The genus *Halopeplis* Ung.-Sternb. *(Salicorniaceae)* in the Iberian Peninsula

CÈSAR BLANCHÉ & JULIÀ MOLERO

Abstract

BLANCHÉ, CÈSAR & JULIÀ MOLERO (1987) The genus *Halopeplis* Ung.-Sternb. *(Salicorniaceae)* in the Iberian Peninsula. Collect. Bot. (Barcelona) 17(1): 67-77.

New data on anatomy, biology, seed morphology, ecology and nomenclature of *Halopeplis amplexicaulis* (Vahl) Cesati & al. are presented; this species is the only Iberian representative of the genus *Halopeplis* Ung.-Sternb. *(Salicorniaceae).* For the first time the whole genus pollen structure is described and chromosome number is reported.

Keywords: *Salicorniaceae, Halopeplis,* Cariology, Palinology, Morphology, Anatomy, Taxonomy.

Resumen

BLANCHÉ, CÈSAR & JULIÀ MOLERO (1987) El género *Halopeplis* Ung.-Sternb. *(Salicorniaceae)* en la Península Ibérica. Collect. Bot. (Barcelona) 17(1): 67-77.

Se aportan nuevos datos sobre la anatomía, ciclo biológico, morfología de la semilla, ecología y nomenclatura de *Halopeplis amplexicaulis* (Vahl) Cesati & al., único representante del género *Halopeplis* Ung.-Sternb. *(Salicorniaceae)* en la Península Ibérica. Se describe el polen y se estudia el número cromosómico por primera vez en el género.

Palabras clave: *Salicorniaceae, Halopeplis,* Cariología, Palinología, Morfología, Anatomía, Taxonomía.

INTRODUCTION

The genus *Halopeplis* Ung.-Sternb. comprises three species: *H. amplexicaulis* (Vahl) Cesati & al., *H. perfoliata* (Forssk.) Schwinf & Ascherson and *H. pygmaea* (Pall.) Ung.-Sternb. The last two are represented in the Eastern Mediterranean and the Caucasus while only the first is present in the Iberian Peninsula (JALAS & SUOMINEN, 1980; GREUTER, BURDET & LONG, 1984).

Though *H. amplexicaulis* was reported in the Iberian Peninsula very early by WILLKOMM (1852), it is a relatively little known taxon which is difficult to identify when discovered in a new

C. BLANCHÉ & J. MOLERO: Departament de Botànica, Facultat de Farmàcia, Universitat de Barcelona. 08028 Barcelona.

locality, (cf. A. DE BOLÒS, 1957). In this study we present some data on its anatomy, palinology, seed micromorphology and cariology, as well on its nomenclature and typification.

MATERIAL AND METHODS

The material studied comes from the herbarium samples listed in the section on chorology. The studies on live material are based on samples we collected in two localities in the Monegros area (ZARAGOZA: Alborge, Salada del Rebollón, 30T YL 28; ZARAGOZA: Bujaraloz, Laguna del Guallar, 30 TYL 38), evidence of which is kept in the herbarium BCF.

Prior to undertaking a palynological study with the optical microscope, we carried out acetolysis using the micromethod described by SÁENZ (1978: 52) and counting 30 grains of pollen for each population. For the purposes of observing fresh pollen and ripe seeds with the scanning electron microscope (S.E.M.), the samples were metallized with gold using a Diode-Sputtering E-5000 device and photographs at 15-20 kV were taken with a Cambridge Instruments Stereoscan S-180 microscope from the Institut d'Investigacions Pesqueres de Barcelona (CSIC).

The anatomical study was performed on samples previously fixed in the field with F.A.A. Sections about 5 µm thick were produced with a Reichert microtome and dyed using iodine green red and ruthenium red.

For the cariological study the samples were fixed with glacial acetic acid-absolute ethanol (3:1), then coloured through boiling in acetic carmine for five minutes and prepared by the squash method.

