CHROMOSOME NUMBERS IN THE SICILIAN SPECIES OF *LIMONIUM* MILLER *(PLUMBAGINACEAE)*

by

SALVATORE BRULLO & PIETRO PAVONE*

Abstract

BRULLO, S. & P. PAVONE (1981). Chromosome numbers in the sicilian species of Limonium Miller (Plumbaginaceae). *Actas III Congr. OPTIMA. Anales Jard. Bot. Madrid* 37 (2): 535-555.

The authors present the results of a study on the chromosome numbers of most of the *Limonium* species which occur in Sicily and neighbouring islets. The chromosome counts were made in the somatic mitosis of the germinated seeds. Among the taxa caryologically investigated there are diploid species with 2n = 16 *(L. sinuatum, L. ferulaceum)* and with 2*n* = 18 *(L. calcarae, L. bocconei, L. syracusanum, L. tenuiculum, L. lopadusanum, L. panormitanum)*, triploid species with 2*n* = 26 *(L. minutiflorum, L. exaristatum)* and with 2*n* = 27 *(L. cosyrense, L. flagellare, L. pignattii, L. furnarii, L. oleifolium, L. halophilum, L. lilybaeum, L. selinuntinum, L. aegusae, L. catanzaroi, L. densiflorum, L. sibthorpianum)*, tetrapolid species with 2*n* = 32 *(L. lojaconi, L. intermedium)*, with 2*n* = 35 *(L. ionicum)* and with 2*n* = 36 *(L. serotinum, L. ponzoi, L. tauromenitanum, L. hyblaeum, L. mazarae, L. secundiramemum, L. pachymense)*. For each species the taxonomic, phytogeographical and ecological aspects are also taken into consideration.

Resumen

BRULLO, S. & P. PAVONE (1981). Números cromosomáticos en especies sicilianas de Limonium Miller (Plumbaginaceae). *Actas III Congr. OPTIMA. Anales Jard. Bot. Madrid* 37 (2): 535-555 (En inglés).

Los autores presentan los resultados del estudio de los números cromosomáticos de la mayoría de las especies de *Limonium* de Sicilia e islotes vecinos. Los recuentos cromosomáticos se realizaron en mitosis somáticas de semillas germinadas. Entre los taxones investigados cariológicamente, existen especies diploides con 2*n* = 16 *(L. sinuatum, L. ferulaceum)* y con 2*n* = 18 *(L. calcarae, L. bocconei, L. syracusanum, L. tenuiculum, L. lopadusanum, L. panormitanum)*, especies triploides con 2*n* = 26 *(L. minutiflorum, L. exaristatum)* y con 2*n* = 27 *(L. cosyrense, L. flagellare, L. pignattii, L. furnarii, L. oleifolium, L. halophilum, L. lilybaeum, L. selinuntinum, L. aegusae, L. catanzaroi, L. densiflorum, L. sibthorpianum)*, especies tetraploides con 2*n* = 32 *(L. lojaconi, L. intermedium)*, con 2*n* = 35 *(L. ionicum)* y con 2*n* = 36 *(L. serotinum, L. ponzoi, L. tauromenitanum, L. hyblaeum, L. mazarae, L. secundirameum, L. pachymense)*. Para cada especie se hacen comentarios sobre aspectos taxonómicos, fitogeográficos y ecológicos.

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INTRODUCTION

Regarding the genus *Limonium* in Sicily there are numerous taxonomic studies (GUSSONE, 1827, 1832, 1843; LOJACONO-POJERO, 1907; PIGNATTI, 1971; BRULLO, 1980) but only few data about the cytology are available (DOLCHER & PIGNATTI, 1971; BARTOLO *et al.*, 1978).

Recently, ERBEN (1978, 1979) has evidenced the importance of the caryological study for the taxonomy of the genus *Limonium*. From the observation of the chromosome complements, ERBEN *(l.c.)* has, in fact, put in relief the presence of long metacentric chromosomes in the taxa of the Subgen. *Mimonium* characterized by the basic number $x = 8$ both diploid and polyploid as well as aneuploid with $2n = 25, 26, 34, 35, 42, 43$. Instead, this type of chromosome is always absent in the diploid and eupolyploid taxa with basic number $x = 9$.

With regards to Sicily, out of 40 taxa known for the island and the neighbouring islets (see BRULLO, 1980), 35 were caryologically investigated (Table 1), as it was not possible to collected material for all of them.

MATERIAL AND METHODS

The caryological investigation was made on the root-tips of seed from the herbarium specimens. The root-tips were pretreated with 0,2 colchicine for abouth three hours, fixed in Carnoy and then stained according to the usual Feulgen squash method. The herbarium specimens are conserved in the Botanical Institute of Catania (CAT).

CARYOLOGICAL AND PHTYTOGEOGRAPHICAL CONSIDERATION

Within the genus *Limonium* Limited to the Sicilian species, it is possible to individualize, on the grounds of the morphological characters, some groups. Among these we have:

Limonium minutiflorum group — In this group we can include 5 species (Fig. 26) characterized by a rigid inflorescence with absent or rare sterile braches, by lax spikes and by bracts and calyx minute (3,5-5 mm long). The species present themselves as triploid with $2n = 26$ *(L. minutiflorum)* and $2n = 27$ *(L. furnarii)* or as tetraploid with $2n = 32$ *(L. lojaconi)*, $2n = 35$ *(L. ionicum)* and $2n = 36$ *(L. tauromenitanum)*. These species, all endemic, are always localized on the coastal rocks and have a very small distribution which is sometimes like a spot, that is limited only to a couple of hundred of metres of shoreline. They occur in the extreme part of W-Sicily and along the coasts of NE-Sicily and in the Aeolian Islands.

Limonium albidum group — The species belonging to this group are characterized by markedly spathulate leaves arranged in hemispherical basal rosettes, by flexouous and fragile at nodes inflorescence with sterile branches generally absent, by lax spikes and by precociously caducous spikelets. This group is represented by diploid species with $2n = 18$ *(L.*

