Zobary & U.Plitmann 62457*, 24 May 1963 [\*LE]; Hubeh, *F.S.Meyers et J.E.Dinsmore B 247*, 12 May 1911 [\*K]; **AFRICA: EGYPT:** Al

Wādī al Jadīd, Bir el Dīnāria, Dakhla Oasis, *N.D.Simpson 6044*, 13 Apr. 1928 [\*K]; Gudwall, Gennah, Kharga Oasis, *N.D.Simpson 5982*, 11 Apr. 1927 [K]; **ERITREA**: Env. de Saganeiti, *G.Schweinfurth & D.Riva s.n.*, 21 Apr. 1892 [\*LE]; **MOROCCO**: Atlas medium, Tioumliline, prope pag. Azrou, *H.Lindberg 4130*, 26 Jun. 1926 [\*K]; pr. Xauen, in herbosis, Font-Quer., It. Marocc. 1928 [BM];

**(5) *Lotus parviflorus* Desf.** 1799, *Fl. Atl.* 2: 206; Boissier, 1872, *Fl. Orient.* 2: 172; Ball, 1878, *Journ. Linn. Soc.*: 424; Willkomm et Lange, 1880, *Prodr. Fl. Hisp.* 3: 347; Brand, 1898, *Bot. Jahrb. Syst.* 25: 216; Ball et Chrtková-Žertová, 1968, *Fl. Europ.* 2: 175; Heyn, 1970, *Isr. J. Bot.* 19: 271–292; Greuter et al. 1989, *Med-Checklist* 4: 133; Valdes, 2000, *Flora Iberica* 7(2): 798. — Type: “in Atlante prope Mayane, Algeria” [P]; photo in *Flora Atlantica* t. 211 (type drawing: the lower right specimen!).

*Dorycnium microcarpum* (Brot.) Ser., in DC., 1825, *Prodr.* 2: 209.

*Dorycnium parviflorum* (Desf.) Ser., in DC., 1825, *Prodr.* 2: 208.

*Lotus hispidus* DC., 1805, *Fl. Fr.* 4: 556. — Lectotype (designated here): *Lotus involucratus* Noisette, Corsica, *Noisette s.n.* [G – DC, photo!].

*Lotus humilis* Schousb. ex Ball, 1878, *Journ. Linn. Soc.* 16: 424. — Protologue: “Tanger (Schsb. Herb. sub “*L. humilis*”)” — from Ball (1878).

*Lotus microcarpus* Brot., 1804, *Fl. Lusit.* 2: 119. — Protologue: “Hab. in collibus sabulosis, pinetisque circa Conimbricam, et alibi in Beira”. — Type n.v.

*Lotus pilosus* Schousb. ex Ball, 1878, *Journ. Linn. Soc.* 16: 424. — Protologue: “Tanger (Schsb. Herb. sub “*L. pilosus*”)” — from Ball (1878).

Illustrations: figure 9.

Annual herbaceous plants with taproots. Shoots spreading, ascending or erect. Main shoot and lateral shoots of first order 6–23 cm long, usually highly branching. The plant covered with very long, straight, highly deflected, thin white hairs. On calyces and leaves hairs 0.5–2.5(3.0) mm long, on stems and peduncles hairs of two types: long deflected straight hairs 0.6–3.0 mm long and short curved semi-appressed ones 0.1–0.5 mm long. Leaf rachis 2.2–5.5 mm long, about twice smaller than upper leaflets. Upper lateral leaflets inserted 0.2–1.0 mm below the rachis top, as a rule, more or less symmetrically. Three upper leaflets 5–10 × 1.5–4 mm, elliptic, obovate, or oblanceolate, the lateral ones slightly oblique. Leaflets of basal pair 4–9 × 2.5–5 mm, oblique-ovate. All leaflets with acute apex, on short petiolules (0.2–0.6 mm long). Stipules as small black or purple glands near the rachis base. Flowers in (2)3–6-flowered heads, on peduncles 0.9–2.7 cm long, 1.5–2 times as long as subtending leaves, in fruits elongating up to 3.2 cm. Pseudobract as a rule with 1 leaflet without or on a very short rachis. Flowers 4.5–6.8 mm long. Calyx 3.0–6.2 mm long, only a little bit shorter than the corolla, slightly zygomorphous: its teeth of unequal width (maximum in upper teeth, minimum in lower one), all teeth curved upwards. Calyx teeth narrow, subulate-lanceolate, 2.0–2.5 times longer than conic tube. Corolla yellow, standard with purple lines. Standard usually longer than keel, the latter longer than wings. Standard claw is gradually widening upwards and not clearly delimited from obovate or oblanceolate blade. Wings oblong. Keel bent upward from near the base, its length above the bent 3.4–4.3 mm, with long, straight-tipped beak (1.8–2.5 mm long, 49–67% of the keel length above the point of upward flexure). Style 3.1–4.0 mm long. Ovary a little bit triangular (the third side is a wide ventral suture). Fruit

