



Distribution, morphology and systematics of the genus *Salvia*

(Rasprostranjenost, morfologija i sistematika roda *Salvia*)

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Projekt: Epigenetička vs. genetička raznolikost prirodnih biljnih
populacija: Studija slučaja hrvatskih endemičnih kadulja

The genus *Salvia* (tribe *Mentheae*)

- cosmopolitan
- ca. 1000 taxa
- species radiation in 3 regions



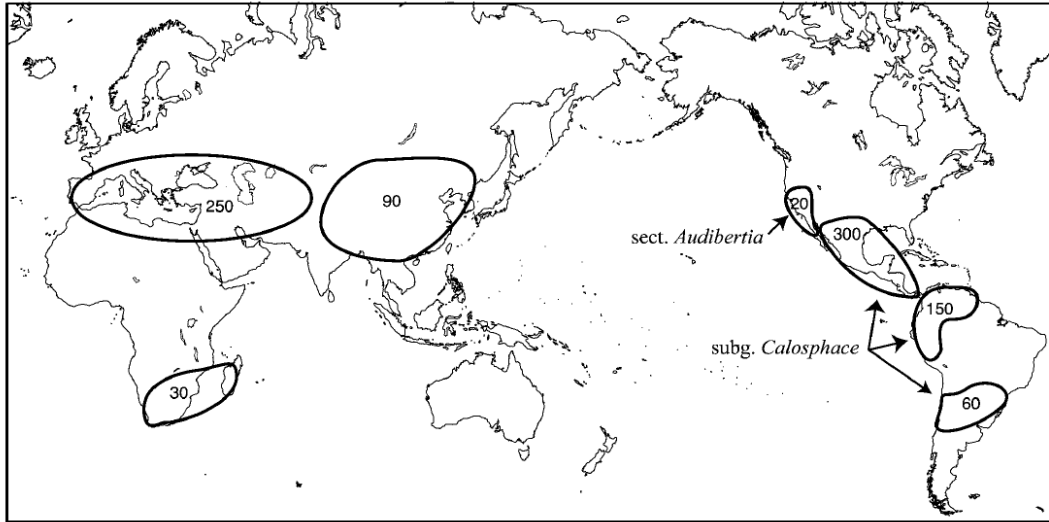
S. coccinea



S. divinorum



S. patens



C and S America ~ 500 sp.

E Asia ~ 90 sp.

C Asia + Mediterranean ~ 250 sp.

S Africa ~ 30 sp.



S. sclarea



S. hyerosolymitana



S. tomentosa



S. fruticosa



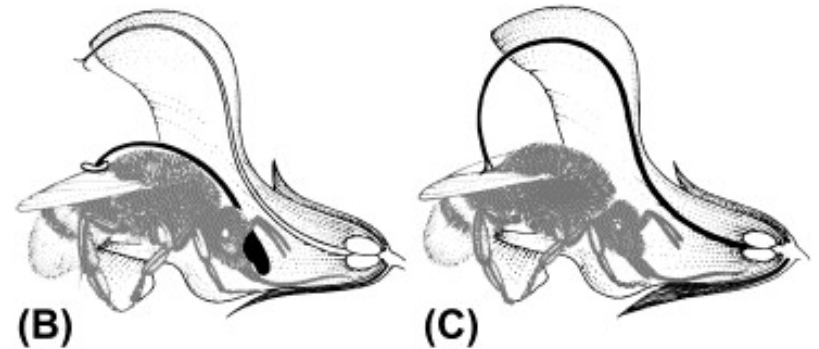
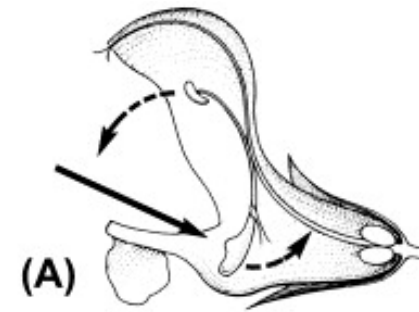
S. nipponica

Salvia

- 2 stamens (instead of 4)
- lever mechanism
- is *Salvia* monophyletic?
- how are other genera of Mentheae related to *Salvia*?
- how many major lineages are contained within *Salvia*?
- where did the major lineages originate?

- pollination:
entomophylous and ornithophylous

(Walker i sur., 2004; Walker & Sytsma, 2007)



Staminal structure

Bentham (1848, 1876)

Subgenus Salvia

- Old World
 - corolla with annulus
 - 2 posterior anther thecae sterile, rudimentary, connivent
- Hymenosphace, Eusphace, Drynosphace*

Subgenus Sclarea

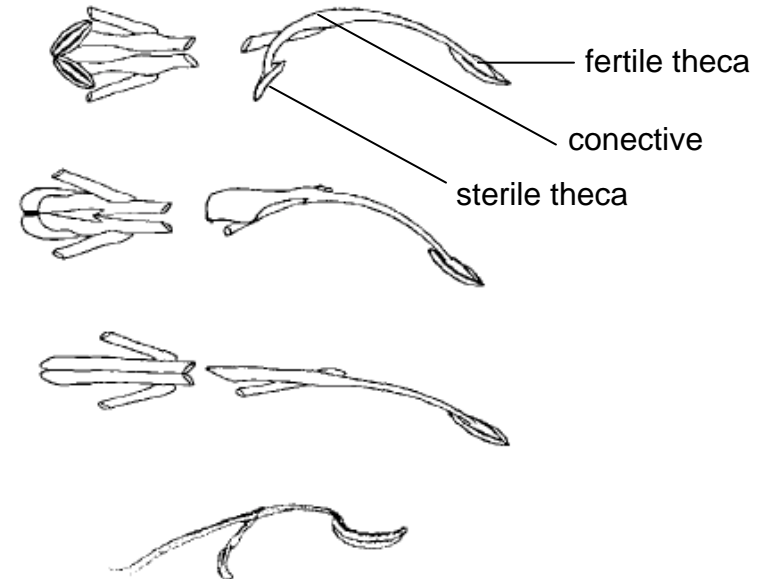
- Old World
 - corolla without annulus
 - 2 posterior anther thecae sterile, forming glutinatorium
- Horminum, Aethiopsis, Plethiosphace*

Subgenus Calosphace

- New World
 - corolla without annulus
 - 2 posterior anther thecae sterile, connate, forming gubernaculum
- Calosphace*

Subgenus Leonia

- Old and New World
 - corolla with annulus
 - 2 posterior anther thecae fertile, separate
- Echinosphace, Pycnosphace, Heterosphace, Notiosphace, Hemisphace*



American Journal of Botany 91(7): 1115–1125. 2004.

***SALVIA* (LAMIACEAE) IS NOT MONOPHYLETIC: IMPLICATIONS FOR THE SYSTEMATICS, RADIATION, AND ECOLOGICAL SPECIALIZATIONS OF *SALVIA* AND TRIBE MENTHEAE¹**

JAY B. WALKER,² KENNETH J. SYTSMA,² JENS TREUTLEIN,³ AND
MICHAEL WINK³

rbcL seq.

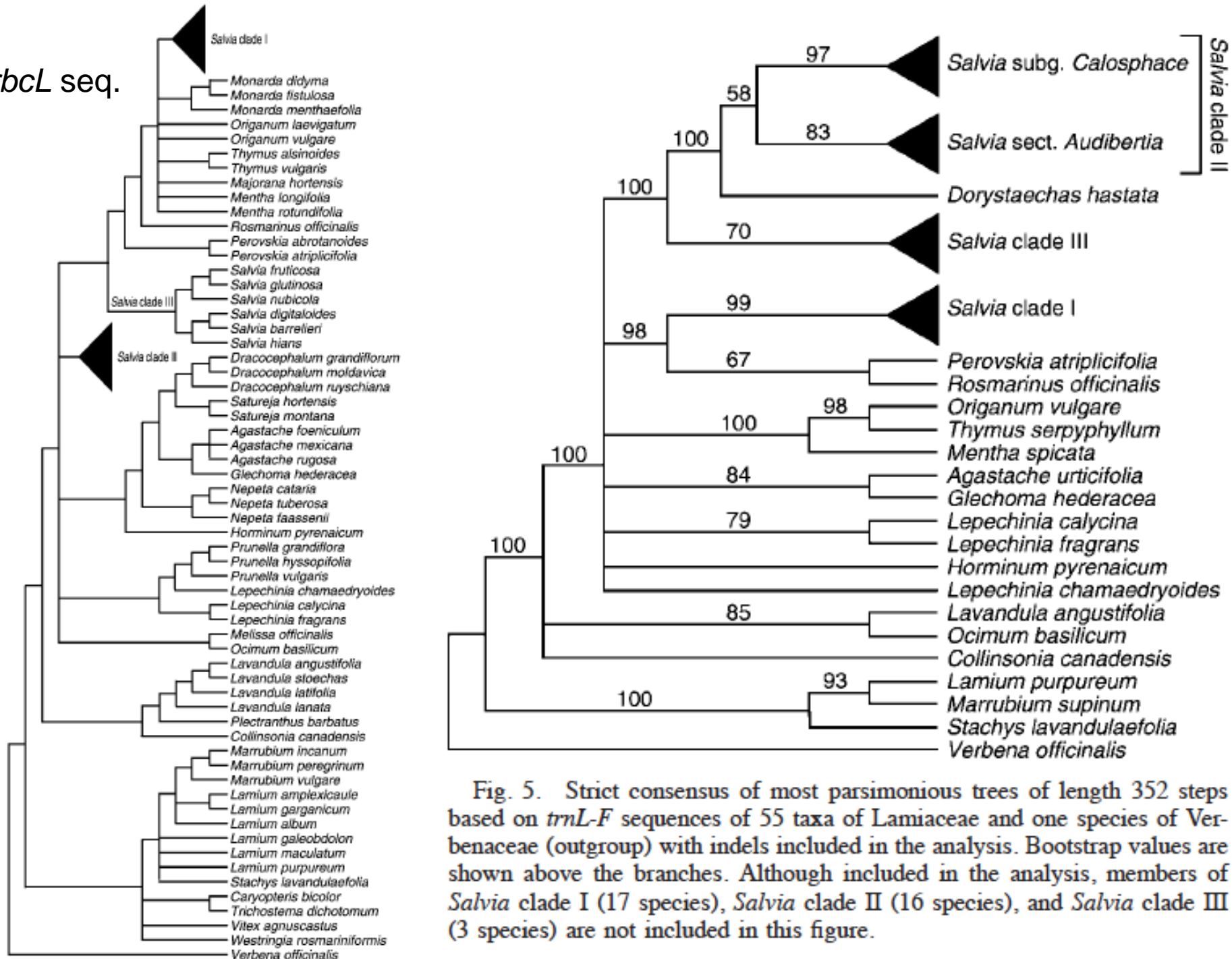


Fig. 5. Strict consensus of most parsimonious trees of length 352 steps based on *trnL-F* sequences of 55 taxa of Lamiaceae and one species of Verbenaceae (outgroup) with indels included in the analysis. Bootstrap values are shown above the branches. Although included in the analysis, members of *Salvia* clade I (17 species), *Salvia* clade II (16 species), and *Salvia* clade III (3 species) are not included in this figure.