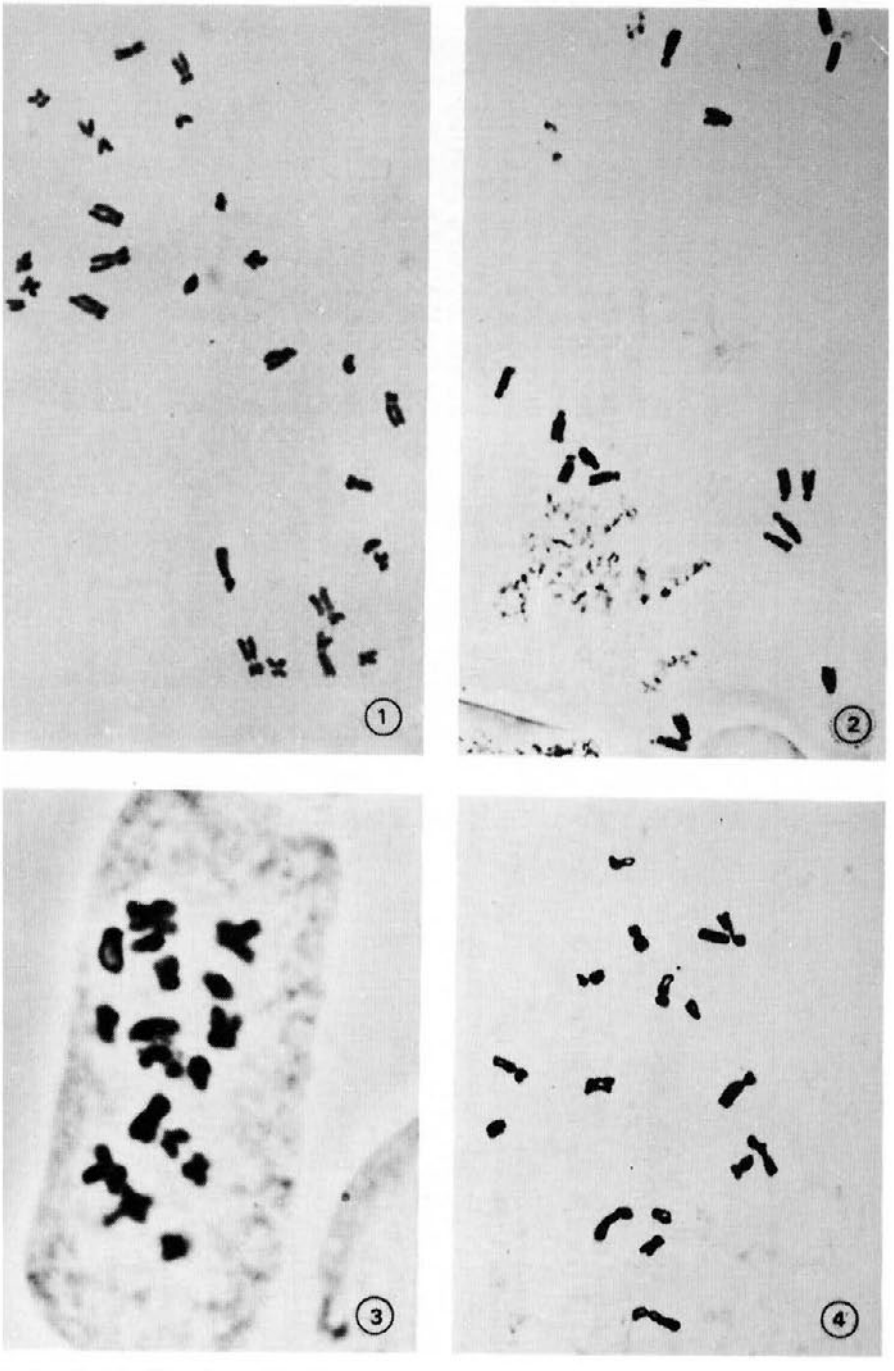


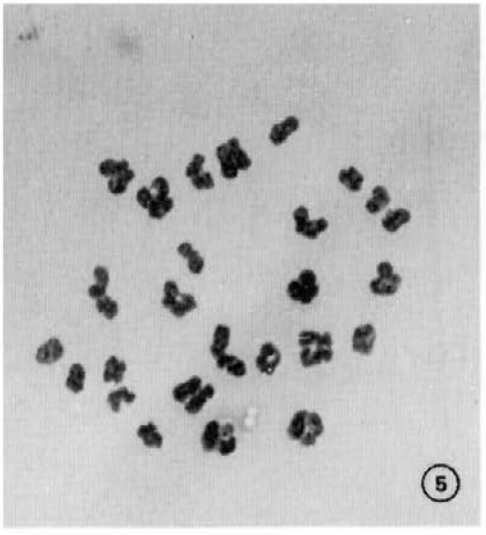
Fig. 1.—*L. halophilum*, $2n = 27$. Fig. 2.—*L. sinuatum*, $2n = 16$. Fig. 3.—L. syracusanum, $2n = 18$. Fig. 4.—*L. lopadusanum*, $2n = 18$.

TABLE I

CHROMOSOME COUNTS OF LIMONIUM SPECIES OF SICILY

Taxon	*2n*	*Ploidy*	*Locality*	*Reference*
L. sinuatum Miller	16	2x	Sampieri	BRULLO 8-VIII-1975
L. ferulaceum (L.) O. Kuntze	16	2x	Isola Grande Stagnone	BRULLO & PAVONE 30-VIII-1978
L. serotinum (Reichenb.) Pignatti	36	4x	Capo Passero	BRULLO 27-IX-1975
L. calcarae (Tod. ex Janka) Pignatti	18	2x	Caltanissetta	BRULLO & PAVONE 25-VII-1977
L. cosyrense (Guss.) O. Kuntze	27	3x	Pantelleria	BRULLO 15-IV-1976
L. bocconei (Lojac.) Litard.	18	2x	M. Gallo (Palermo)	BRULLO & PAVONE 9-IX-1975
L. ponzoi (Fiori & Béguinot) Brullo	36	4x	S. Bonagia (Trapani)	BRULLO & PAVONE 8-IX-1975
L. flagellare (Lojac.) Brullo	27	3x	Balestrate	BRULLO & PAVONE 8-IX-1975
L. syracusanum Brullo	18	2x	Vendicari (Pachino)	BRULLO 27-IX-1975
L. tenuiculum (Tineo ex Guss.) Pignatti	18	2x	Marettimo	BRULLO & PAVONE 1-IX-1978
L. pignattii Brullo & Di Martino ex Brullo	27	3x	Isola Grande Stagnone	BRULLO & PAVONE 10-VIII-1977
	27	3x	Ronciglio (Trapani)	BRULLO & PAVONE 29-VIII-1978
L. catanzaroi Brullo	27	3x	Ribera	BRULLO 17-VI-1978
L. minutiflorum (Guss.) O. Kuntze	26	3x	Capo Milazzo	BRULLO & PAVONE 29-VIII-1975
L. lojaconi Brullo	32	4x	Favignana	BRULLO & PAVONE 9-IX-1975
L. tauromenitanum Brullo	36	4x	Naxo (Taormina)	BRULLO & PAVONE 9-VIII-1975
L. ionicum Brullo	35	4x	Isola Bella (Taormina)	BRULLO & PAVONE 1-X-1978
L. furnarii Brullo	27	3x	Mazara del Vallo	BRULLO & PAVONE 8-IX-1975
L. lopadusanum Brullo	18	2x	Lampedusa	BRULLO 12-X-1975
L. hyblaeum Brullo	36	4x	Sampieri	BRULLO 8-VIII-1975
L. mazarae Pignatti	36	4x	Mazara del Vallo	BRULLO & PAVONE 8-IX-1975
L. panormitanum (Tod.) Pignatti	18	2x	M. Gallo (Palermo)	BRULLO & PAVONE 25-VII-1977
L. intermedium (Guss.) Brullo	32	4x	Lampedusa	BRULLO 12-X-1975
L. oleifolium Miller subsp. oleifolium	27	3x	Sampieri	BRULLO 8-VIII-1975
	27	3x	Capo Passero	BRULLO 8-VIII-1975
	27	3x	Favignana	BRULLO & PAVONE 9-IX-1975

subsp. algusae Brullo	27	3x	Linosa	BRULLO & PICCIONE 20-IV-1977
subsp. opulentum (Lojac.) Brullo	27	3x	Porto Empedocle	BRULLO 8-X-1975
L. halophilum Pignatti	27	3x	Mazara del Vallo	BRULLO & PAVONE 8-IX-1975
L. secundirameum (Lojac.) Brullo	36	4x	Pantelleria	BRULLO 14-IV-1979
L. lilybaeum Brullo	27	3x	Isola Grande Stagnone	BRULLO & PAVONE 30-VIII-1978
L. selinuntinum Brullo	27	3x	Selinunte	BRULLO & PAVONE 30-VIII-1978
L. aegusae Brullo	27	3x	Favignana	BRULLO & PAVONE 9-IX-1975
L. pachynense Brullo	36	4x	Capo Passero	BRULLO 27-IX-1975
L. densiflorum (Guss.) O. Kuntze	27	3x	Sampieri	BRULLO 7-VIII-1977
	27	3x	Isola Grande Stagnone	BRULLO & PAVONE 30-VIII-1978
L. sibthorpianum (Guss.) O. Juntze	27	3x	Capo D'Alì (Messina)	BRULLO & PAVONE 29-VIII-1975
L. exaristatum (Murb.) P. Fourn.	26	3x	Isola Grande Stagnone	BRULLO & PAVONE 30-VIII-1978



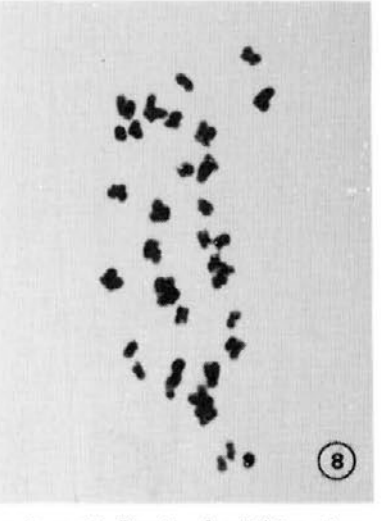


Fig. 5.—*L. lilybaeum*, 2*n* = 27. Fig. 6.—*L. secundirameum*, 2*n* = 36. Fig. 7.—*L. oleifolim* subsp. *oleifolium*, 2*n* = 27. Fig. 8.—*L. ponzoi*, 2*n* = 36.