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

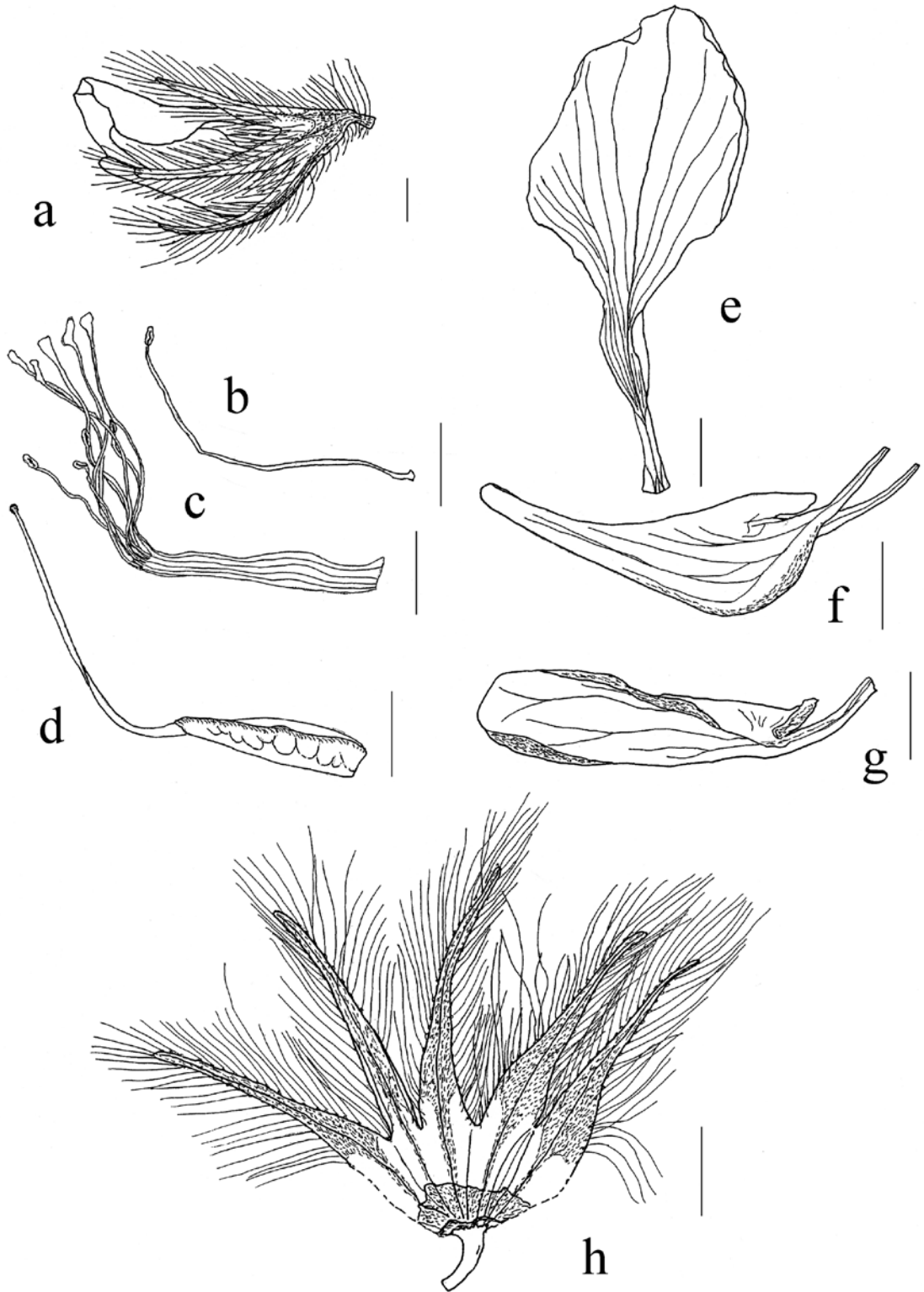


Figure 9: Characters of *Lotus parviflorus* Desf.: a – flower, b & c – androecium, d – gynoecium, e – standard, f – keel, g – wing, h – calyx.

barely exceeding calyx, 4–6.8 × 1.5–2.4 mm, dark-brown, glabrous, more or less straight, a little compressed, between seeds slightly contracted, with 4–8(14) seeds. Seeds spheroid-disciform with prominent radicular lobe, from the lateral-side view almost rounded, from the hilum-side view oval, smooth, dull (to semiglossy?), light-sandy-yellow, self-coloured, 0.7–0.8 × 0.7–0.8 × 0.5–0.6 mm. Radicular lobe discernible, small, straight. Hilum rounded, slightly flush, with small rim aril. Hilar rim and rim aril with purple tint. Hilar rim a little bit darker than other seed surface. Raphe narrow-triangular or linear, as dark as the other seed surface. Lens small protuberance. Micropyle very small, triangular.

2n = 12 (HEYN 1970 b; GRANT 1995).

Open dry places, dry meadows, hills, evergreen bushes (macchie, garigue), rocks, roadsides, along fields and vineyards; on sandy and silicole soils.

**Geographical distribution: Europe:** (\*\*)Albania, France (incl. Corsica), Greece (incl. Crete), Italy (incl. Sardinia and Sicily), (\*\*)former Yugoslavia (Croatia, Macedonia, Serbia and Montenegro, Slovenia), (\*\*)Luxembourg, Portugal, Spain (incl. Balearic Islands); **Asia:** (\*\*)Lebanon, (\*\*)Syria; **Africa:** Algeria, Morocco, (\*\*)Tunisia, Portugal (Madeira, Azores).

SELECTED MATERIAL EXAMINED (fig. 5): **EUROPE: FRANCE:** [Bor̄es], *Mercier s.n.*, 26 Apr. 1862 [LE]; **Dep. Provence**, *D.Deslongebogs s.n.*, 31 Oct. 1813 [\*LE]; **Dep. Hyères:** ins. Porquerolles, *Shufflerworth s.n.