Hypothetical evolutionary development
of stamen structure in *Salvia*

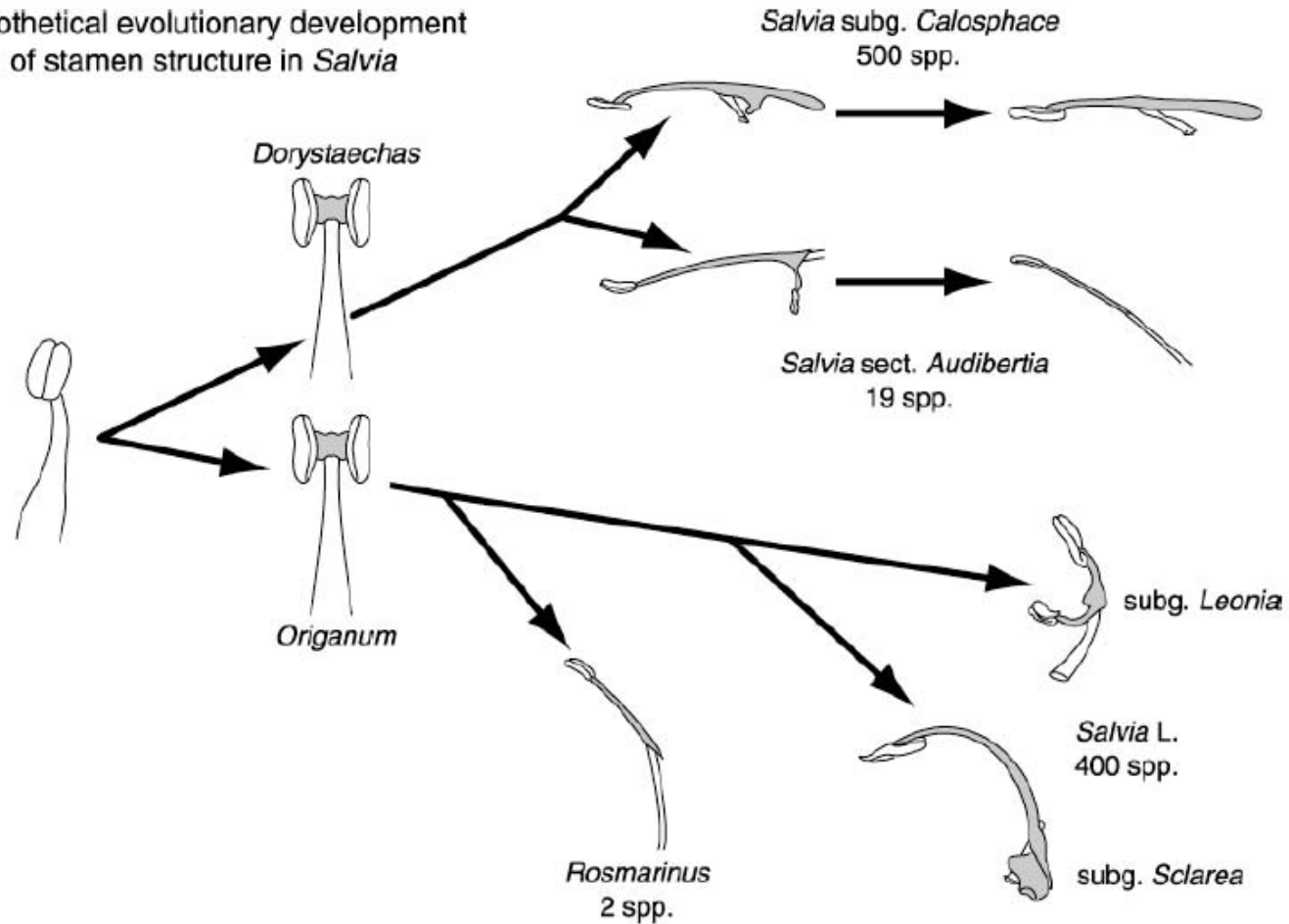
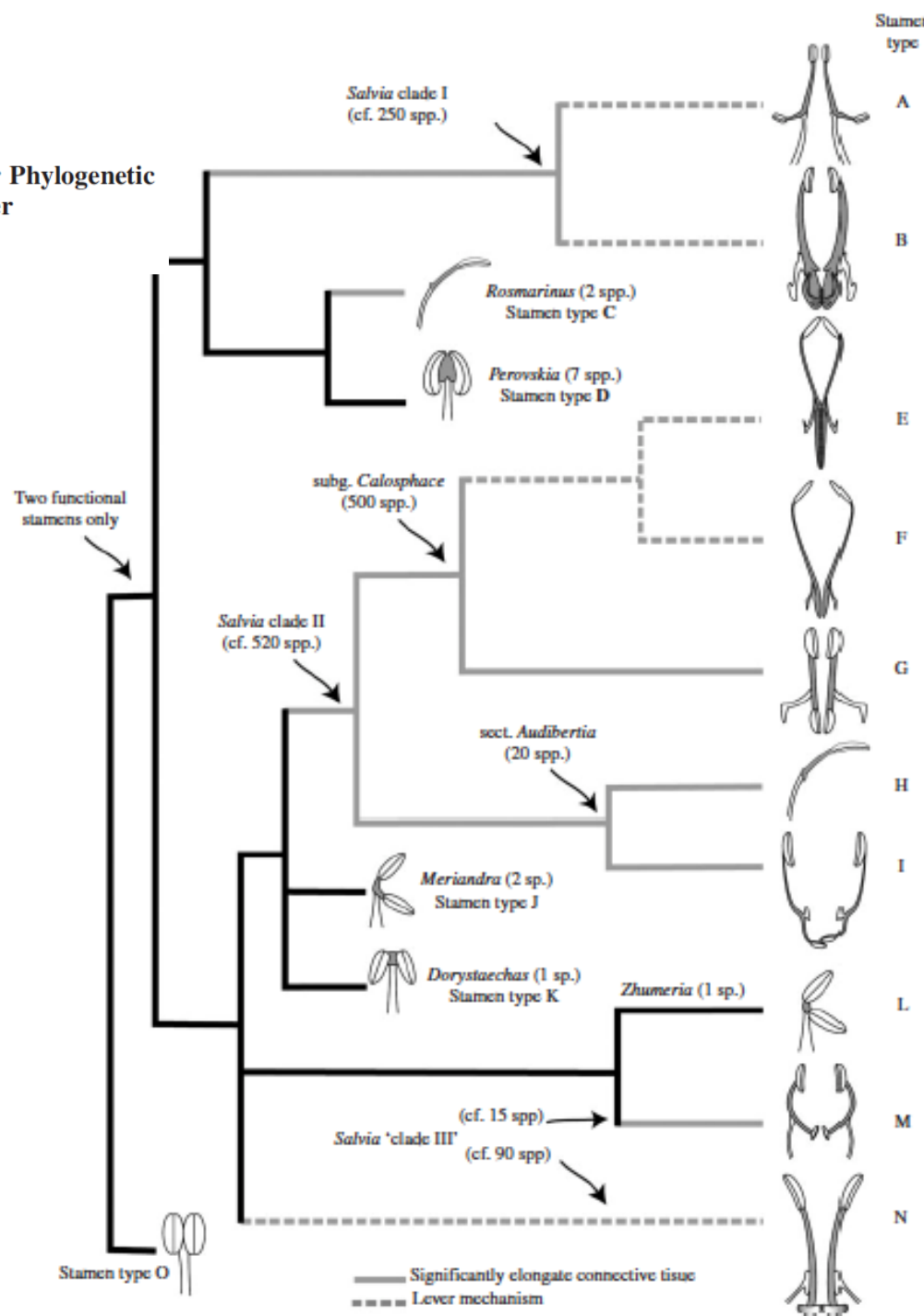


Fig. 7. Hypothetical stamen development in the genus *Salvia*. Results of this project suggest at least two independent origins of an elongate connective (shown in gray) and of the lever mechanism in the tribe Mentheae. Each origin of the lever mechanism has resulted in large species radiations, while the sister groups not employing the lever mechanism (represented in this sketch by *Rosmarinus* and *Salvia* sect. *Audibertia*) have remained relatively species poor.

Staminal Evolution in the Genus *Salvia* (Lamiaceae): Molecular Phylogenetic Evidence for Multiple Origins of the Staminal Lever

JAY B. WALKER* and KENNETH J. SYTSMA



Salvia species in Croatian flora (19)

Flora Croatica Database:

Salvia aethiopsis L.

Salvia amplexicaulis Lam.

Salvia argentea L.

Salvia austriaca Jacq.

***Salvia x auriculata* Mill.**

Salvia bertolonii Vis.

*** *Salvia brachyodon* Vandas (NT)**

***Salvia fruticosa* Mill. (NT)**

Salvia glutinosa L.

Salvia nemorosa L. (EN)

***Salvia officinalis* L.**

Salvia peloponnesiaca Boiss. et Heldr. (NT)

Salvia pratensis L.

Salvia ringens Sibth. et Sm.

Salvia sclarea L.

Salvia tomentosa Mill.

Salvia verbenaca L.

Salvia verticillata L.

Salvia viridis L.



***Salvia aethiops* L.**

- protected
- dubious occurrence



***Salvia amplexicaulis* L.**

- stems densely villosus, verticillasters with 6-8 flowers - *S. amplexicaulis*
 - stems pubescent, verticillasters with 2-6 flowers – *S. nemorosa*
- dubious occurrence
 - closely related to *S. nemorosa*



Salvia argentea L.

- protected



***Salvia austriaca* Jacq.**

- Papuk (Pandža 2010)



Salvia bertolonii Vis.



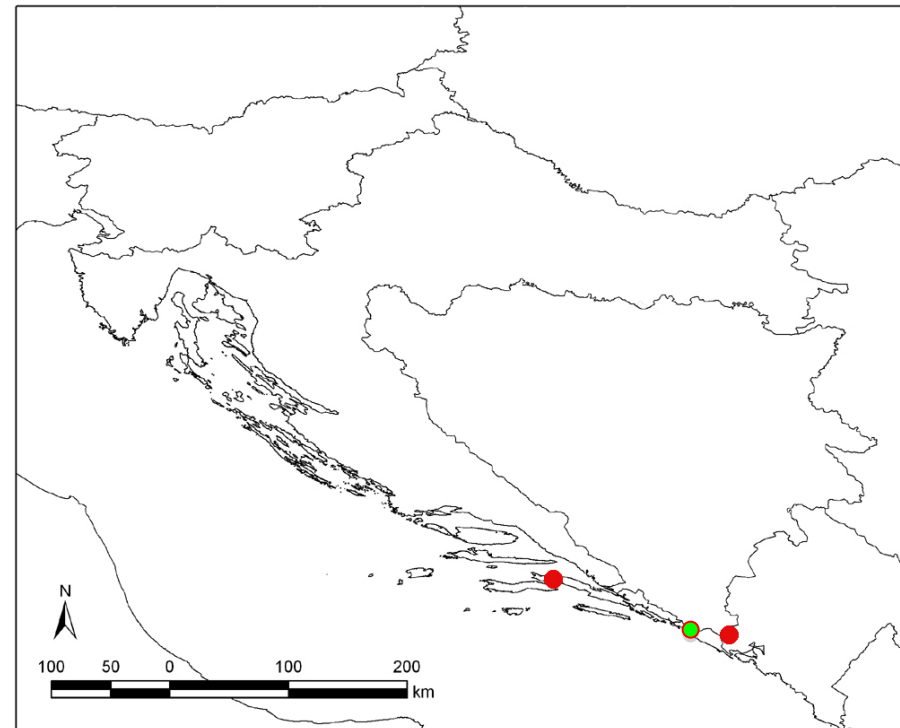
Salvia brachyodon Vandas

- endemic
- protected
- described 1889



Photo by Antun Alegro

In collibus siccis calcareis, dumosis inter castella Ulica et Vrbanje (prope Orien) Hercegovinae australis ca. 900 m. s. m., copiose.