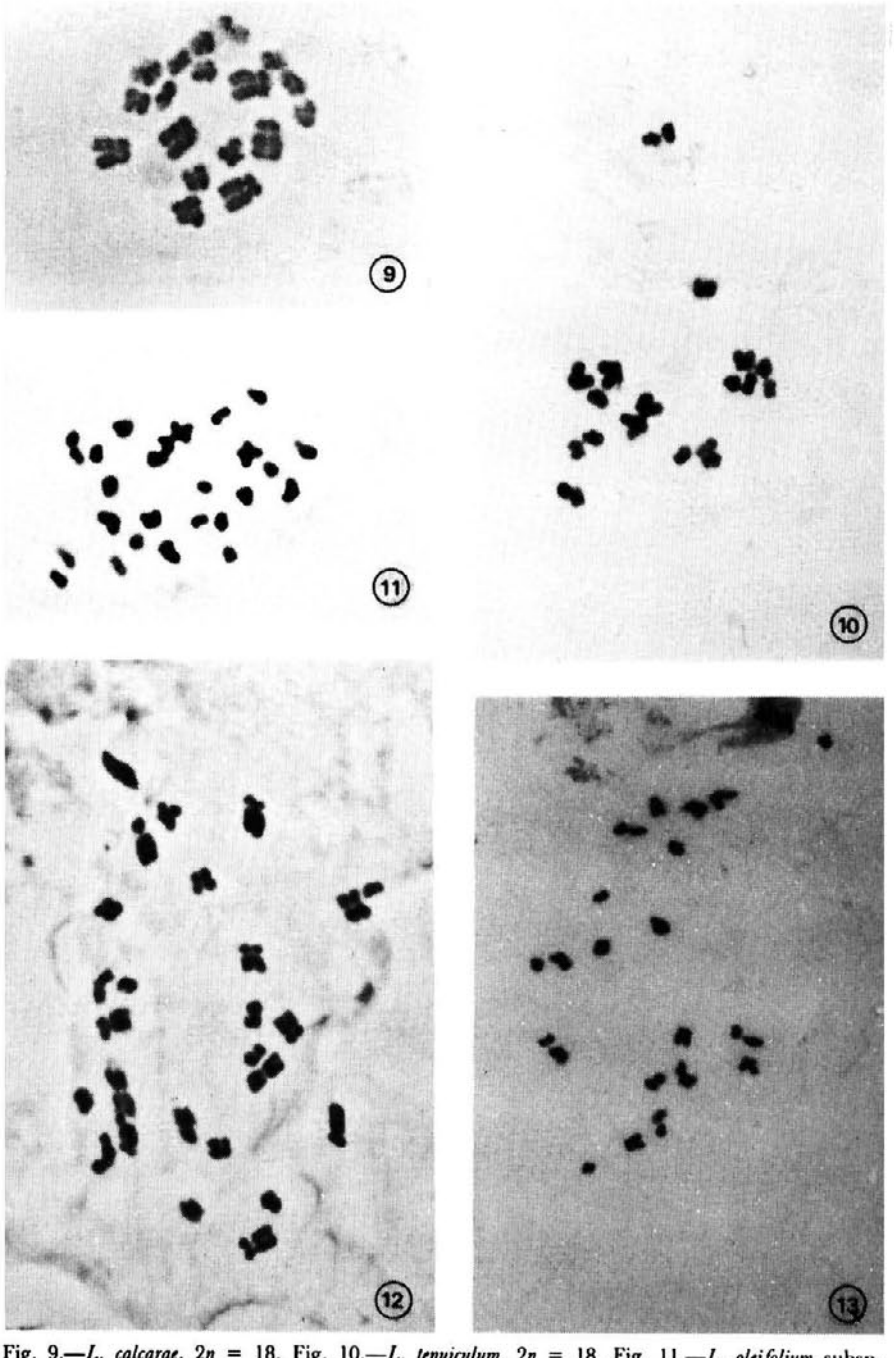


Fig. 9.—*L. calcarae*, $2n = 18$. Fig. 10.—*L. tenuiculum*, $2n = 18$. Fig. 11.—*L. oleifolium* subsp. *algusae*, $2n = 27$. Fig. 12.—*L. densiflorum*, $2n = 27$. Fig. 13.—*L. oleifolium* subsp. *opulentum*, $2n = 27$.

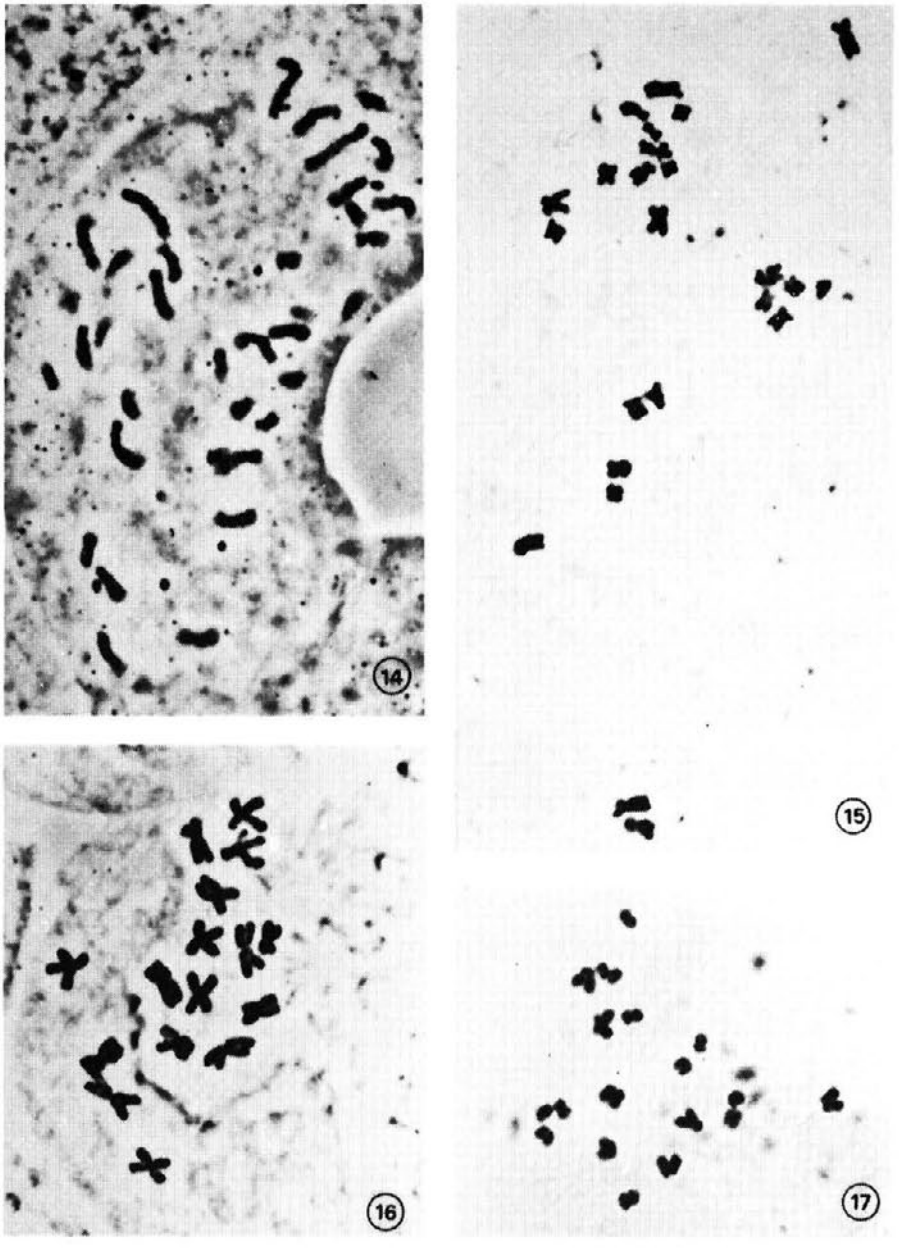
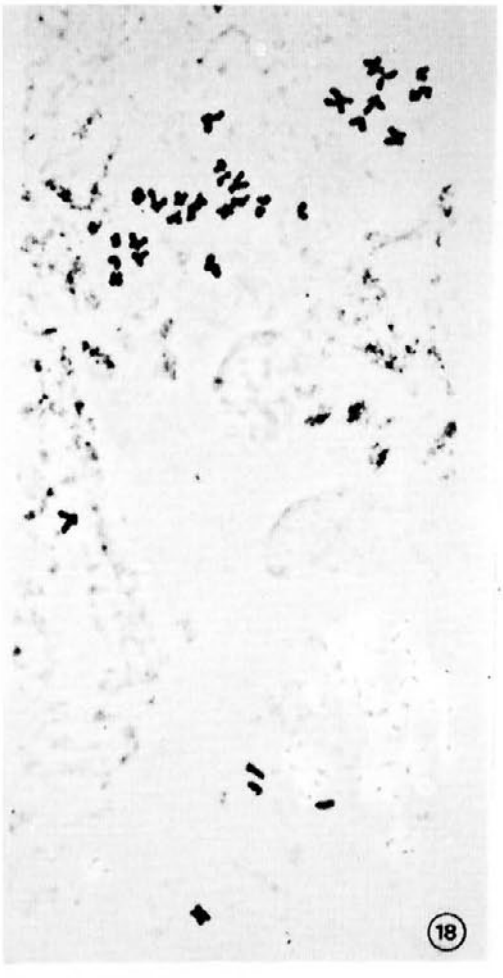
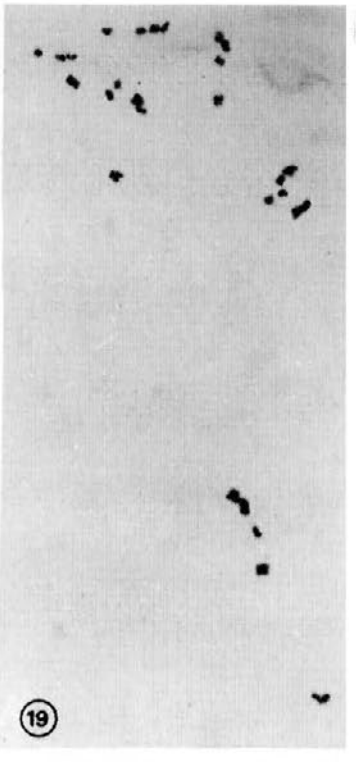
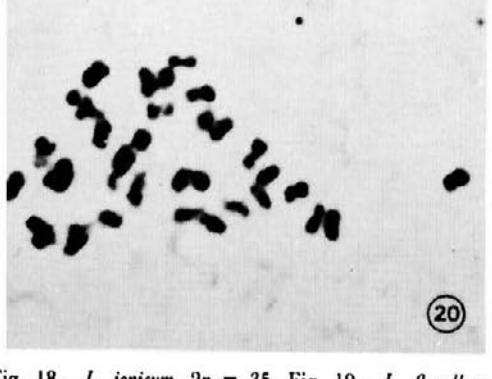