*, May 1863 [LE]; **Dep. Var:** dans la forêt des Maures, *H.Hanry s.n.*, 10 Jun. 1852 [LE]; **Corsika:** *D.Robert s.n.*, 1807 [LE]; *Lazmann s.n.*, 1842 [LE]; Porto-Vecchio, *C.Revelière s.n.* [LE]; inter Bastia et St. Florent, *P.Thomas s.n.*, Apr. 1824 [LE]; **GREECE:** isl. Paros, *Wiedemann s.n.* [LE]; **ITALY:** Capri, *Fischer s.n.* [LE]; **Sardinia:** *Fischer s.n.* [LE]; Tortoli, *P.Thomas s.n.*, Mar.1828 [LE]; **Sicilia:** *Fischer s.n.* [LE]; Palermo, *H.Ross 526*, May 1905 [\*LE]; **PORTUGAL: Prov. da Alemtejo:** entre Almodovar et Ourique, *J.Daveau s.n.*, Jun., Jul. 1885 [LE]; Povoia da Legua (cerca de 3 km de Tomar), *A.Fernandes et al. 11566*, 8 Jun. 1971 [\*MHA]; **SPAIN: Prov. ?** [former Prov. da Estremadura]: Tapada de Queluz, *J.Daveau 1068*, Apr. 1884 [LE]; *Welwitsch s.n.* [LE]; prope Loires, *Welwitsch 120*, May 1840 [LE]; **Prov. Cadis:** circà Gibraltar et San Roque, *Boissier et Reuter s.n.*, 1849 [\*LE]; **Prov. Andalucia (de Córdoba): Córdoba:** La Jarosa, *A. Segura Zubizarreta 14.988*, 3 May 1977 [LE]; **Prov. Malaga:** Estepona et ad fl. Guadiaro, *Willkomm s.n.*, 1847 [LE]; **Prov. Toledo:** Talavera de la Reina, Gamonal, *A. Segura Zubizarreta 34.567*, 9 May 1987 [\*LE, \*MHA]; **AFRICA: MOROCCO:** Tanger, *Boissier et Reuter s.n.*, 1849 [LE]; ex maritimis prope Tanger, *J.Ball s.n.*, Apr. 1871 [LE]; entre Mehedia et l'Oued Lebau, *Grant s.n.*, 27 Apr. 1887 [LE]; **ALGERIA:** *M.Winkler s.n.*, 12 May 1843 [LE]; in ditione urbis Alger, loco dicto Slaoneli, *M.Gandoger s.n.*, Apr. 1879 [LE]; Bou Ismaël, *Clauson 26*, 10 May 1859 [LE]. **PORTUGAL: Azores**, *G. et H. s.n.*, May, Jun. 1838 [LE]; **Madeira:** Calheta, Levada de Rabacal, *J.Bornmüller 545*, 16 Jul. 1900 [LE].