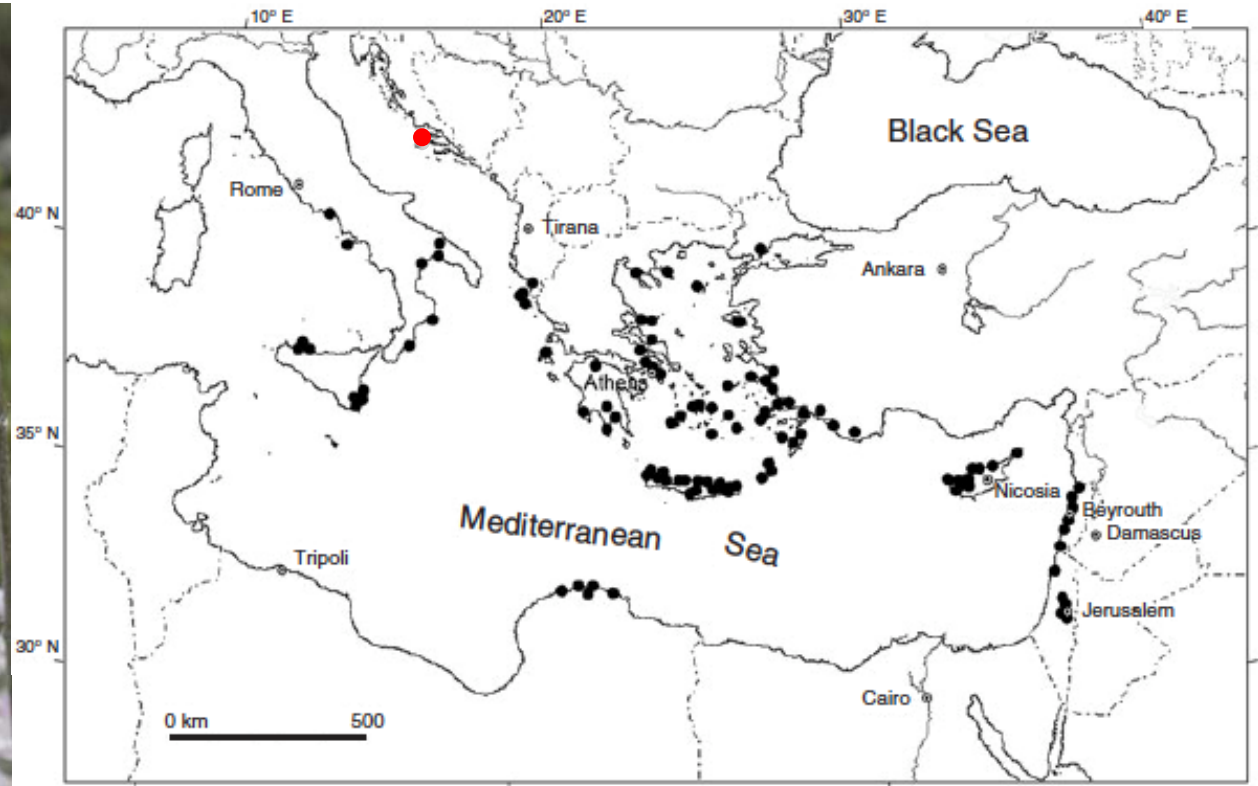
Salvia brachyodon Vandas

- herbarium W
- material of Vandas
- NOT type material

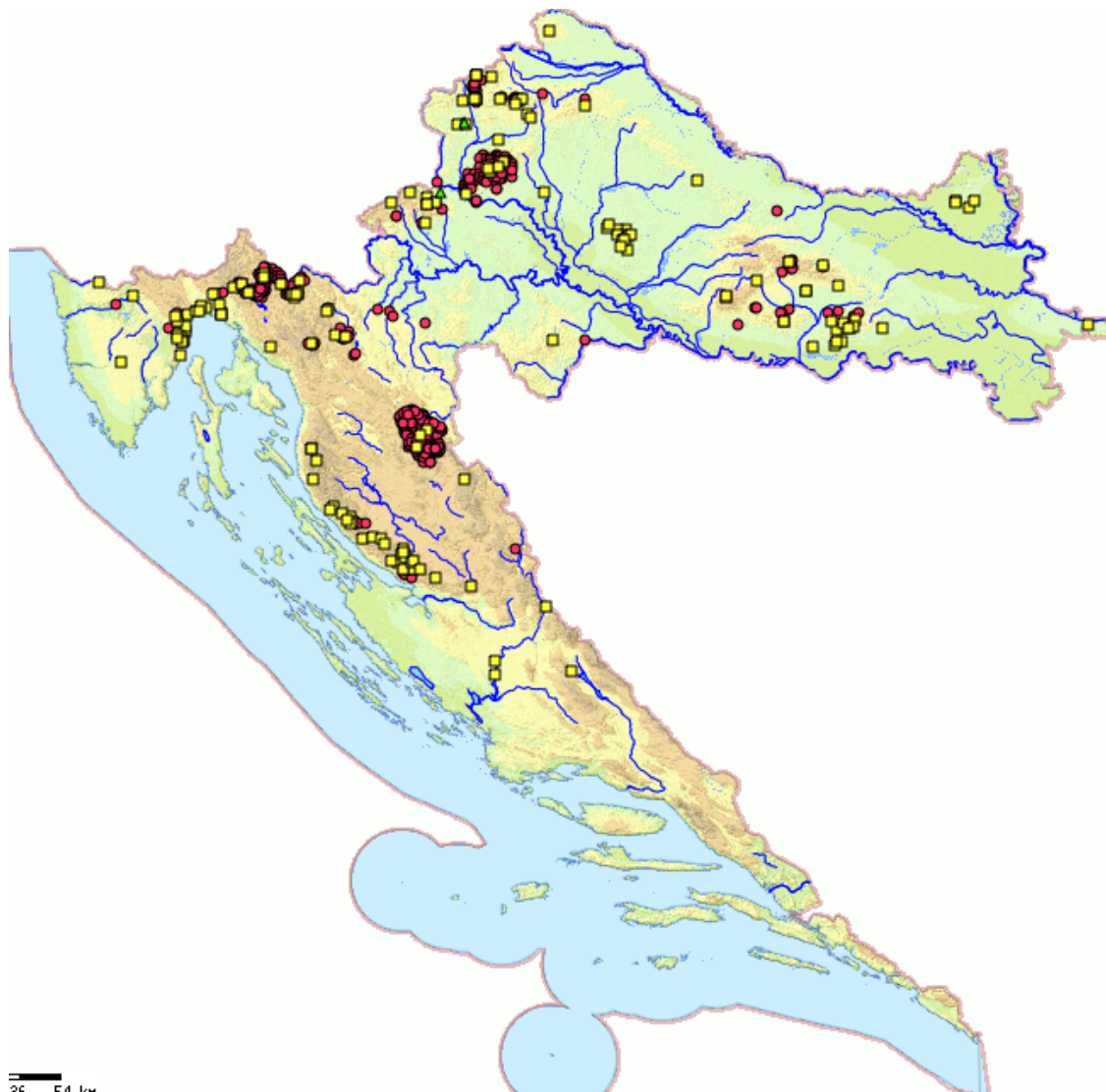


Salvia fruticosa Mill.

- protected
- very rare
- island of Vis

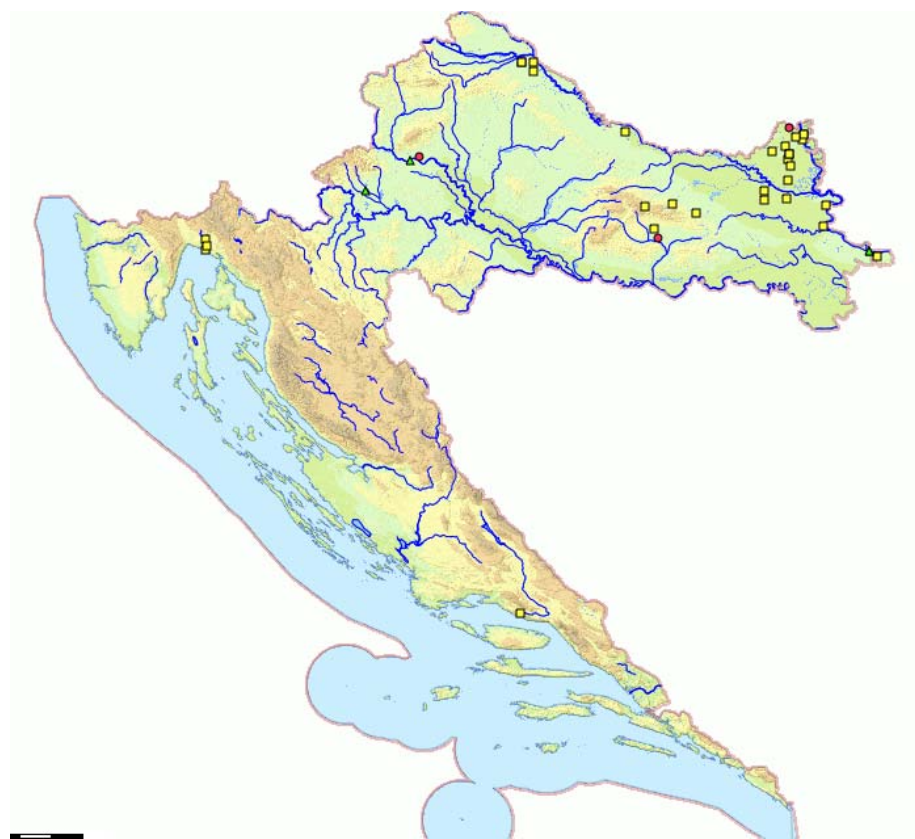


Salvia glutinosa L.