Fig. 14.—*L. hyblaeum*, 2*n* = 36. Fig. 15.—*L. exaristatum*, 2*n* = 26. Fig. 16.—*L. ferulaceum*, 2*n* = 16. Fig. 17.—*L. panormitanum*, 2*n* = 18.







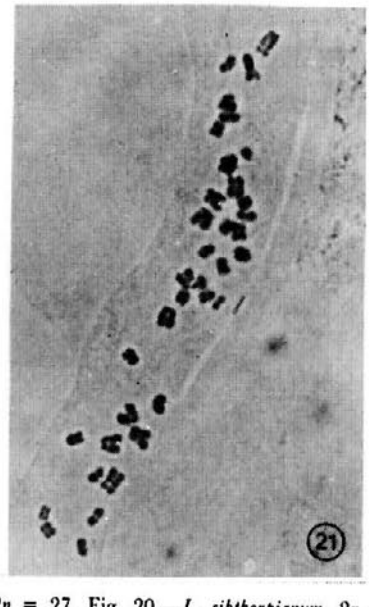
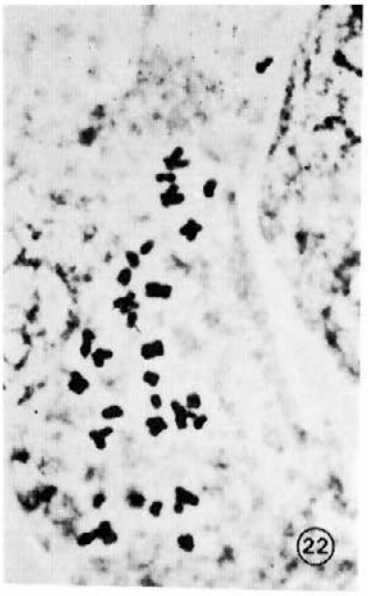
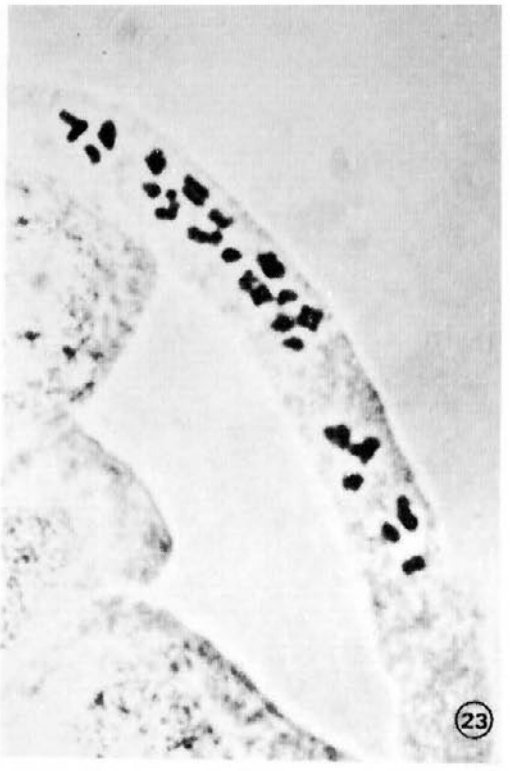


Fig. 18.—*L. ionicum*, 2*n* = 35. Fig. 19.—*L. flagellare*, 2*n* = 27. Fig. 20.—*L. sibthorpianum*, 2*n* = 27. Fig. 21.—*L. tauromenitanum*, 2*n* = 36.





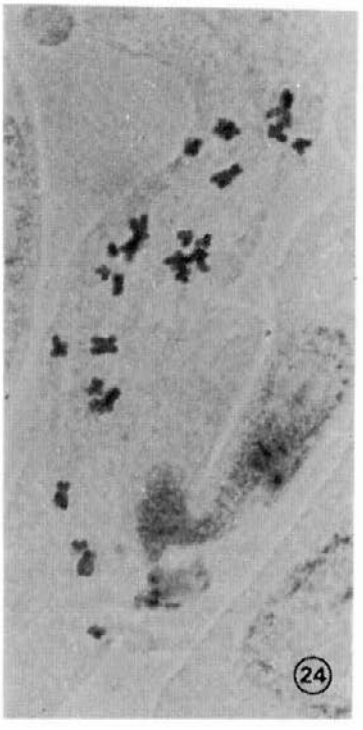


Fig. 22.—*L. intermedium*, 2*n* = 32. Fig. 23.—*L. furnarii*, 2*n* = 27. Fig. 24.—*L. minutiflorum*, 2*n* = 26. Fig. 25.—*L. pignattii*, 2*n* = 27.

lopadusanum, L. panormilanum) or tetraploid ones with $2n = 32$ *(L. intermedium)* and with $2n = 36$ *(L. mazarae, L. hyblaeum)*. They are circumscribed (Fig. 27) to the coast of the Channel of Sicily (except *L. panormitanum* which occurs in the Tyrrhenian slope) where they grow on coastal rocks or in the case of *L. intermedium* in the salt-marshes. They are all endemic with a very localized distribution.