(6) *Lotus macrotrichus* Boiss. 1854, Ann. Sci. Nat. Bot., Ser. 4, 2: 250; Heyn, 1970, Isr. J. Bot. 19: 271–292; Greuter et al. 1989, Med-Checklist 4: 133. — Type: N. slope of Mt. Mesogis 1854 Tchihatcheff [G – Boiss., photo].

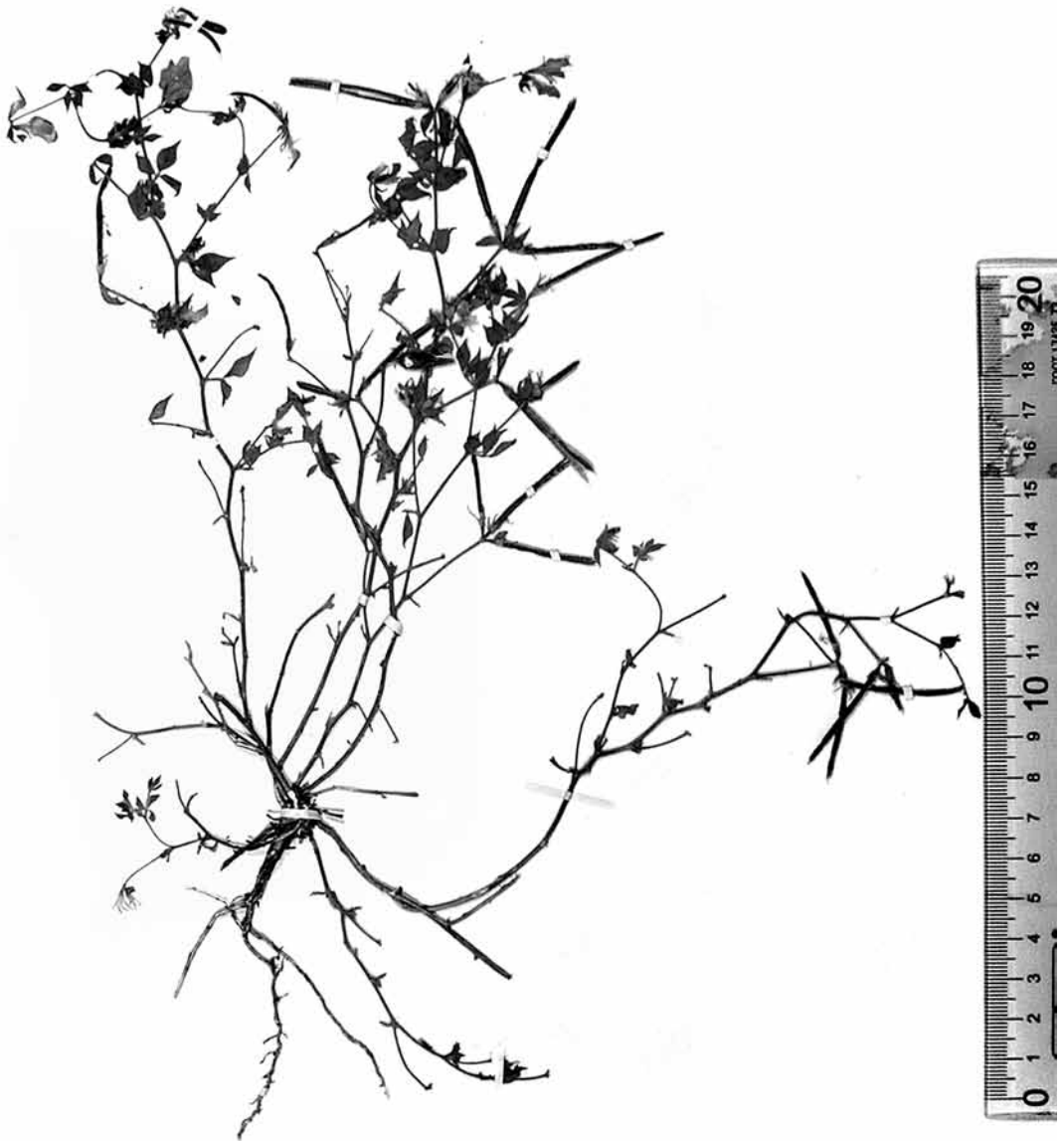
*Lotus divaricatus* Boiss., 1843, Diagn. ser. 1, 2: 37; Boissier, 1872, Fl. Orient. 2: 171; non Sol. ex Buch., Abh. Acad. Berl. 1816: 198. — Type: Turkey: “In Mesogi ad basin montium inter Dervent et Alascher”, 6.1842, Boissier [G – Boiss., photo].