PALYNOLOGY

H. amplexicaulis presents pantopored grains of pollen, roughly spherical in shape (P/E = 1) and of a size which varies between 16 and 21 µm ($m \pm ES = 18{,}33 \pm 0{,}11$ µm). The openings consist of 24-26 (30) pores, approximately 2,5 µm in diameter (fig. 1-D). The exine is about 1 mm thick, and shows ornamentation, visible on the S.E.M. (fig. 1-C), in the form of small granulations not exceding 0,1 µm. These are spread fairly regularly over the entire surface but are more abundant and dense in the pores.

The pollen belongs to *Chenopodiaceae* s.l., both because of its shape (nearly spherical) and its class (pantopored). The two populations studied are homogeneous in terms of their size which presents a typically Gaussian distribution.

The pollen of *H. amplexicaulis* is considerably smaller than that of most species of *Chenopodium* (UOTILA, 1974) and it differs from them by the smaller number of pores as well as the thickness of the exine and its ornamentation, which is much more visible in *Chenopodium*. The grains are also smaller than those of *Salicornia* (BALL & BROWN, 1970), *Salsola* (PLA DALMAU, 1957; FAEGRI & IVERSEN, 1975) and *Microcnemum* (MOLERO, 1986).

SEEDS

Subreniform, $0{,}5 \times 0{,}8$ mm, slightly flattened on the sides. Brilliant, translucid brownish episperm. Comma-shaped embryo enveloped in abundant starchy endosperm, in an anatropous position. Under the S.E.M. the seeds are seen to be partially covered with saline efflorescences. With respect to ornamentation, the lower and upper ventral region appears smooth or slightly rough (fig. 1-A), while in the dorsal region there are digitiform invaginated