Limonium cosyrense group — The species that belong to this group have very numerous sterile branches, internodes curved and fragile at nodes, lax spikes and spikelets that are generally quite small. Regarding the chromosome number, 3 species are diploid with $2n = 18$ *(L. bocconei, L. syracusanum, L. tenuiculum)*, two are triploid with $2n = 27$ *(L. cosyrense, L. flagellare)* and one is tetraploid with $2n = 36$ *(L. ponzoi)*. These species all have and endemic distribution; in particular, two of them *(L. bocconei* and *L. syracusanum)* are distributed along many kilometres of shoreline, while the remainder are very localized (Fig. 28). They colonize all the rocky coastal stations; among these 4 are exclusive of NW-Sicily including the Egadi Islands and Ustica, one occurs at Pantelleria and another one along the Ionian slope of S-Sicily.

L. densiflorum group — This group comprises hemicryptophytes with rosulate habit and with dense spikes. The diploid taxa are lacking; only triploid ones with $2n = 27$ *(L. halophilum, L. lilybaeum, L. selinuntinum, L. densiflorum)* and tetraploid ones with $2n = 36$ *(L. aegusae, L. secundirameum, L. pachynense)* are present. They occur especially in the salt-marshes and they rarely colonize sea rocks (for instance *L. selinuntinum*). They are localized exclusively along the coast of the Channel of Sicily (Fig. 29).

Besides, in Sicily there are also some endemic species quite isolated taxonomically (Fig. 30), as: *L. sibthorpianum,* which is triploid with $2n = 27$ and whose relationships have already been evidenced by BRULLO (1978); *L. calcarae* is a diploid species with $2n = 18$; *L. catanzaroi,* triploid species with $2n = 27$, which together with the previous, represents the only species of this genus which in Sicily grows in the inland steppe; *L. pignattii,* which is triploid with $2n = 27$ and it is known from W Sicily and Sardinia.

In Sicily, among the species with a wide mediterranean distribution occur: *L. oleifolium,* triploid species ($2n = 27$) represented in the island by the subsp. *oleifolium* which is widely distributed (Fig. 31) and by two endemic sub-species as subsp. *opulentum* exclusive of Porto Empedocle and subsp. *algusae* known only from Linosa; *L. exaristatum* with $2n = 26$, in Sicily (Fig. 30) up to now known from Lampedusa and from Isola Grande dello Stagnone (for its relationships and its general distribution see MURBECK, 1889); *L. sinuatum* is a diploid species with $2n = 16$ and it is the sole representative in Sicily of the Subgen. *Pteroclados,* is especially diffused in the Iblean territory (Fig. 32); *L. ferulaceum,* diploid species ($2n = 16$) of the Subgen. *Myriolepis,* in Sicily is exclusive of the salt-marshes near Trapani and Marsala (Fig. 32); *L. serotinum,* tetraploid species ($2n = 36$) frequent along the Western and South-Eastern coasts of the Island, whilst it is absent in the neighbouring Sicilian islets (Fig. 32).

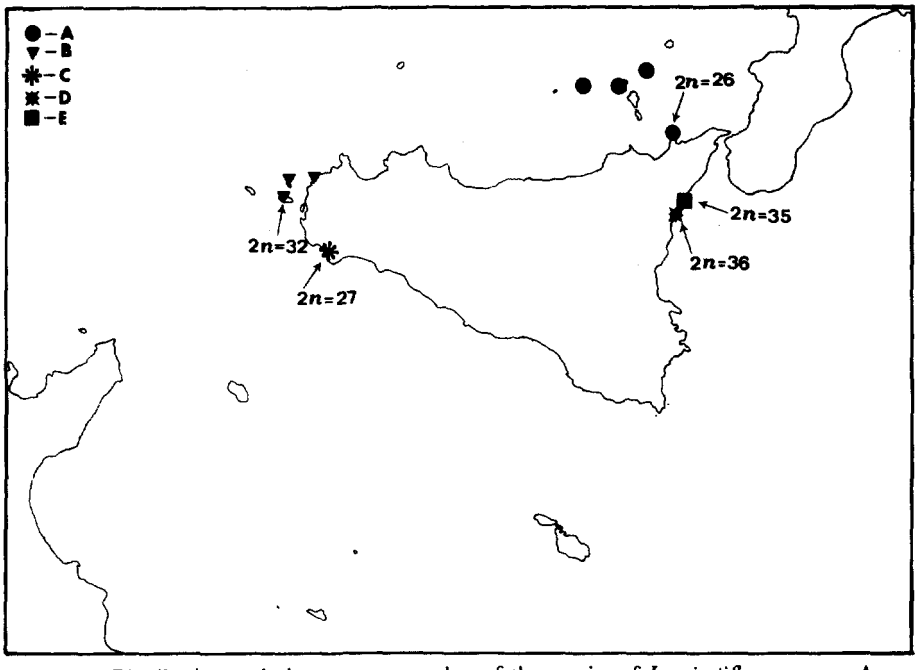


Fig. 26.—Distribution and chromosome number of the species of *L. minutiflorum* group. A.—*L. minutiflorum*, B.—*L. lojaconi*, C.—*L. furnarii*, D.—*L. tauromenitanum*, E.—*L. ionicum*.

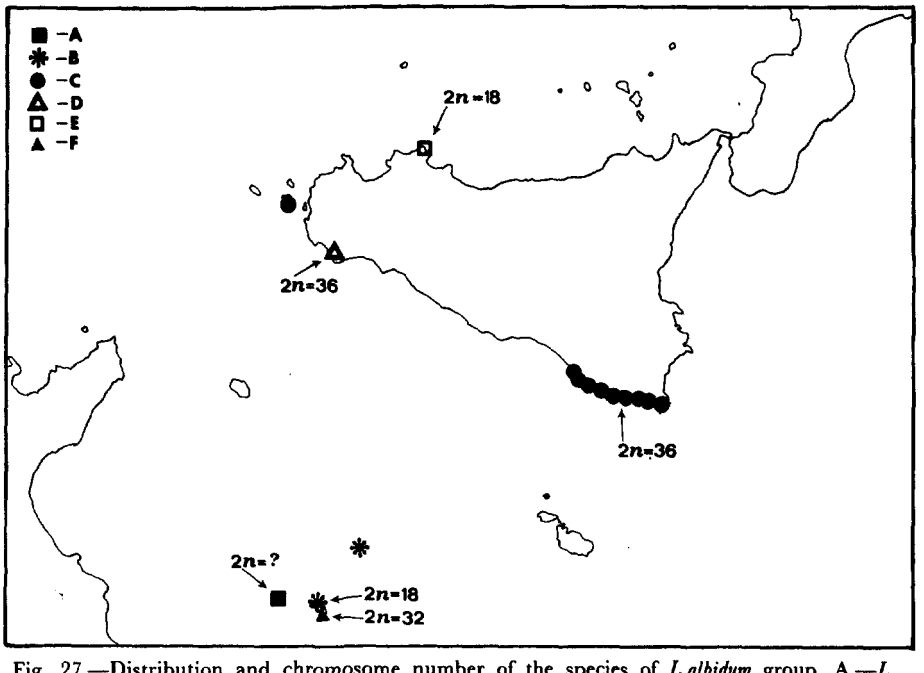


Fig. 27.—Distribution and chromosome number of the species of *L.albidum* group. A.—*L. albidum*, B.—*L. lopadusanum*, C.—*L. hyblaeum*, D.—*L. mazarae*, E.—*L. panormitanum*, F.—*L. intermedium*.