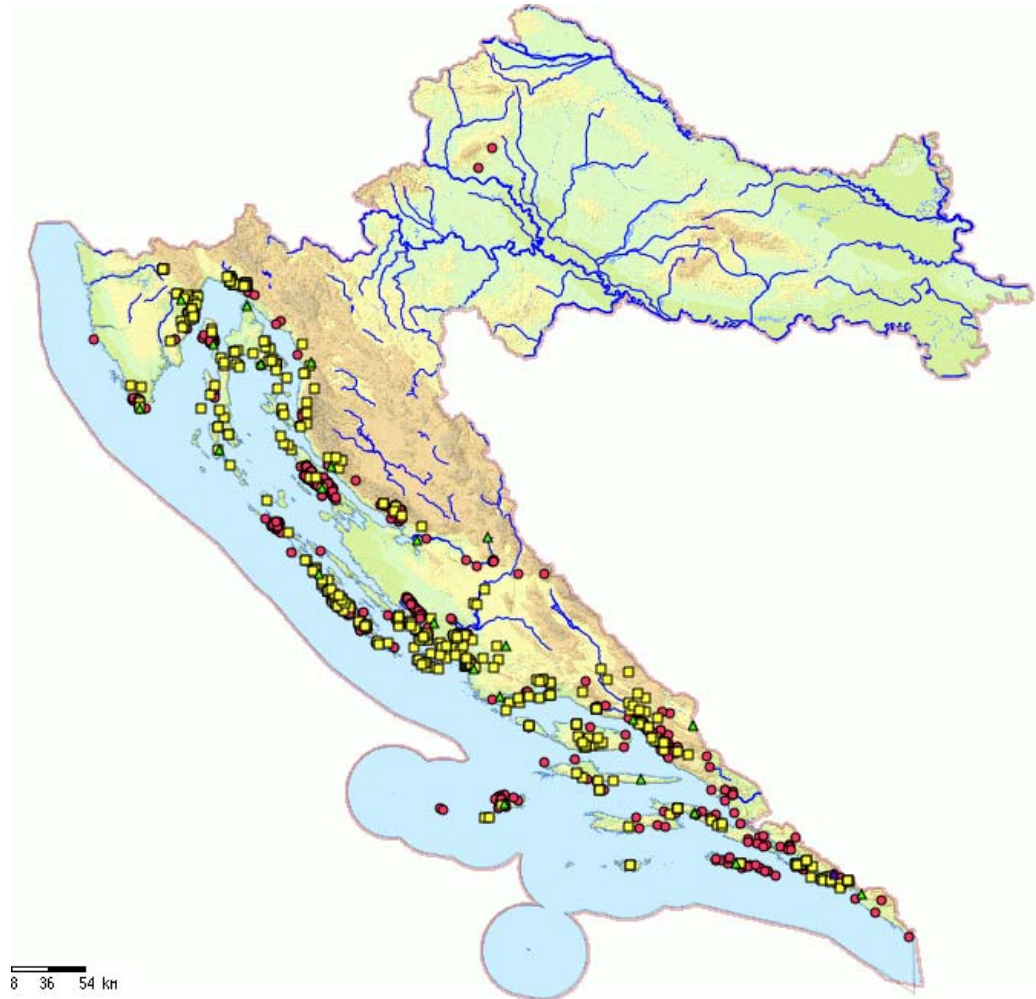
Salvia nemorosa L.

- endangered (EN)
- protected



Salvia officinalis L.

- Species Plantarum 1753

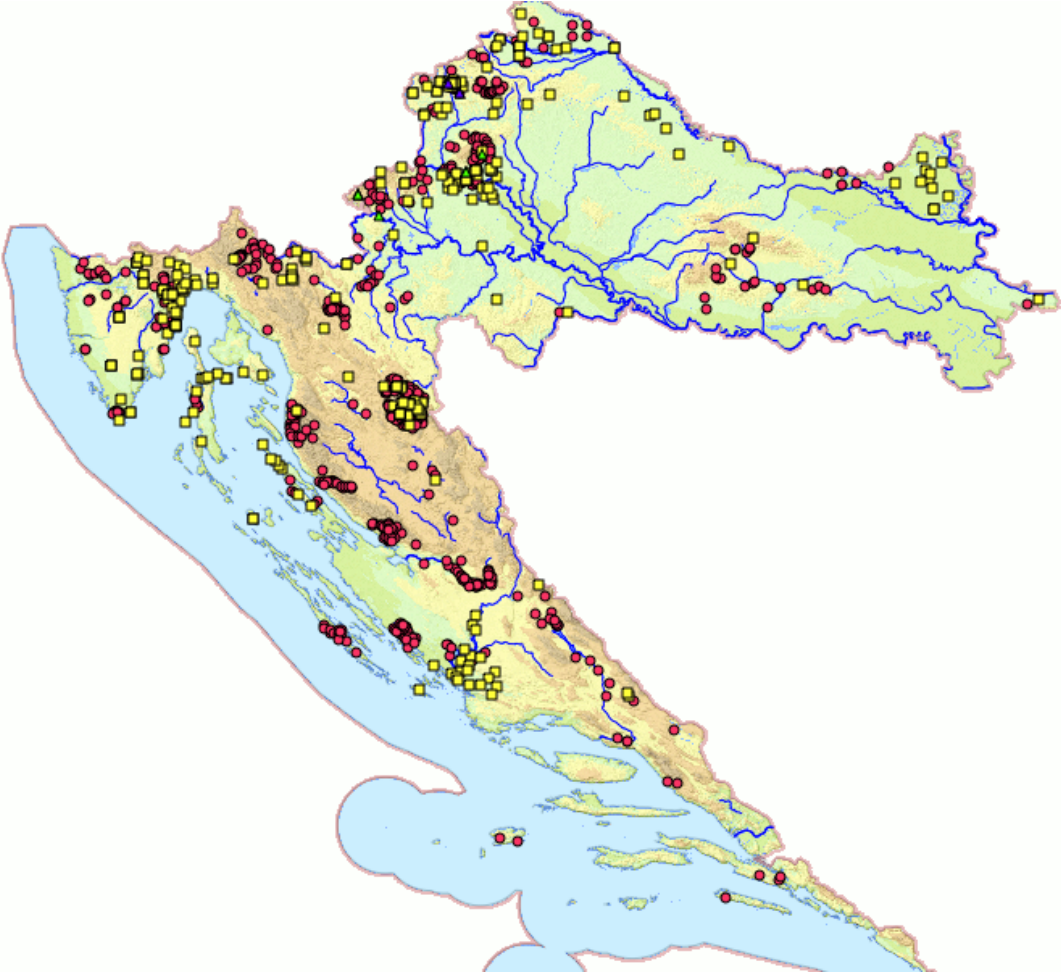


Salvia peloponnesiaca Boiss. et Heldr.

- protected
- very rare
- unconfirmed from 1969
- Island of Mljet



Salvia pratensis L.



***Salvia ringens* Sibth. et Sm.**



- dubious occurrence
- Balkan species (Macedonia, Greece, Albania, Serbia, Romania)



Salvia sclarea L.

- protected



Salvia tomentosa Mill.

- dubious occurrence
- similar to *S. officinalis*
- occur in Turkey



***Salvia verbenaca* L.**



Salvia verticillata L.



***Salvia viridis* L.**



The genus *Salvia* in Croatian flora (19/15)

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Salvia sclarea L.

Salvia tomentosa Mill.

Salvia verbenaca L.

Salvia verticillata L.

Salvia viridis L.



To be, or not to be...

Section *Salvia*

Shrubs or perennial herbs. Calyx not or scarcely accrescent. Upper lip of corolla more or less straight; tube with a ring of hairs inside. Staminal connective shorter than or equalling the filament.