Illustration: figure 10.

Annual herbaceous plants with taproots, about 22 cm high. Shoots erect, divaricately branched, zigzag-form. The plant densely covered with very long, straight, highly deflected, thin white



A contribution to the taxonomic revision of the *Lotus angustissimus*-complex



FLORA OF Asia Minor  
Botanical Name: *Lotus angustissimus* L.  
Vernacular Name:  
Locality: Demirdji S. of Simav.  
Altitude: Date: July-Aug. 1931  
Habitat:  
Notes:

*Lotus divaricatus* Boiss.  
Determinavit. P. H. Davis. 1963  
*L. macrotrichus* Boiss.

Collector: B. P. Uvarov. No. 53.

Figure 10: *Lotus macrotrichus* Boiss. from Turkey: Demirdji, S. of Simav, B.P.Uvarov 53, Jul.–Aug. 1931 [BM].

hairs. On calyces and leaves hairs 0.1–1.6 mm long, on stems and peduncles hairs of two types: long deflected straight hairs 0.5–1.5 mm long and short curved semi-appressed hairs 0.1–0.3 mm long. Leaf rachis ca. 4.4 mm long, about 2 times shorter than upper leaflets. Upper lateral leaflets inserted ca. 0.9 mm below the rachis top, always nonsymmetrically. Three upper leaflets 8–8.8 × 2.7–3.5 mm, rhombic-ovate (maximal width below the middle), the lateral leaflets slightly oblique. Leaflets of the basal pair 4–9 × 2.5–5 mm, oblique-ovate. All leaflets with acuminate, attenuate apex, on short petiolules (0.4–0.5 mm long). Stipules as small black or purple glands near the rachis base. Flowers in 1–3-flowered umbels, on axillary peduncles 1.2–1.8 cm long, plus-minus as long as subtending leaves. Pseudobract with 3 oblong, acuminate leaflets 5 × 1.8 mm long on a short rachis ca. 0.9 mm long. Flowers 10.0–11.2 mm long. Calyx ca. 6.3 mm long, its teeth of plus-minus equal width. Calyx teeth plus-minus as long as tube. Corolla yellow. Keel bent upward from the middle, its length above the bent 6.0–6.5 mm, with middle-sized, straight-tipped beak (2.2–3.2 mm long, 37–61% of the keel length above the point of upward flexure). Style 4.5–6.5 mm long. Fruit 3–6.5 times longer than calyx, 24–50 × 1.6–1.9 mm, dark-brown, glabrous, more or less straight, with 18–34 seeds. Seeds spheroid, yellow.