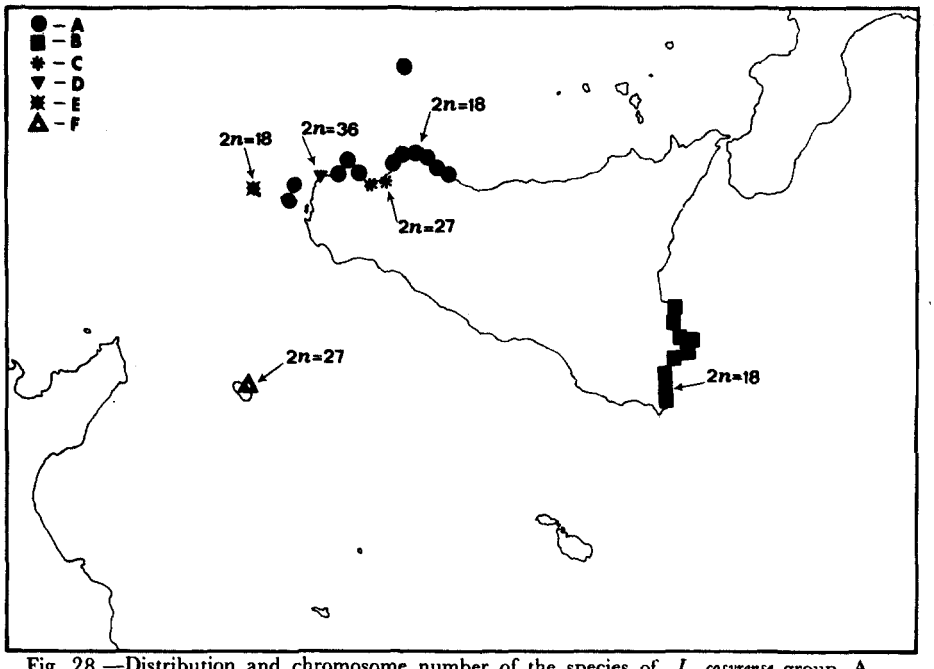


Fig. 28.—Distribution and chromosome number of the species of *L. cosyrense* group. A.—*L. bocconei*, B.—*L. syracusanum*, C.—*L. flagellare*, D.—*L.ponzoi*, E.—*L. tenuiculum*, F.—*L. cosyrense*.

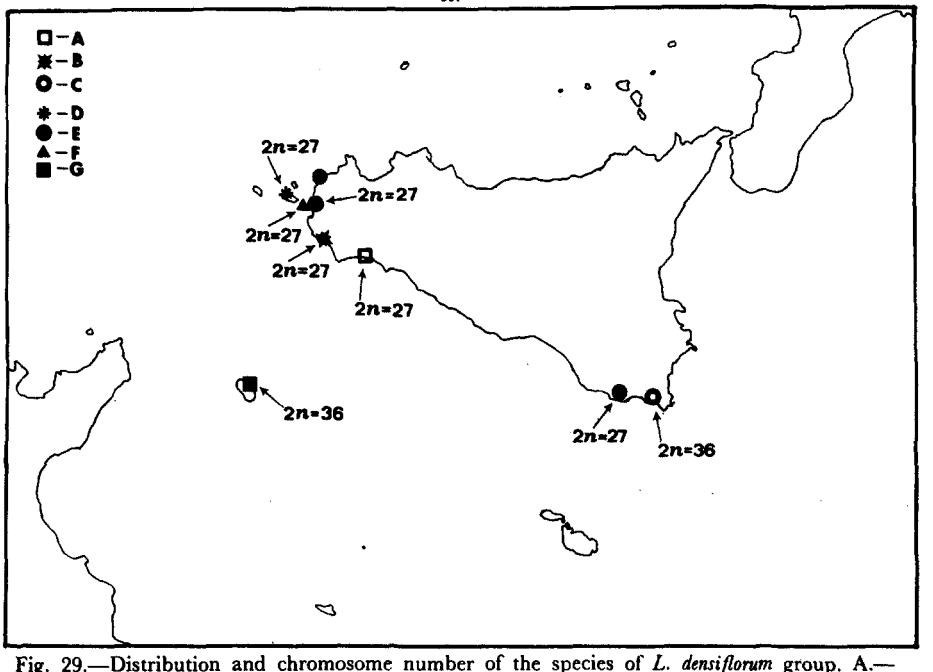


Fig. 29.—Distribution and chromosome number of the species of *L. densiflorum* group. A.—*L. selinuntinum*, B.—*L. halophilum*, C.—*L. pachynene*, D.—*L. aegusae*, E.—*L. desiflorum*, F.—*L. lilybaeum*, G.—*L. secundirameum*.

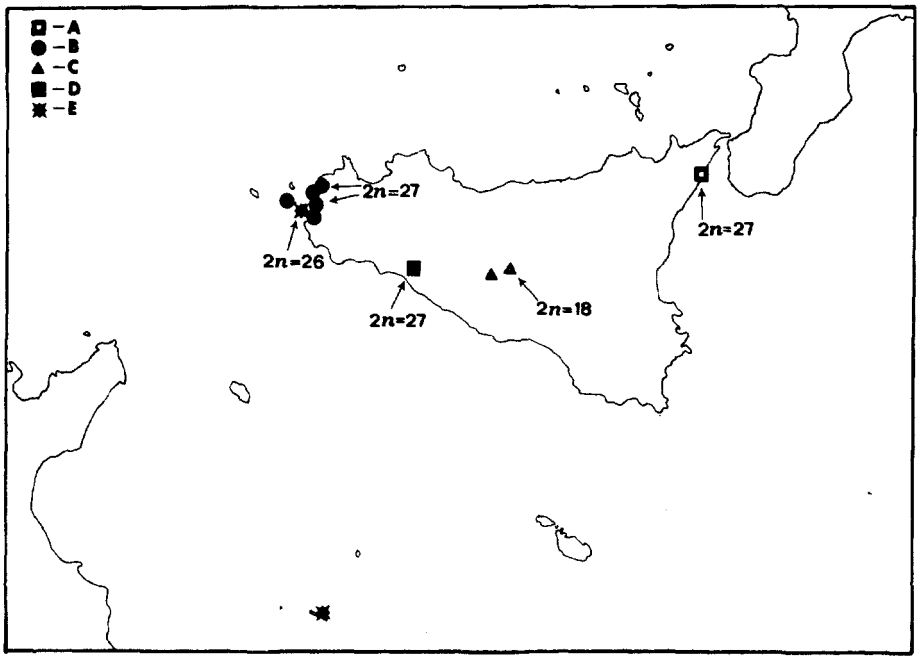


Fig. 30.—Local distribution and chromosome number of *L. sibthorpianum* (A), *L. pignattii* (B), *L. calcarae* (C), *L. catanzaroi* (D), *L. exaristatum* (E).

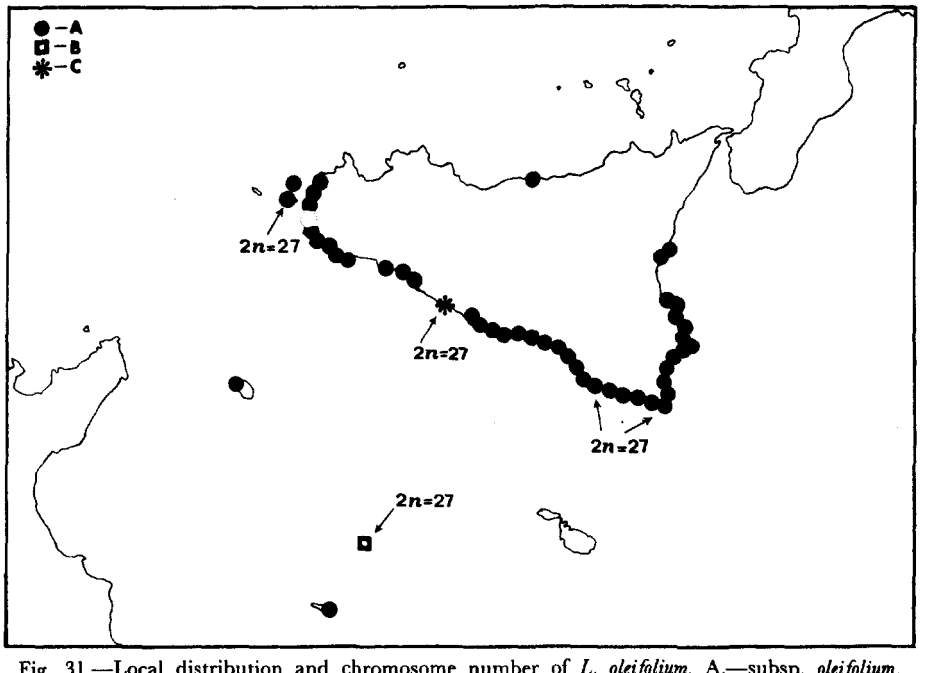


Fig. 31.—Local distribution and chromosome number of *L. oleifolium*. A.—subsp. *oleifolium*, B.—subsp. *algusae*, C.—subsp. *opulentum*.