***S. officinalis* complex**

S. officinalis

S. lavandulifolia

S. grandiflora

S. eichlerana

S. fruticosa

S. candelabrum

S. blancoana

S. brachyodon

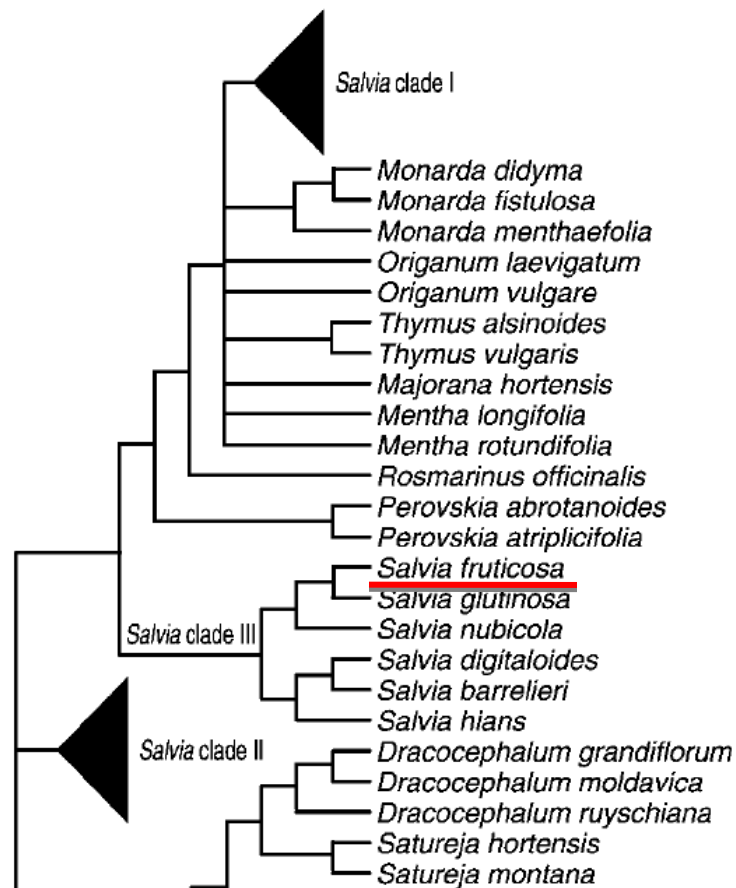
S. ringens

S. pinnata

S. scabiosifolia

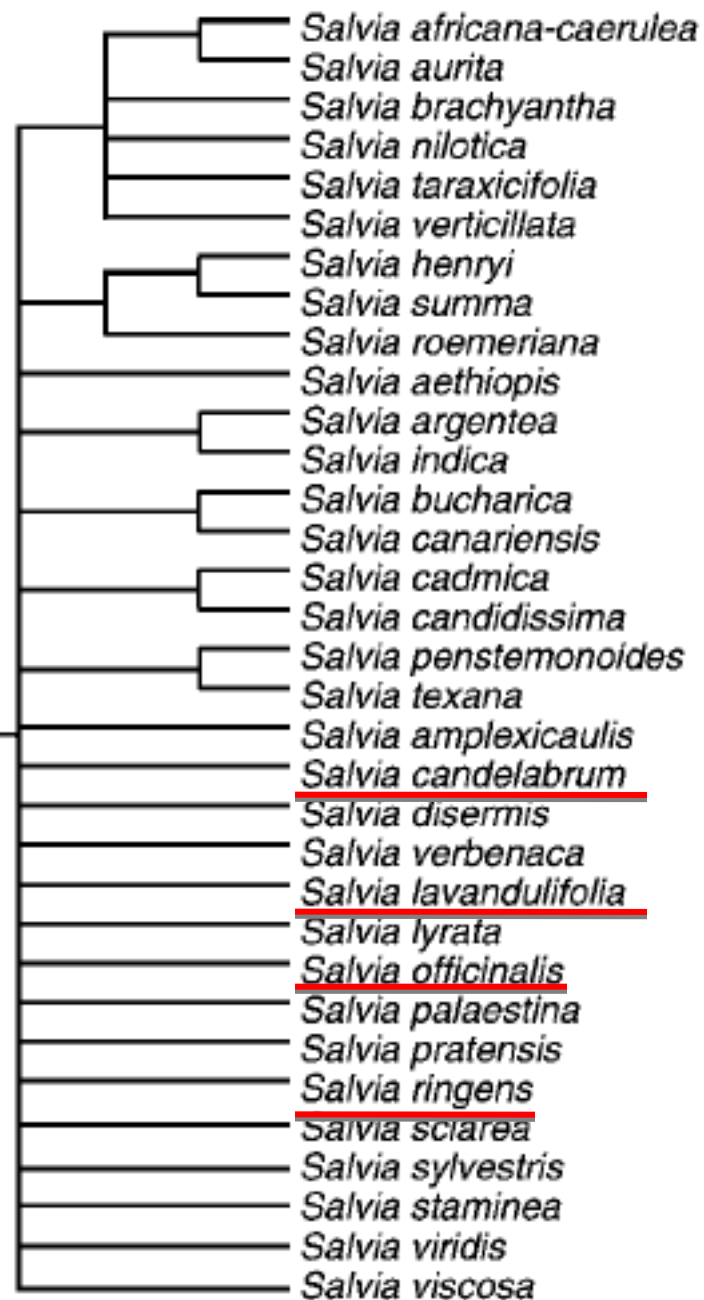
S. bracteata





rbcL sequences

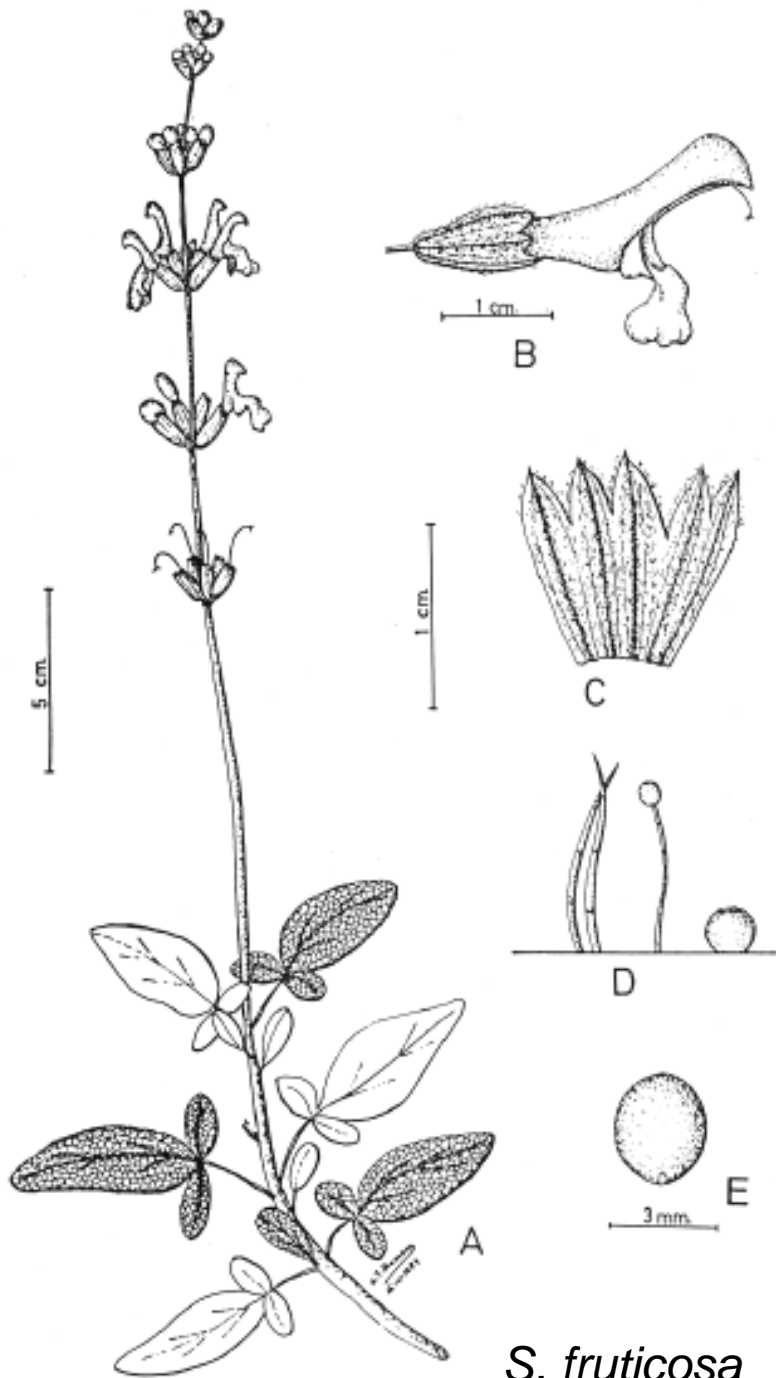
Salvia clade I



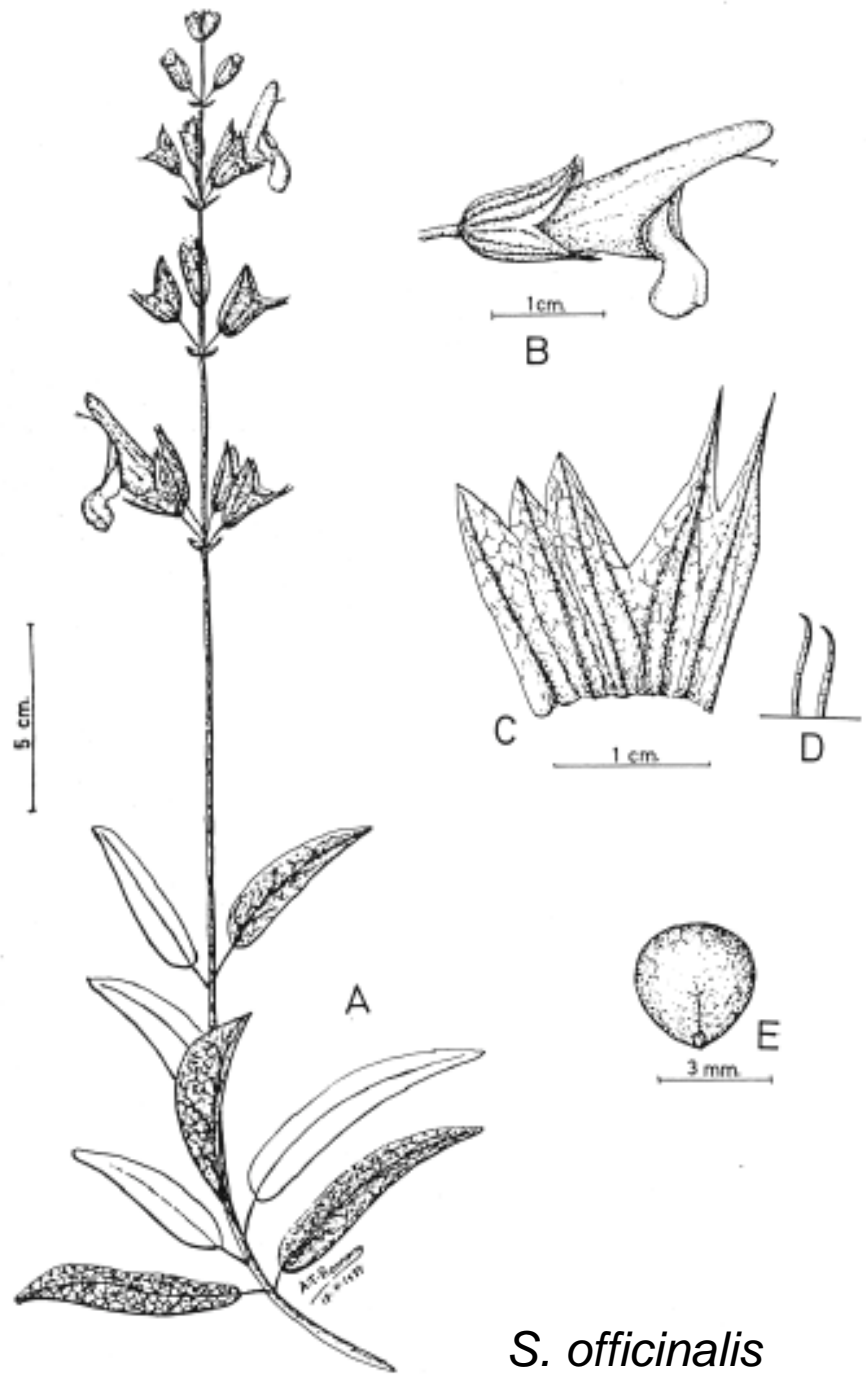
REVISION DEL GENERO *SALVIA* L. (*LAMIACEAE*) EN EL MEDITERRANEO OCCIDENTAL: LA SECCION *SALVIA*

J.L. ROSUA & G. BLANCA

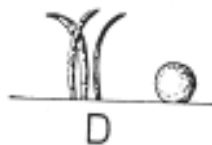
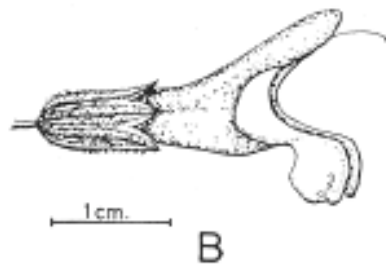




S. fruticosa



S. officinalis



Salvia lavandulifolia
- 8 podvrsta

- subsp. *lavandulifolia*
- subsp. *gallica*
- ▽ subsp. *pyrenaicum*
- ▼ subsp. *mesatlantica*
- subsp. *maurorum*
- subsp. *blancana*
- subsp. *vellerea*
- + subsp. *aethysea*