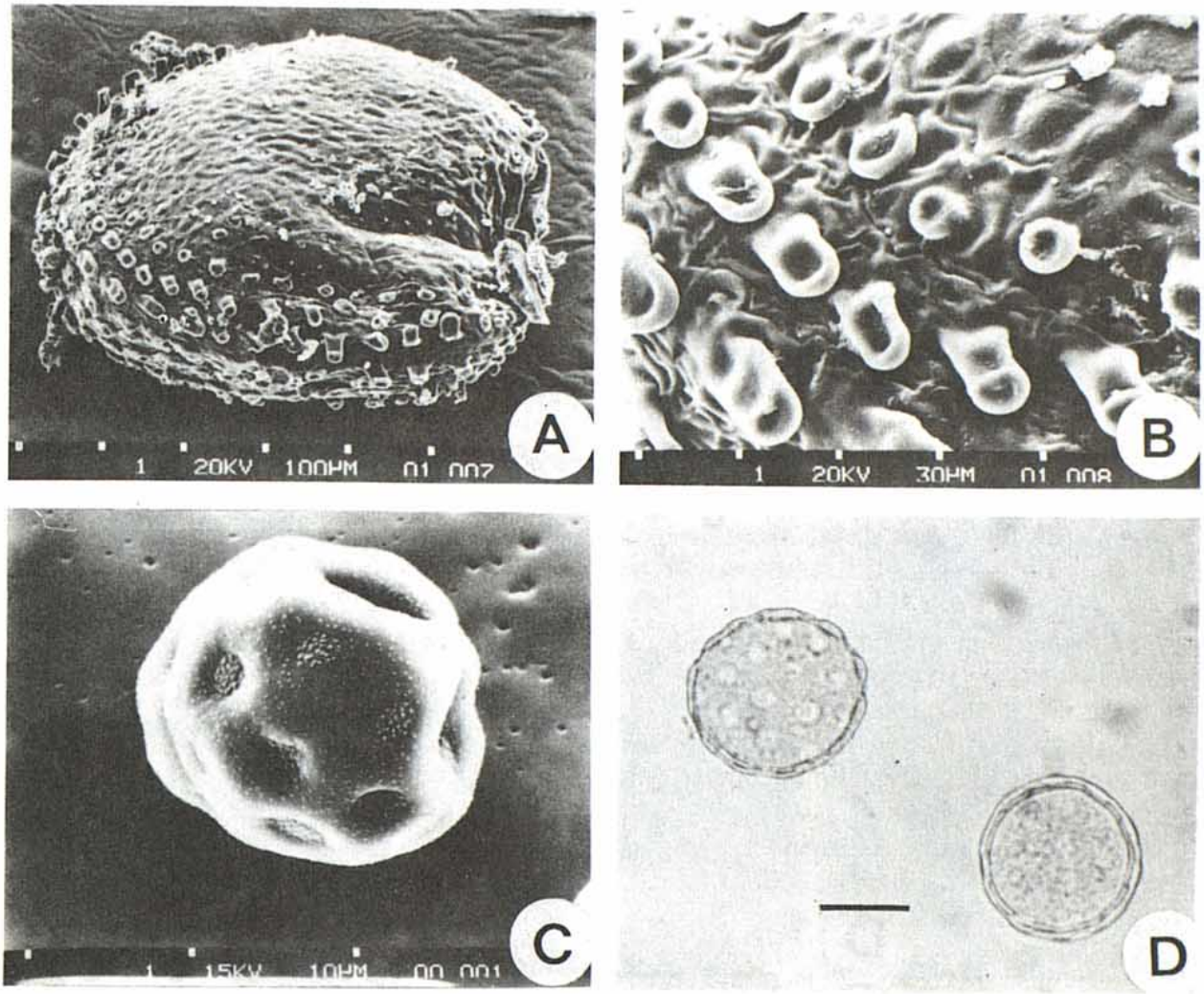

Fig. 1.— *H. amplexicaulis:* **a)** General view of the seed under the S.E.M.; **b)** Detail of the dorsal papillae of the seed under the S.E.M.; **c)** General view of the pollen under the S.E.M.; **d)** General view of the pollen under the O.M. (the line corresponds to 10 µm).

or evaginated papillae, arranged in long parallel rows. The papillae protrude from the central zone of the dorsal integument which has indented walls (fig. 1-B).

Compared with other Iberian *Salicorniaceae,* the seeds of *H. amplexicaulis* differ from those of *Microcnemum* and *Arthrocnemum* by their brownish colour and from those of *Sarcocornia* by the absence of circinated hairs and long papillae in the dorsal region. They most closely resemble the grains of *Salicornia* but can be distinguished from them because the episperm of the albumen region is quite smooth, while in *Salicornia* this zone bears clearly visible rough patches (CASTROVIEJO & COELLO, 1980).

ANATOMY

Leaf: Epidermis with a large number of stomata on both the front and back. Epidermic cells with walls that are not indented, roughly polygonal in shape (fig. 2-D). 2-4 undifferentiated neighbouring cells defining anomocytic stomata and a smaller number of paracytic stomata. The assimilatory system of the leaf is located close to the lower epidermis which, on account of the special morphology of the leaf, is situated on the outer side. The cross section shows a cutinized epidermis, a palisade-like tissue with two rows of cells and peculiarly