2n=12, 14, 24 (HARNEY & GRANT 1965; HEYN 1970b; GRANT 1995, as *L. divaricatus* Boiss.).

Most characters are similar to *L. angustissimus* incl. *L. praetermissus* (dimensions of leaves, number of flowers and others) but differing from the latter by the shape of terminal and upper lateral leaflets (with maximal width near the base of the leaflet and not near the middle or apex), larger flowers (11–11.5 mm and not 4.5–8.5 mm), styles (about 4.8 mm and not 2.3–3.3 mm), and pods (24–50 mm and not 9–28 mm). By the keel shape *L. macrotrichus* is intermediate between *L. angustissimus* and *L. subbiflorus*.

**Geographical distribution:** Asia; Turkey, endemic to Western Anatolia and adjacent islands.

SELECTED MATERIAL EXAMINED (fig. 6): **Asia:** Turkey: Demirdji, S. of Simav, *B.P.Uvarov 53*, Jul.–Aug. 1931 [\*BM]; N. slope of Mt. Mesogis, *Tchibatebeff s.n.*, 1854 [G – Boiss., photo!]; “In Mesogi ad basin montium inter Dervent et Alascher”, *Boissier s.n.*, Jun. 1842, [G – Boiss., photo!].

## Acknowledgements

The author is very grateful to The Royal Society and B. D. Schrire for facilitating her visit to U. K. [K, BM]. The author is indebted to B. D. Schrire and D. D. Sokoloff for helpful discussions of the paper, P. Weston [NSW] for making material from Europe and Australia available, F. Jacquemoud, L. Gautier and M. Hecquet [G] for digitalized pictures of type specimens of *Lotus castellanus* Boiss. et Reut., *Lotus divaricatus* Boiss., and *Lotus macrotrichus* Boiss., R. Vogt and U. Starck [B] for digitalized pictures of the type specimen of *Lotus palustris* Willd., B. Fernández de Caleyá and V. Rodríguez [MA] for digitalized pictures of the type specimen of *Lotus subbiflorus* Lag. and A. Seregin for his help in preparing the maps. Financial support from the Russian Foundation for Basic Research (grants № 03-04-48831-a and 06-04-48484-a) is gratefully acknowledged.

## References

- AKERROYD J. R. (1986):** *Lotus* L. – In: STRID A. [ed.]: Mountain flora of Greece. Vol. 1: 518–521. – Cambridge: Cambridge University Press.
- ALLAN G. J., ZIMMER E. A., WAGNER W. L. & SOKOLOFF D. D. (2003):** Molecular phylogenetic analyses of tribe Loteae (Leguminosae): implications for classification and biogeography. – In: KLITGAARD