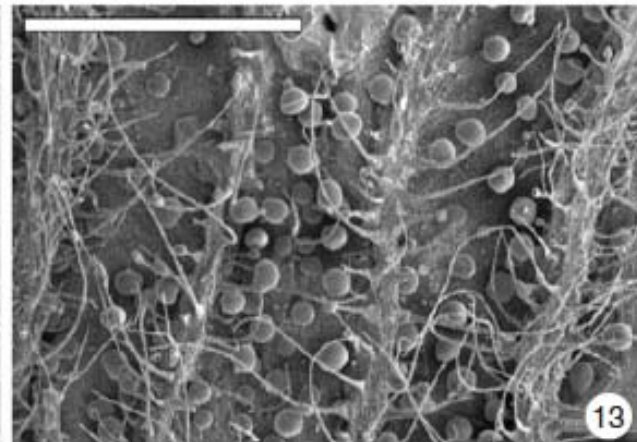
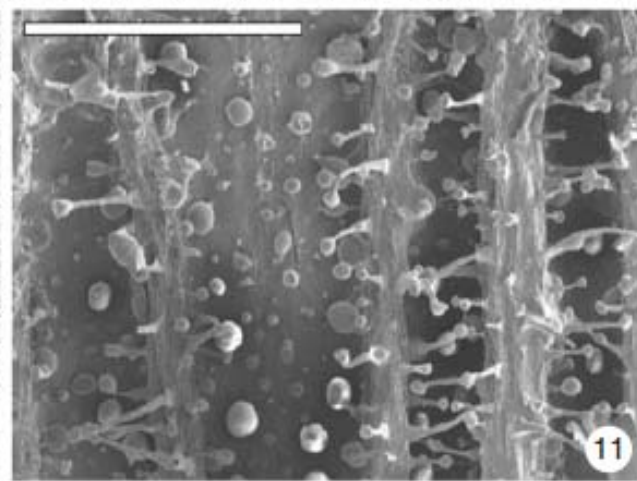
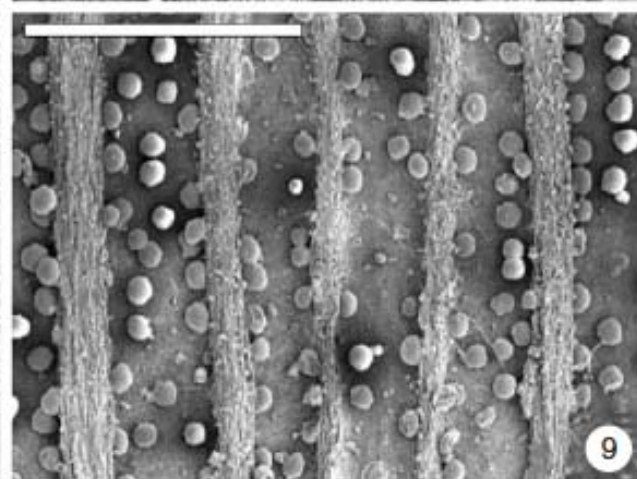
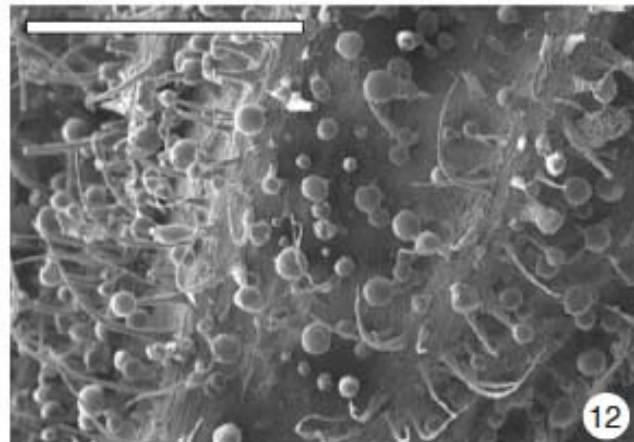
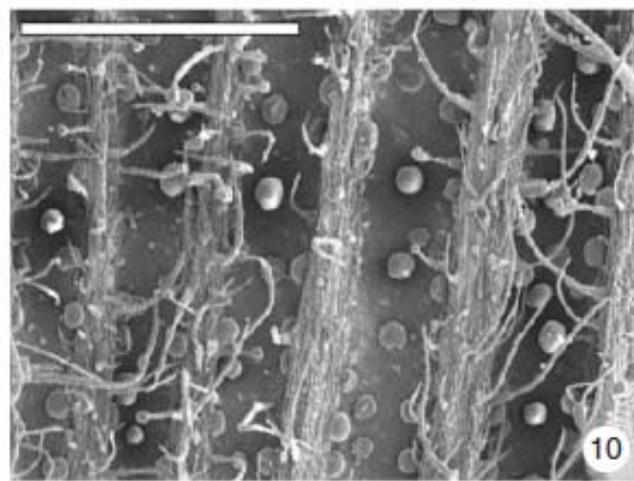
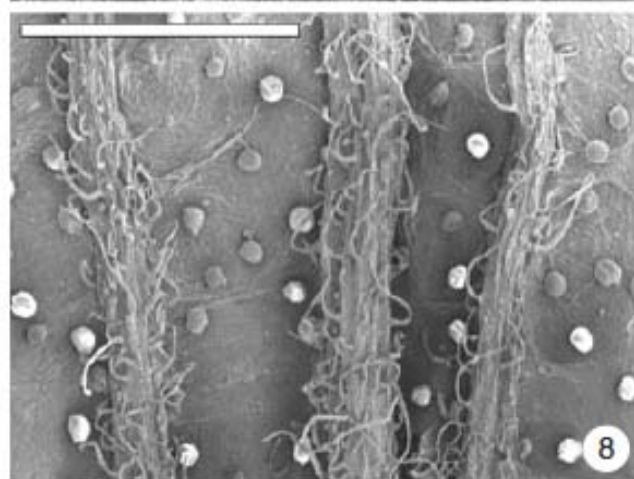
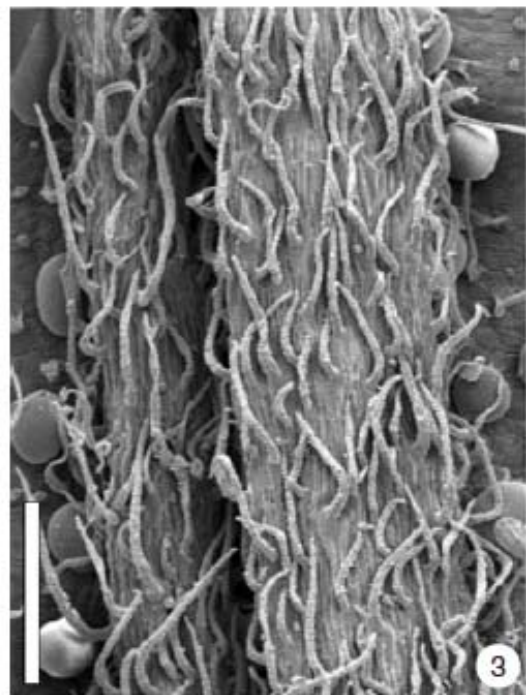
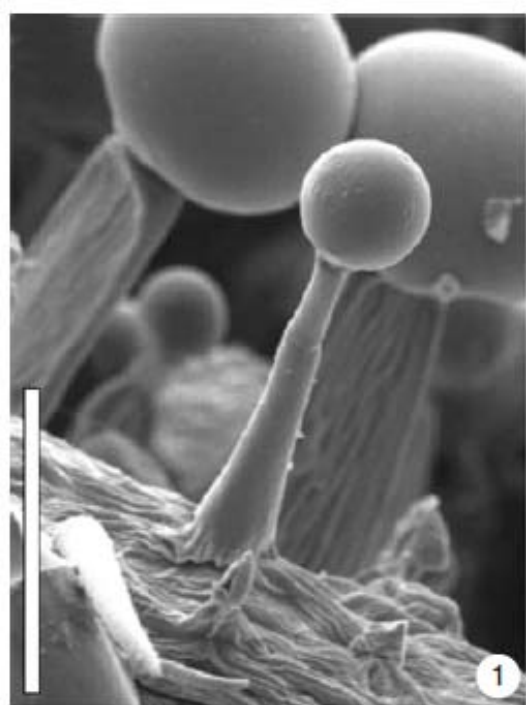


Fig. 11.- Localidades estudiadas de *S. lavandulifolia*

Numerical taxonomy study of *Salvia* sect. *Salvia* (Labiatae)

ANTONIO REALES¹, DIEGO RIVERA FLS^{1*}, JOSÉ ANTONIO PALAZÓN²
and CONCEPCIÓN OBÓN FLS^{3*}

No.	Character	Scoring
1	Glandular hairs 'type 1' (short) in the base of stems	Absent: 0; Present: 1
2	Glandular hairs 'type 2' (long, cup-shaped) in the base of stems	Absent: 0; Present: 1
3	Leaves markedly trilobed	Absent: 0; Present: 1
4	Leaves with 4 or 5 lobes	Absent: 0; Present: 1
5	Sessile glands in the inflorescence axis	Absent: 0; Present: 1
6	Stalked glands in the inflorescence axis	Absent: 0; Present: 1
7	Glandular hairs 'type 1' (short) in the inflorescence axis	Absent: 0; Present: 1
8	Glandular hairs 'type 2' (long, cup-shaped) in the inflorescence axis	Absent: 0; Present: 1
9	Lower verticillaster peduncle	Absent: 0; Present: 1
10	Sessile glands in the pedicels	Absent: 0; Present: 1