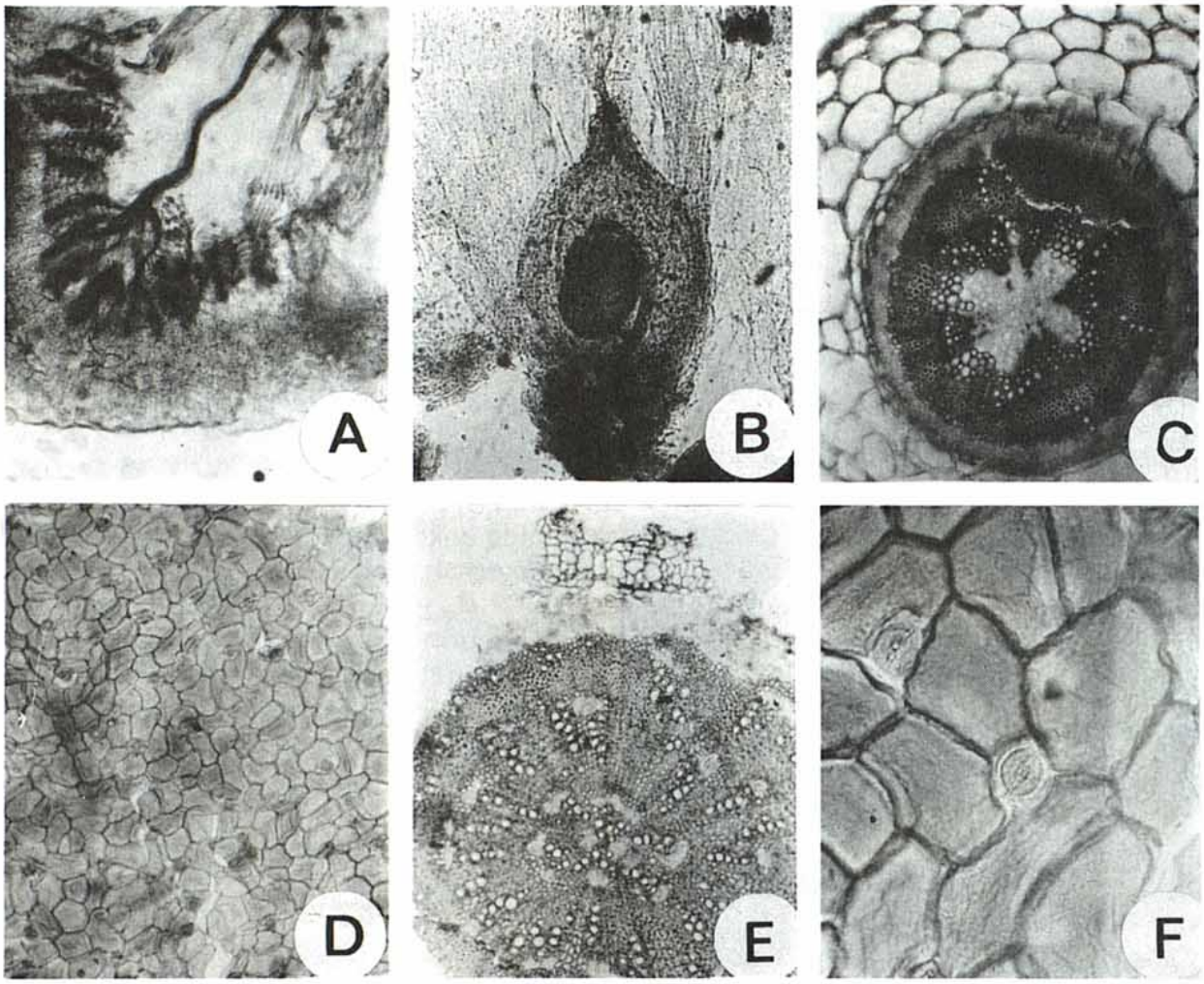

Fig. 2.– *H. amplexicaulis:* **a)** Arborescent bundles of the leaf (x 100); **b)** Ovary with ovule in anatropous position (x 100); **c)** Cross section of the stem (x 100); **d)** General view of the epidermis (x 100); **e)** Cross section of the root (x 100); **f)** Detail of an epidermic fragment with anomocytic and paracytic stomata (x 400).

arranged vascular bundles which make up a single common bundle devoid of branches up to the terminal regions, where it presents a typical arborescent pattern (fig. 2-A).