A contribution to the taxonomic revision of the *Lotus angustissimus*-complex

- B. B. & BRUNEAU A. [eds.]: Advances in legume systematics. Pt. 10, Higher Level Systematics: 371–393. – Kew: Royal Botanic Gardens Kew.
- ARAMBARRI A. M. (2000): A cladistic analysis of the Old World species of *Lotus* L. (Fabaceae: Loteae). – Can. J. Bot. **78**: 351–360.
- ASAI Y. (1987): *Lotus subbiflorus* Lag. newly naturalized in Japan. – J. Jap. Bot. **62**(12): 370–372. [In Japanese]
- BALL J. (1878): Spicilegium Florae Maroccae. – Journ. Linn. Soc. **16**: 422–425.
- BALL P. W. & CHRŤKOVÁ-ŽERTOVÁ A. (1968): Genus *Lotus* L. – In: TUTIN T. G. et al. [eds.]. Flora Europaea Vol. 2: 173–176. – Cambridge: Cambridge University Press.
- BOISSIER E. (1843): Diagnoses Plantarum Orientalium novarum. ser. 1, 2: 37. – Lipsiae: B. Hermann.
- BOISSIER E. (1849): Diagnoses plantarum novarum. No. 9: 34. – Paris: M. Dulcoux et Cons.
- BOISSIER E. (1872): Flora orientalis. Vol. 2. – Genève, Bâle & Lyon: H. Georg.
- BOISSIER E. & REUTER G. F. (1852): Pugillus plantarum novarum Africae australis Hispaniaeque australis: 38. – Genève: Ramboz et Soch.
- BRAND A. (1898): Monographie der Gattung *Lotus*. – Bot. Jahrb. Syst. **25**: 166–232.
- CANDOLLE A. P. DE (1825): Prodromus systematis naturalis regni vegetabilis sive enumeratio contracta ordinum, generum, specierumque plantarum huc usque cognitarum, juxta methodi naturalis normas digesta. – Paris: Treuttel et Würtz.
- CHRŤKOVÁ-ŽERTOVÁ A. (1984): *Lotus* L. – In: RECHINGER K. H. et al. [eds.]. Flora Iranica **157**: 327–342. – Graz, Austria: Akademische Druck- und Verlagsanstalt.
- DEGTJAREVA G. V., KRAMINA T. E., SOKOLOFF D. D., SAMIGULLIN T. H., VALLEJO-ROMAN C. M. & ANTONOV A. S. (2006): Phylogeny of the genus *Lotus* (Leguminosae, Loteae): evidence from nrITS sequences and morphology. – Can. J. Bot. **84**: 813–830.
- DESFONTAINES R. (1799): Flora Atlantica: sive historia plantarum quae in Atlante, agro Tunetano et Algeriensi crescunt. Vol. 2: 206. – Paris: L. G. Desgranges.
- DESFONTAINES R. (1804): Tableau de l'École de botanique du Muséum d'histoire naturelle: 190. – Paris: J. A. Brosson.
- GAUTHIER P., LUMARET R. & BEDECARRATS A. (1997): Chloroplast-DNA variation in the genus *Lotus* (Fabaceae) and further evidence regarding the maternal parentage of *Lotus corniculatus* L. – Theor. Appl. Genet. **95**: 629–636.
- GILLET J. B. (1958): *Lotus* in Africa south of the Sahara (excluding the Cape Verde islands and Socotra) and its distinction from *Dorycnium*. – Kew Bull. **3**: 361–381.
- GRANT W. F. (1995): A chromosome atlas and interspecific-intergeneric index for *Lotus* and *Tetragonolobus* (Fabaceae). – Can. J. Bot. **73**: 1787–1809.
- GREUTER W., BURDET H. M. & LONG G. (1989): Med-Checklist. Vol. 4: 1–458. – Genève: Conservatoire et Jardin botaniques.
- GROSSHEIM A. A. (1952): Flora Kavkaza. [2<sup>nd</sup> ed.] Vol. 5. – Moskva: Akad. Nauk SSSR. [In Russian]
- HARNEY P. M. & GRANT W. F. (1965): A polygonal presentation of chromatographic investigations on the phenolic content of certain species of *Lotus*. – Canad. J. Genet. Cytol. **7**: 40–51.
- HEYN C. C. (1970 a): *Lotus* L. – In: DAVIS P. H. [ed.]: Flora of Turkey and the East Aegaen Islands. Vol. 3: 518–531. – Cambridge: Cambridge University Press.
- HEYN C. C. (1970 b): Studies in *Lotus*. III. The *L. angustissimus* group. – Isr. J. Bot. **19**: 271–292.
- KUPRIANOVA L. A. (1937): New annual *Lotus*. – Bot. Mat. Herb. Bot. Inst. **7**: 37–39. [In Russian]
- KUPRIANOVA L. A. (1945): *Lotus* L. – In: KOMAROV V. L. [ed.]: Flora SSSR. **11**: 284–297. – Leningrad & Moskva: Akad. Nauk SSSR. [In Russian]
- KURBATSKY V. I. (1994): *Lotus* L. – In: MALYSHEV L. I. & POLOZHY A. V. [eds.]: Flora Sibiriae. Vol. 9: 168–170. – Novosibirsk: VO Nauka. [In Russian]