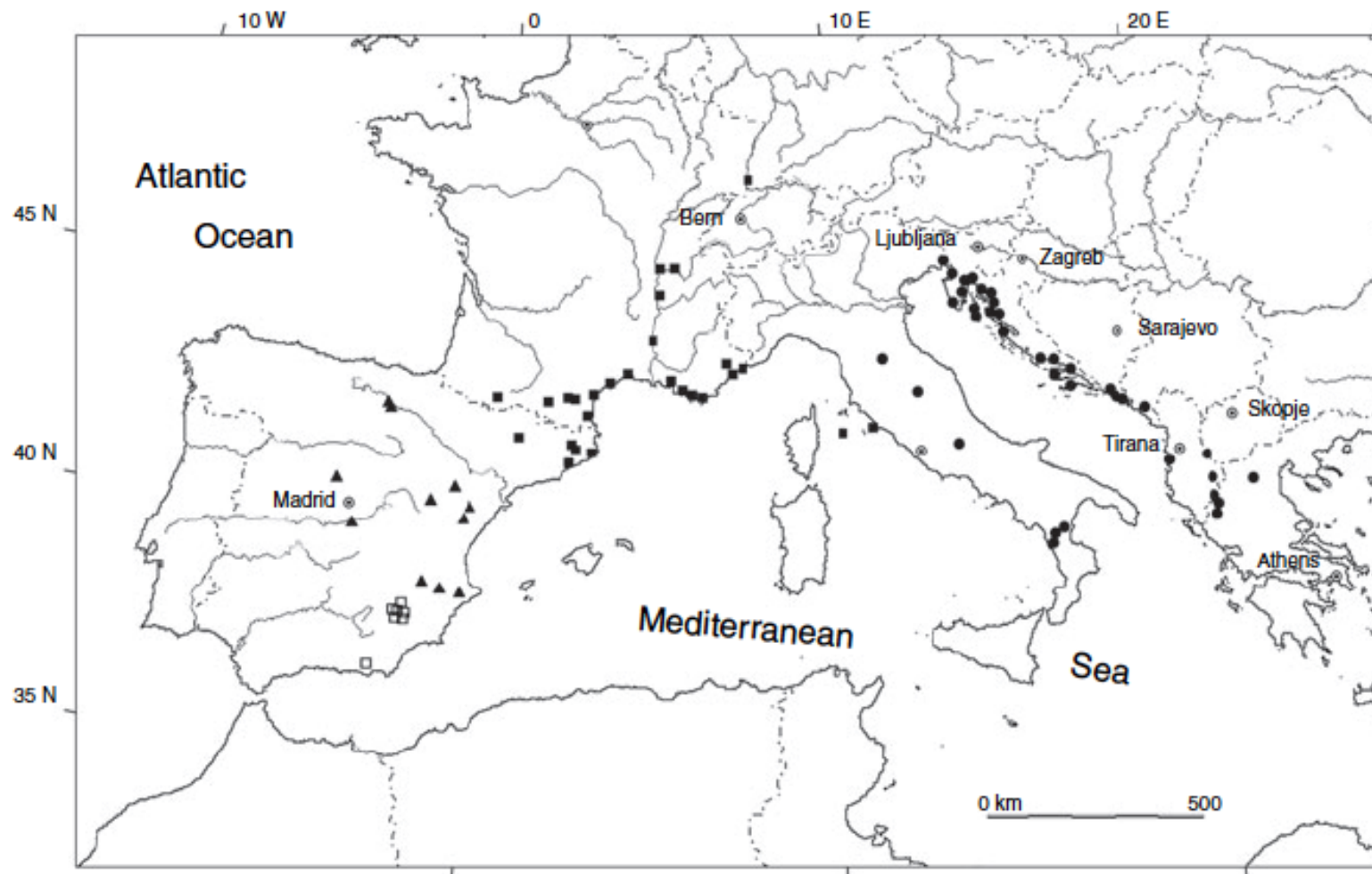


Figure 14. Distribution map for *S. officinalis* with reviewed specimens: *ssp. officinalis* (●); *ssp. gallica* (■); *ssp. lavandulifolia* (▲); *ssp. oxyodon* (□).

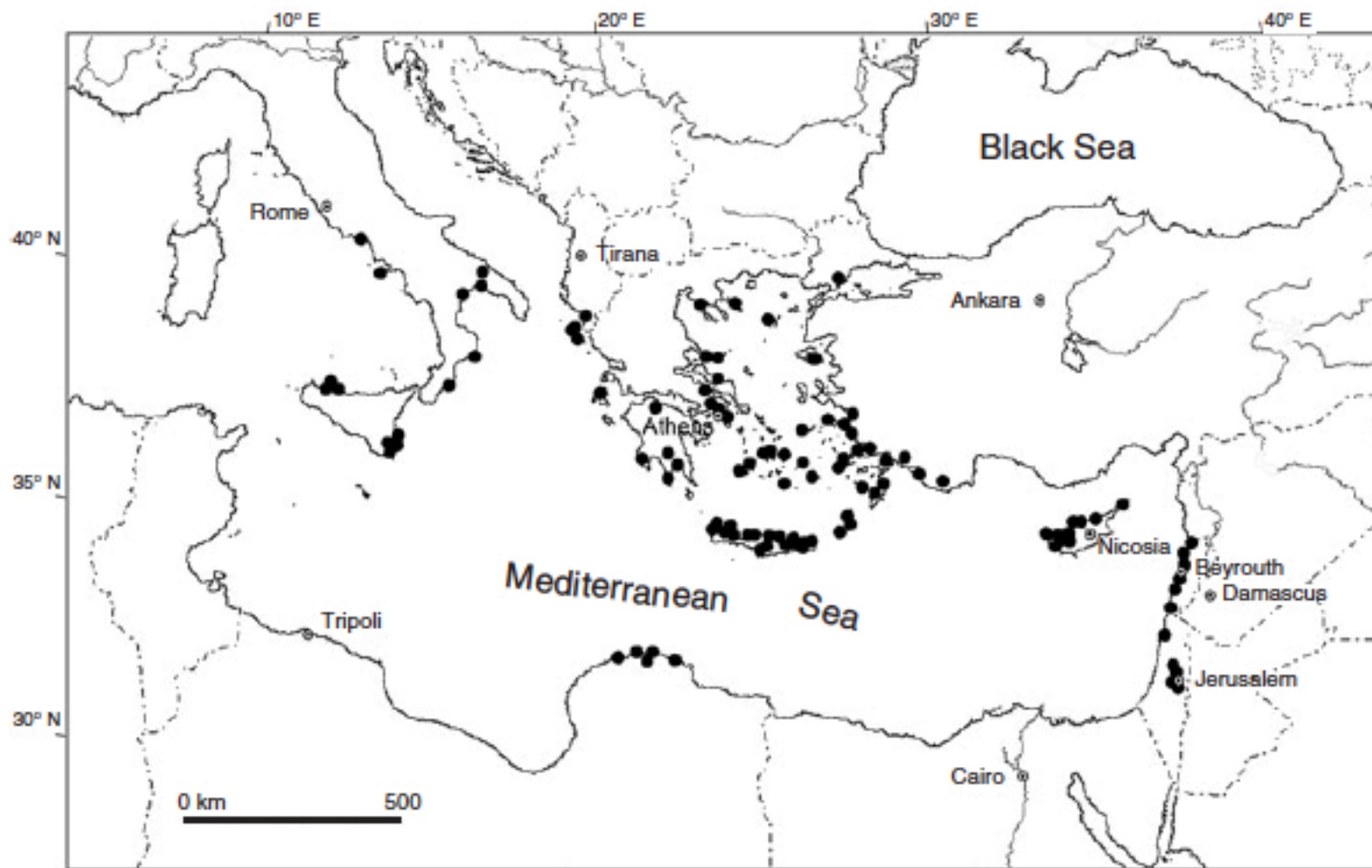
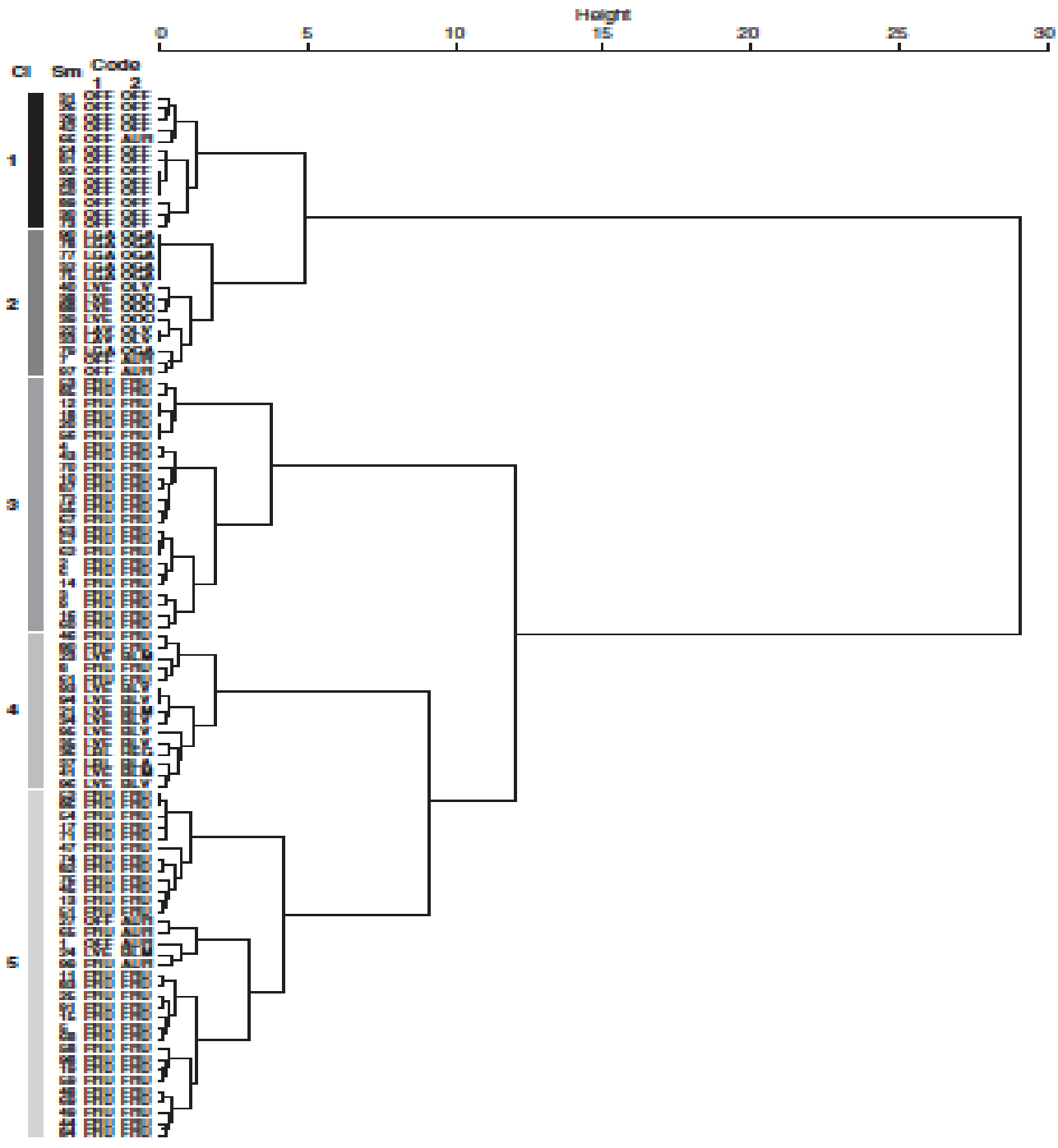


Figure 16. Distribution map for *S. fruticosa*.



KEY FOR THE SPECIES RECOGNIZED IN THIS STUDY

1. Calyx with both glandular and long (0.6–2 mm) subpatent eglandular hairs 2
1. Calyx glabrescent or with short (0.05–0.6 mm) antrorse adpressed eglandular hairs 1. *S. officinalis*
2. All leaves simple, never trilobed; upper floral bracts deciduous or persistent; calyx without stalked glands..... 3
2. Leaves simple, eared or trilobed; upper floral bracts always deciduous; calyx with stalked glands 4
3. Calyx with triangular teeth 1–4 mm long and abundant glandular and/or eglandular hairs 2. *S. blancoana*
3. Calyx with narrowly acuminate teeth 3–5 mm long and scarce glandular and eglandular hairs 3. *S. × hegelmaieri*
4. Calyx actinomorphic, with abundant glandular hairs, eglandular hairs and stalked glands, teeth 1–3 mm long 4. *S. fruticosa*
4. Calyx slightly bilabiate, with scarce glandular and scattered eglandular hairs; stalked glands scarce or rare, teeth 3–5 mm long..... 5. *S. × auriculata*

1. Calyx markedly bilabiate, strongly reticulate between veins a. *S. officinalis* ssp. *officinalis*
1. Calyx actinomorphic or slightly bilabiate, barely or not reticulate between veins 2
2. Calyx actinomorphic, tubular, without wrinkles between veins 3
2. Calyx slightly bilabiate, campanulate, with slight wrinkles between veins c. *S. officinalis* ssp. *gallica*
3. Calyx with teeth up to 3 mm long, with abundant short antrorse adpressed hairs (0.05–0.6 mm) b. *S. officinalis* ssp. *lavandulifolia*
3. Calyx with teeth over 3 mm long, glabrous or glabrescent..... d. *S. officinalis* ssp. *oxyodon*

Sampling of plant material





50. Dry leafed *Spergularia*
in *Suaeda* *Suaeda*
to *Suaeda* *Suaeda*

(61) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(62) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(63) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(64) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(65) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(66) *Suaeda* *Suaeda* *Suaeda*
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(67) *Suaeda* *Suaeda* *Suaeda*
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(68) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(69) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(70) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(71) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(72) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(73) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(74) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(75) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(76) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(77) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(78) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(79) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

(80) *Suaeda* *Suaeda* *Suaeda*
Suaeda *Suaeda* *Suaeda*

S. officinalis L.

?