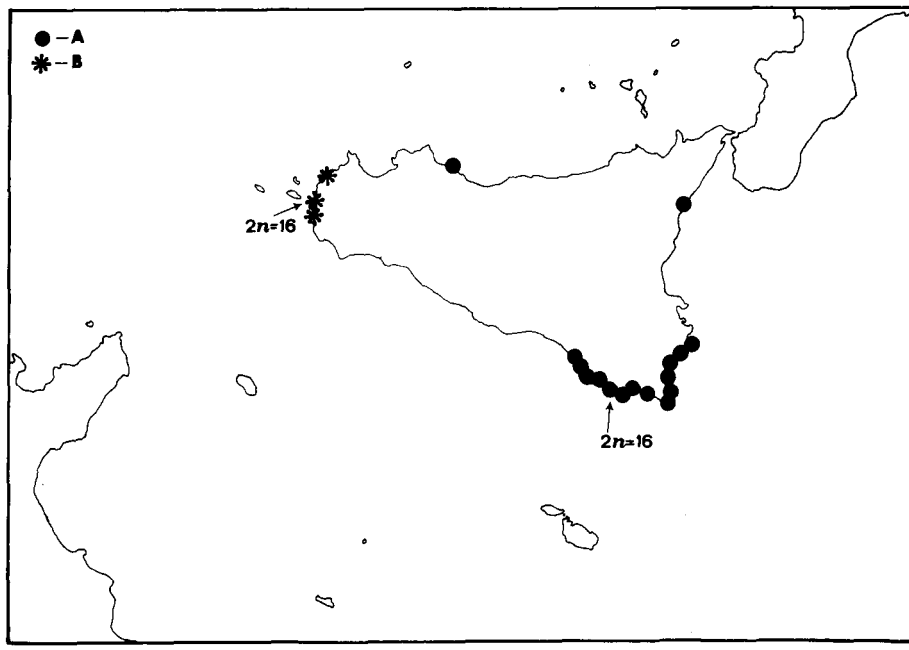


Fig. 32.—Local distribution and chromosome number of *L. sinuatum* (A) and *L. ferulaceum* (B).

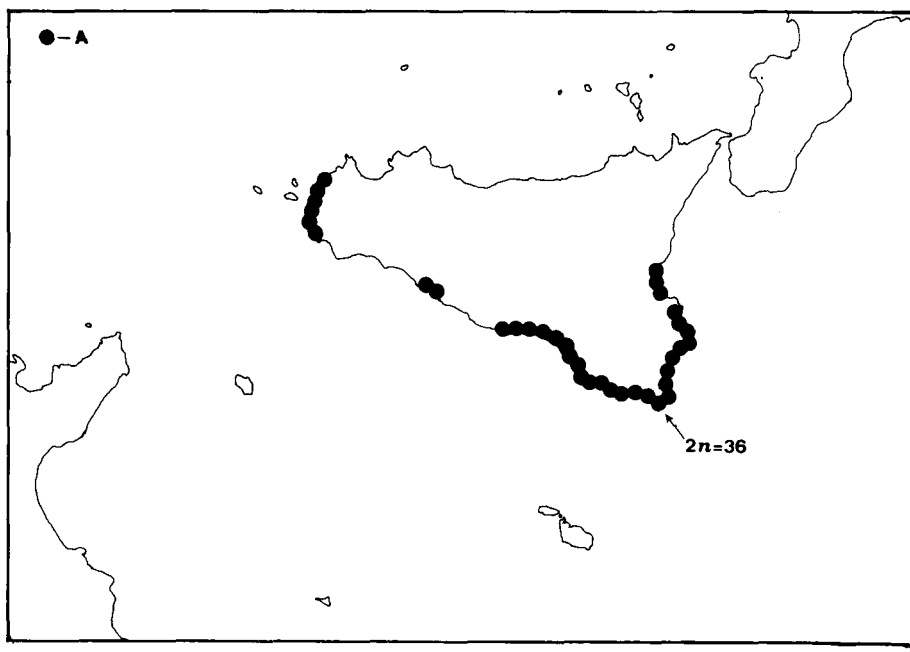


Fig. 33.—Local distribution and chromosome number of *L. serotinum*.

ECOLOGICAL CONSIDERATIONS

Regarding the phytosociological position of the species examined caryologically, a synthetic table is presented (see Table 2). The majority of the species are localized on coastal rocks where they characterize plant communities of the *Chrithmo-Limonietea*. These species, which present gene-

TABLE 2

PHYTOSOCIOLOGICAL POSITION OF *LIMONIUM* SPECIES IN SICILY.
A.—*CRITHMO-LIMONIETEA*; B.—*SALICORNIETEA FRUTICOSAE*; C.—*LYGEO-STIPETALIA*; D.—*PEGANO-SALSOLETEA*; E.—*ASPLENIETEA RUPESTRIS*.

Taxon	*A*	*B*	*C*	*D*	*E*
L. sinuatum			●		
L. ferulaceum		●			
L. serotinum		●			
L. calcarae			●		
L. cosyrense	●				
L. bocconei	●				
L. ponzoi	●				
L. flagellare	●				
L. syracusanum	●				
L. tenuiculum	●				
L. pignattii	●	●			
L. catanzaroi				●	
L. minutiflorum	●				
L. lojaconi	●				
L. tauromenitanum	●				
L. ionicum	●				
L. furnarii	●				
L. lopadusanum	●				
L. hyblaeum	●				
L. mazarae	●				
L. panormitanum					●
L. intermedium		●			
L. oleifolium subsp. oleifolium	●	●			
L. oleifolium subsp. algusae	●				
L. oleifolium subsp. opulentum				●	
L. halophilum		●			
L. secundirameum	●				
L. lilybaeum		●			
L. selinuntinum	●				
L. aegusae		●			
L. pachynense		●			
L. densiflorum	●	●			
L. sibthorpianum					●
L. exaristatum		●			

rally a chamaephytic habit, have a marked pioneer character and therefore they adapt themselves well to conditions of high aridity and salinity of the soil. Sometimes, they characterize particular associations as *Limonietum bocconei* described by BARBAGALLO & *al.* (1979) from the coasts of NW-Sicily, *Limonietum cosyrensis* and *Limonietum secundiramei* described by BRULLO & *al.* (1977) from Pantelleria.

Another quite numerous group is represented by the species linked to salt-marshes where they characterize associations included in the *Salicornietea.* Among these, some have a more or less wide diffusion (for instance *L. serotinum*), others are very localized an they appear to be more specialized in ecological needs. Among these *L. ferulaceum, L. exaristatum, L. intermedium, L. lilybaeum* are exclusive of very salty and arid soils as the ones occupied by the associations of the *Limonietalia,* whilst *L. pachynense, L. aegusae, L. halophilum* prefer less salty and damper soils and, in fact, they only occur in the associations of the *Salicornietalia.* Besides, there are some species that have a wider ecological as *L. oleifolium* subsp. *oleifolium, L. pignattii, L. densiflorum* which are present on the rocky coast as well as in the salt-marshes.

L. panormitanum and *L. sibthorpianum* are localized on cliffs where they participate in the formation of the rupestrian associations of the *Asplenietea rupestris.* In fact, the former is indicated by BRULLO & MARCENO (1979) as differential of subass. *helichrysetosum straminei* of the *Scabioso-Centauretum ucriae,* and the latter of an homonymous subassociation of the *Eucastretum virgati.*

Other species are exclusive of the xeric steppes linked to subhalophilous habitats as *L. calcarae* and *L. sinuatum* which characterize associations of the *Lygeo-Stipetalia* or as *L. catanzaroi* and *L. oleifolium* subsp. *opulentum* that characterize communities of the *Pegano-Salsoletea.*

CONCLUSION

In consideration of the distribution of the endemic taxa with regard to the ploidy level, one observes what follows.

The diploid species (Fig. 34) are all rupicolous (except for *L. calcarae*) and are localized on the rocks geologically among the oldest of the island as Mesozoic and Miocenic limestones. According to DOLCHER & PIGNATTI (1971) because of their suffruticose habit and their quite reduced distribution, they are probably the oldest species of *Limonium* among those present in Sicily.