Stem: Cross section made close to the root showing an integument system with cutinized epidermis, cortical parenchyma made up of large cells, with meatuses becoming more plentiful towards the central cylinder which occupies approximately half the radius of the section. After this there appears a discontinuous zone of pericyclical fibres, consisting of large calibre isolated fibres with an oval cross section, which are succeeded by a broader, woody zone with vessels arranged in the shape of a "U" and abundant fibres. It is important to note that inside the xylem there are anomalous formations consisting of small bundles of secundary woody phloem, which, in an annual plant, is unusual to say the least. This phenomenon is, however, described by METCALFE & CHALK (1979) in connection with certain *Chenopodiaceae* and *Amaranthaceae,* and is believed to be caused by a series of pericyclic cambiums situated in more or less concentric zones. Finally, the central medulla gives the bundle a pentangular configuration (fig. 2-C).

Root: The cross section reveals a very narrow cortical zone and a large central cylinder. The latter contains colateral bundles spread about in conjunctive tissue made up of highly

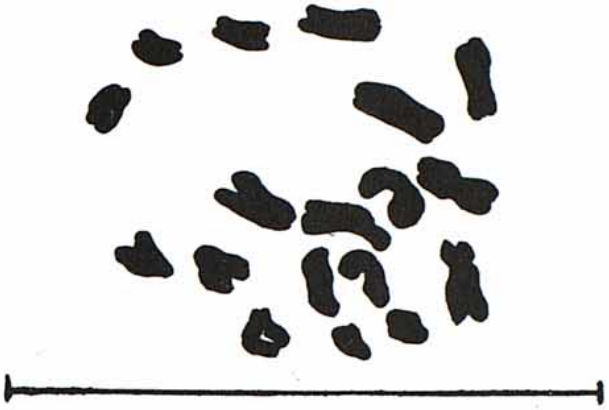

Fig. 3.– Somatic metaphase of *H. amplexicaulis* with 2n=18 chromosomes (Zaragoza: Bujaraloz, Salada del Guallar). The line corresponds to 10 µm.

lignified polygon-shaped fibres. These bundles tend to arrange themselves in concentric circles (fig. 2E). Absence of medullar rays and of medulla. Integument system formed by various layers of roughly polygonal cells, suberificated in character. Rhizodermis also suberificated.

The existence of this type of "primary cortex" is interpreted by METCALFE & CHALK (l. c.) as an impenetrable barrier of great physiological interest for xerophytes since in provides efficient isolation from the surrounding environment. Thickenings of this type, called "casparian thickenings" by some authors, are reported in certain desert plants in the Negev desert in Israel (GINSBURG 1966): *Anabasis, Arthrocnemum, Chenolea, Hammada, Noaea, Salsola, Seidlitzia* and *Suaeda,* among the *Chenopodiaceae* s. l., as well as other families – *(Asteraceae, Caryophyllaceae, Brassicaceae, Cucurbitaceae, Fabaceae, Polygonaceae, Plumbaginaceae, Resedaceae,Tamaricaceae* and *Zygophyllaceae).* METCALFE & CHALK (l. c.) find the same structures in various plants growing in aquatic habitats or marshlands.

CHROMOSOME NUMBER

ZARAGOZA: Laguna del Guallar, 5-VII-1984, leg. *Benedí, Blanchè, Molero & Vallès.* BCF. 2n=18 (fig. 3).

Metaphases obtained from staminal threads showing small chromosomes measuring approximately (0,8)1 – 1,2(1,5) µm.

We have found no reference in the literature of previous chromosome counts, either for *H. amplexicaulis* or for any of the other species. We believe, therefore, that this is the first cariological study of the genus to be conducted. The chromosome number obtained fits the basic number x=9 which is common to the rest of *Salicorniaceae.* The diploid level of 2n=18 coincides with that of Iberian annual species from the same family: *Microcnemum coralloides* and *Salicornia ramosissima* (CASTROVIEJO & COELLO, 1980).