S. fruticosa Mill.



- Hybridogenous population from the island of Vis



A

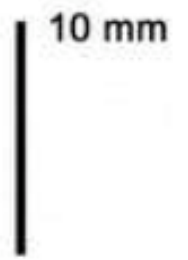


B



C

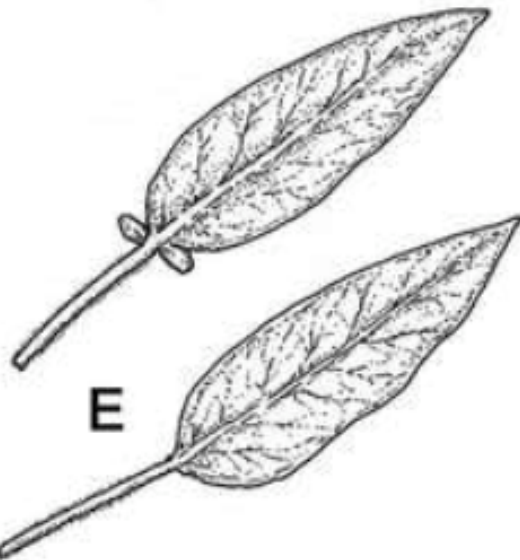
J.A.B.C'02



10 mm



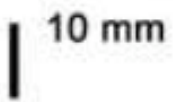
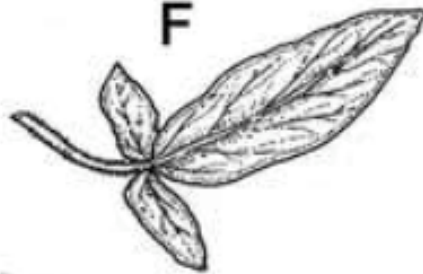
D



E



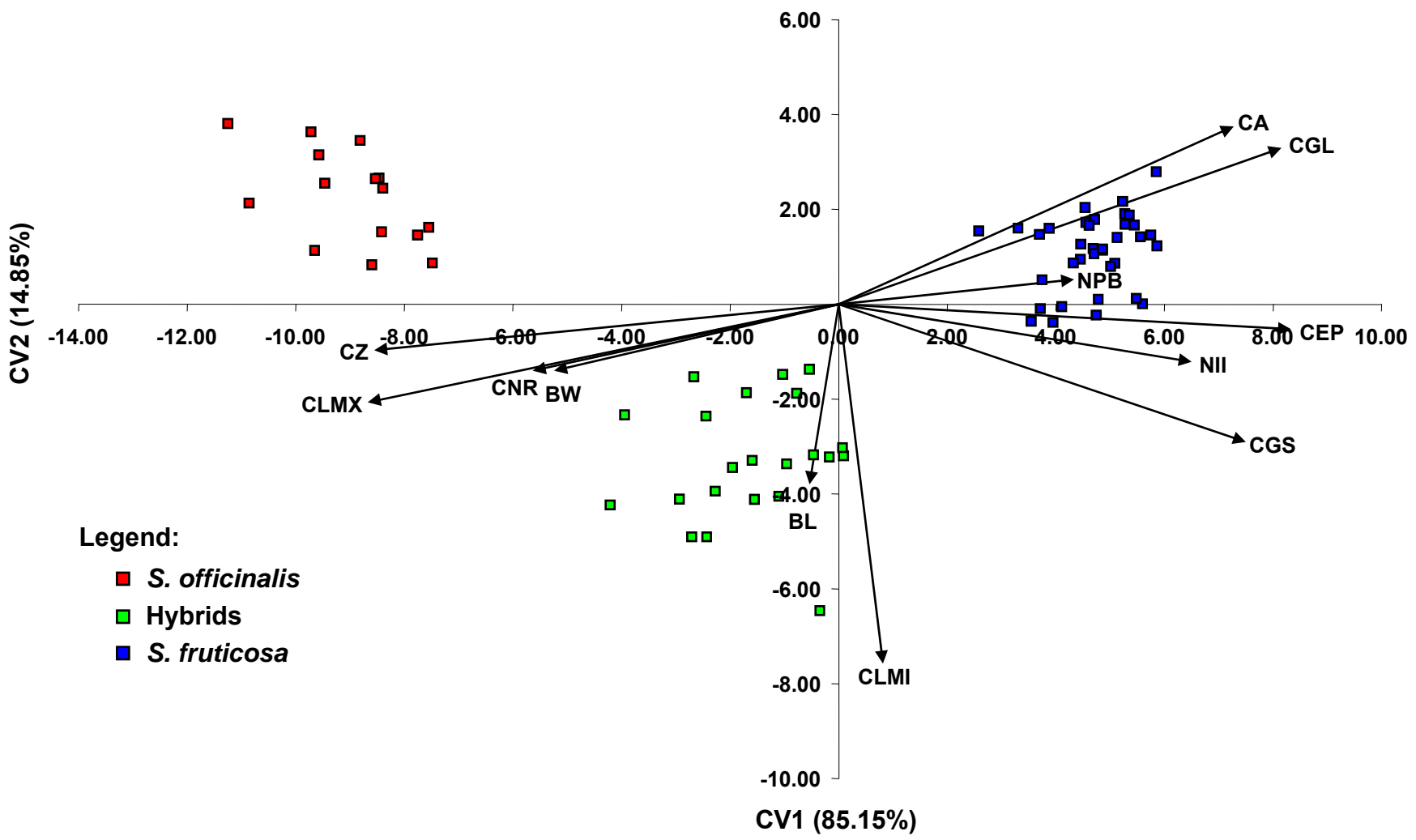
F



10 mm



J.A.B.C'02

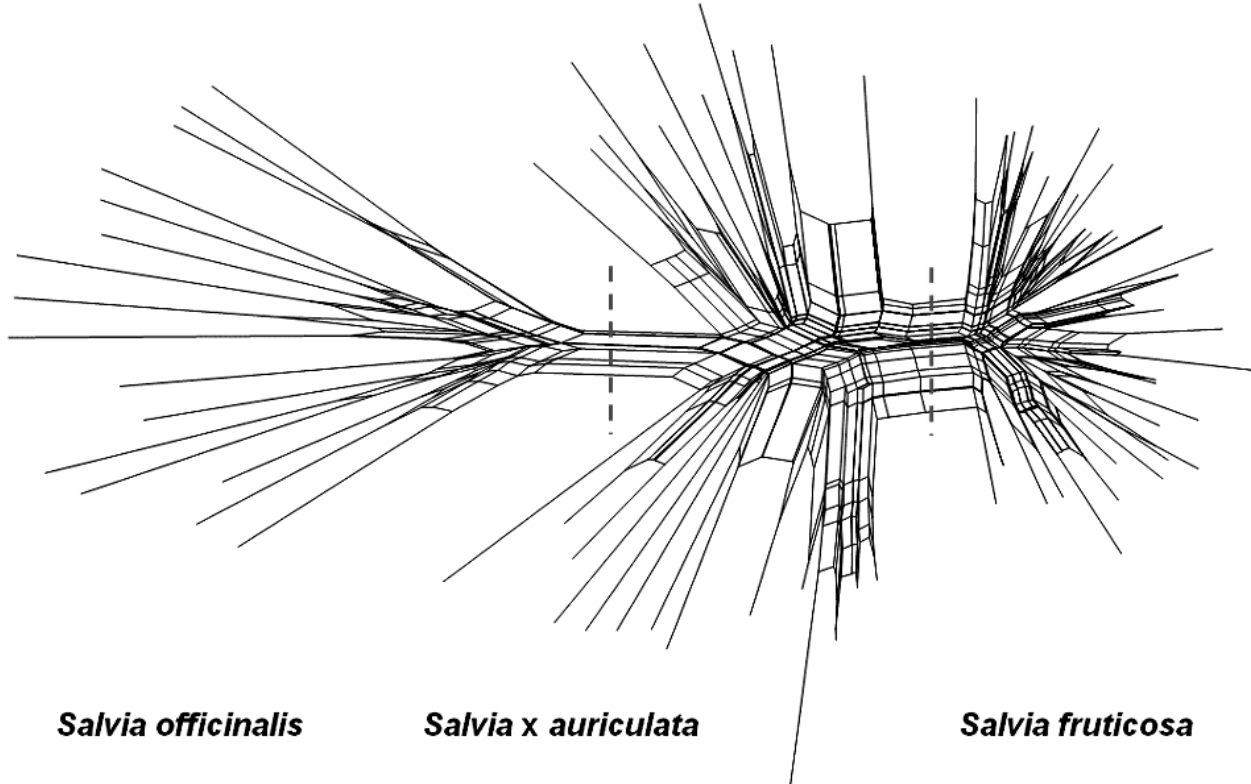




Gerard (1597), "*Salvia minor*"



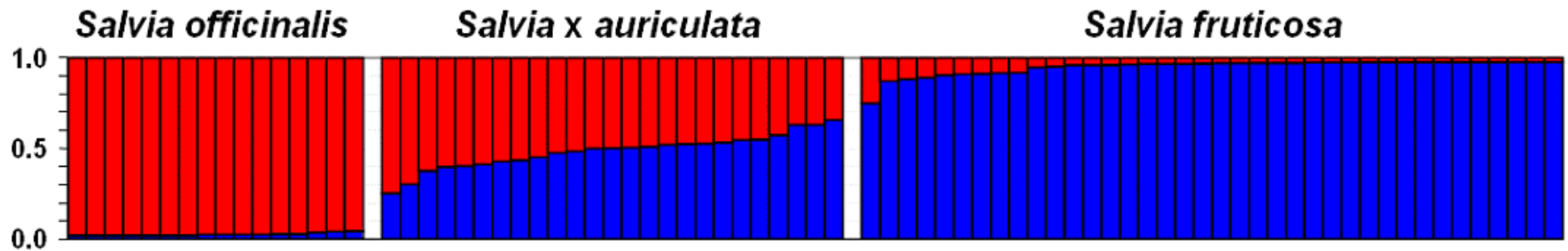
Neotype of *S. x auriculata* (BM)



Salvia officinalis

Salvia x auriculata

Salvia fruticosa



S. officinalis L.

S. x auriculata Mill.

S. fruticosa Mill.



Distribution, morphology and systematics of the genus *Salvia*

Thank you for your attention!