- LAGASCA M. (1805):** Caractères diferenciales de onze especes nuevas de plantas y de otras dos poco conocidas. – Varied. Cienc. Lit. Art. **2**(4): 212–217.
- LAÍNZ M. S. J. (1973):** *Lotus subbiflorus* Lag. et *L. castellanus* Boiss. & Reut.: feliciter, binomina in consueto usu retinenda. – Candollea **28**: 13–14.
- LAMARCK J.-B. P. A. DE MONET DE & CANDOLLE A. P. DE (1805):** Flore française ou descriptions succinctes de toutes les plantes qui croissent naturellement en France: disposées selon une nouvelle méthode d'analyse, et précédées par un exposé des principes élémentaires de la botanique [3<sup>rd</sup> ed.]. – Paris: H. Agasse et Desray.
- LARSEN K. & ŽERTOVÁ A. (1969):** A taxonomic study on *Lotus castellanus* Boiss. et Reuter. – Feddes Repert. **80**(4/6): 305–314.
- LOCK J. M. (1989):** Legumes of Africa: a check-list. – Kew: Royal Botanic Gardens Kew.
- LOCK J. M. & SIMPSON K. (1991):** Legumes of West Asia: a check-list. – Kew: Royal Botanic Gardens Kew.
- LINNAEUS C. (1753):** Species Plantarum. T. **2**. – Holmiae: Salvius.
- MINIAEV N. A. & ULLE Z. G. (1987):** *Lotus* L. – In: FEDOROV A. A. [ed.]: Flora europejskoj chasti SSSR. Vol. **6**: 103–115. – Leningrad: Nauka. [In Russian]
- PERSOON C. H. (1807):** Synopsis Plantarum vol. **2**(2): 354. – Parisiis et Tubingae: Treuttel.
- SERINGE N. C. (1825):** *Lotus*. – In: CANDOLLE A. P. DE [ed.]: Prodromus Vol. **2**: 208–215. – Paris: Argertorati et Londini.
- TULYAGANOVA M. (1981):** *Lotus* L. – In: KAMELIN R. et al. [eds.]: Opredelitel' rasteniy Sredney Azii. Tom. **6**: 48–50. – Tashkent: Izd-vo "Fan" UzSSR. [In Russian]
- VALDES B. (2000):** *Lotus* L. – In: TALAVERA S., AEDO C., CASTROVIEJO S., HERRERO A., ROMERO ZARCO C., SALGUEIRO F. J. & VELAYOS M. [eds.]: Flora Iberica. Vol. **7**(II): 776–812. – Madrid: Real Jardín Botánico, C.S.I.C.
- WEI ZHI & HUANG YIZHI (1993):** *Lotus*. – In: CUN HONGBIN [ed.]: Flora Reipublicae Populares Sinicae. Tom. **42**(2): 221–226. – Science Press, Beijing. [In Chinese]
- WILLDENOW C. L. (1802):** Nomenclator botanicus sistens omnes plantas in Caroli a Linné Speciebus plantarum. Vol. **3**: 1394. – Halle/Saale: Hendel.
- WILLKOMM M. & LANGE J. (1880):** Prodromus Florae Hispanicae. Vol. **3**: 335–348. – Stuttgartiae: E. Schweizerbart (E. Koch).
- YAKOVLEV G. P., SYTIN A. K & ROSKOV Y. R. (1996):** Legumes of Northern Eurasia: a checklist. – Kew: Royal Botanic Gardens Kew.
- ZOHARY M. (1987):** Flora Palaestina. Part **2**: 85–97. – Jerusalem: Israel Academy of Sciences and Humanities.

Address of the author:

Dr. Tatiana E. Kramina  
Higher Plants Department  
Biological Faculty, Moscow State University  
119992, Moscow  
Russia  
kramina@herba.msu.ru

# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Wulfenia](#)

Jahr/Year: 2006

Band/Volume: [13](#)

Autor(en)/Author(s): Kramina Tatiana E.

Artikel/Article: [A contribution to the taxonomic revision of the \*Lotus angustissimus\*-complex \(Leguminosae, Loteae\) 57-92](#)