BIOLOGICAL CYCLE

In the localities studied, once the seeds have fallen from the plant, they remain on the ground until environmental conditions are conducive to growth (one or more years). After a rainy spring, when the playa-lakes or *"saladas"* where *H. amplexicaulis* lives are mostly full, rapid vegetative growth takes place and, in mid-June or July, the plant begins to flower. The intense summer heat exhausts the plant altogether. It begins to dry up from the bottom, while the seeds ripen through sheer *élan vital.* By August and September only shrivelled skeletons

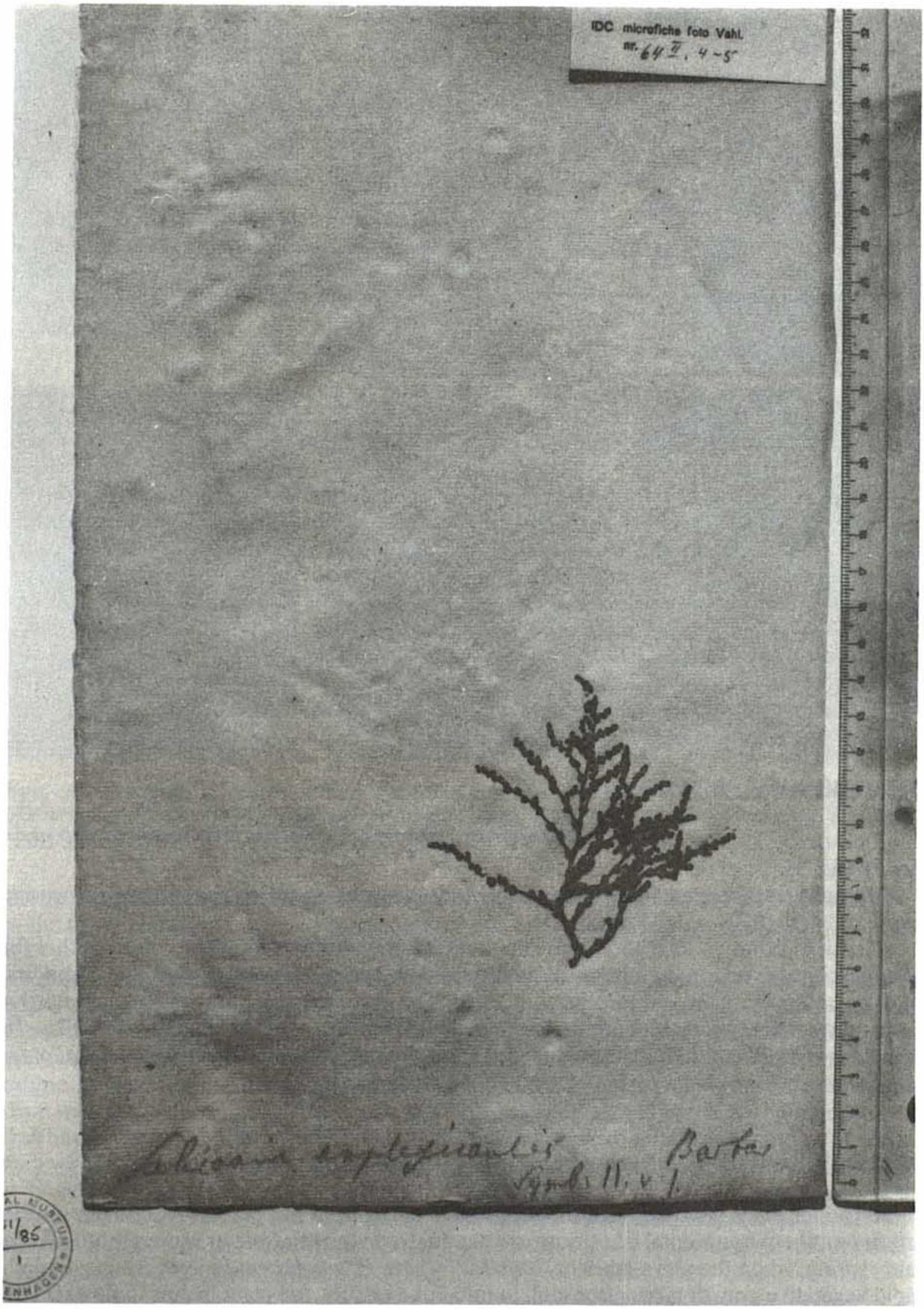

Fig. 4.– Holotype of *Salicornia amplexicaulis* Vahl (C, ex herb. Vahl).

Fig. 5.– Lectotype of *Salicornia nodulosa* Delile (MPU, ex herb. Delile).

remain. Thus the whole life cycle takes 3-4 months and, in years of late frosts and dry summers –not an uncommon occurrence in continental playa-lakes– it can be even shorter.

Turning now to the biology of reproduction, we observed a gradual ripening of the flowers, following a spiral-shaped model which begins at the base of each shoot. Proterandria occurs within individual flowers (fig. 5-g). Anthesis begins with the appearance of three small pores at the axil of the hypsophylla through which the laterally deshiscent stamina emerge. After they have bent and withered, the bifid stigma appears, already in a receptive condition. In view of the dense, compact colonies in which the individual plants are found, it is likely that the pollen is carried a short distance by the wind.

ECOLOGY

H. amplexicaulis colonizes the innermost band of the haloseries established in small endorheic or undrained ponds "(playa-lakes)". On account of their special edaphic and water requirements, only a few specialized halophyte taxa, which in any case play an unimportant part in the colony as a whole, are to be found in these