Regarding the tetraploid species (Fig. 35), they occur in the stations that are geologically more recent than those occupied by the diploids. They occur in the coastal rocks as well as the salt-marshes. They could have originated from diploid parents through allopolyploidy phenomena (as for example the euploid taxa with $2n = 32$ and $2n = 36$) or, according to ERBEN (*l.c.*) through hybridization between a diploid and a triploid taxon owing to a fertilization of an aploid gamate with an unredu-

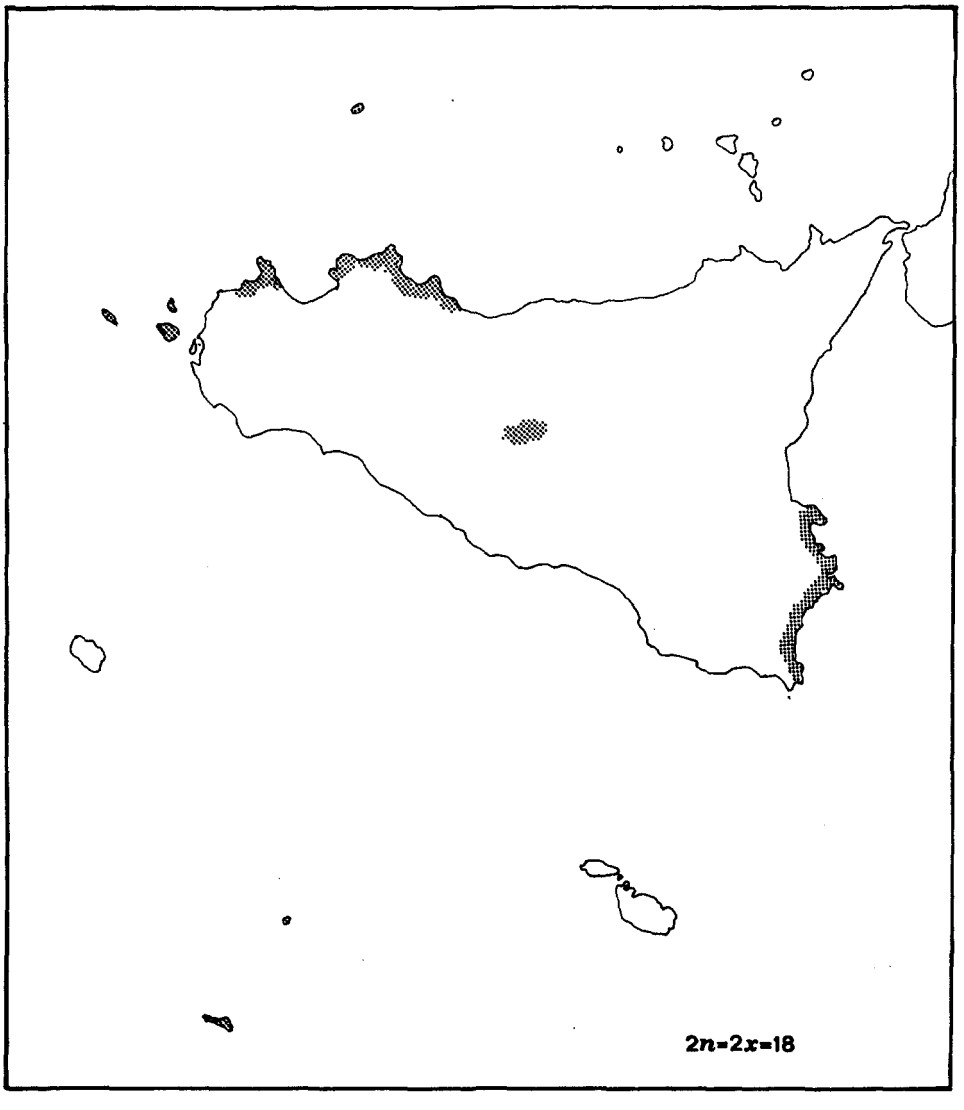


Fig. 34.—Areas in which the diploid endemic species occur.

Fig. 35.—Areas in which the tetraploid endemic species occur.

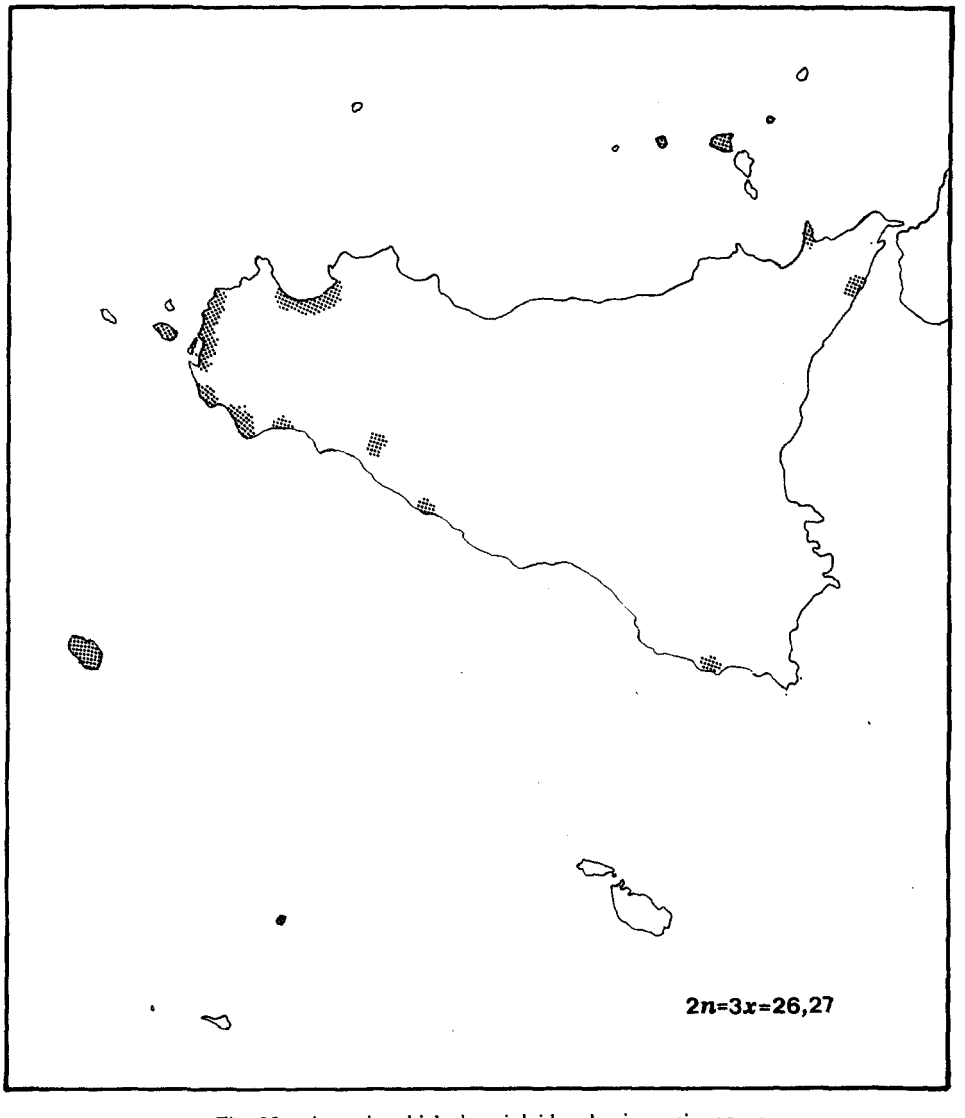


Fig. 36.—Areas in which the triploid endemic species occur.

ced triploid gamete (as for example in the aneuploid taxa with $2n = 34$ and $2n = 35$).

The triploid species (Fig. 36) grow especially on the substrates of recent formation, as lacustrian and alluvial sediments, volcanic rocks and calcarenites all of a post-Pliocene origin. According to ERBEN *(l.c.)*, the triploid taxa have most probably originated through the hybridization of two diploid parents from the fertilization of an aploid gamate with an unreduced diploid gamete; however, one must not exclude the hypothesis advanced by DOLCHER & PIGNATTI (*l.c.*) that some of them may have had origin from the hybridization between a diploid and a tetraploid taxon.

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