stations. Thus *H. amplexicaulis* is seen to form dense, almost monophytic populations, 10-15 cm in height which, when the rainfall is sufficient, can occupy quite large areas (up to 100 m^2). Regarding phytocoenology, in localities in the Monegros it is the dominant and most characteristic species of *Halopeplidetum amplexicaulis* Burollet 1927 subass. *salicornietosum ramosissimae,* of *Salcornion ramisissimae* (BLANCHÉ & MOLERO, 1986). In the Fuente Piedra pond (Málaga) it also occupies a leading position in the haloseries but alongside other nitrohalophilous taxa and as part of *Parapholi-Frankenietum pulverulentae* Rivas Martínez subass. *halopeplidetosum amplexicaulis* (ASENSI & NIETO, 1981).

In other non-continental locations in the Iberian peninsula (the Cadiz and Algarve coasts), we have no information about its phytocoenological behaviour. Its habitats, however, ("in paludosis maritimis", WILLKOMM & LANGE, 1870) suggest the presence of other accompanying species in formations more closely related to *Halopeplidetum amplexicaulis* subass. *salicornietosum emerici* (BLANCHÉ & MOLERO, l.c.).

TAXONOMY AND NOMENCLATURE

Halopeplis amplexicaulis (Vahl) Cesati, Passerini & Gibelli, Comp. Fl. Ital. 271 (1874).
≡ *Salicornia amplexicaulis* Vahl. Symb. Bot. 2:1, 1791.

TYPE: "Habitat ad littora lacus prope Bardo Tuneti". LECTOTYPE: Herbarium sheet with a single specimen and an inscription in pencil: "*Salicornia amplexicaulis.* Barba / Symb. II v. I."

C, ex Herb. Vahl (fig. 4).

= *Haloplepis nodulosa* (Delile) Bunge, Linnaea 28: 573, 1856.
≡ *Salicornia nodulosa* Delile, Fl. Egypt. 3, 1813.

TYPE: "à Alexandrie, où nous l'avions trouvée une seule fois assez abondamment dans un des fossés de la ville, près du port vieux, au mois d'août 1798". LECTOPYPE: Herbarium sheet with a single specimen bearing two labels, a) and b):

a) Salicornia - - - 6) ex locis - - - - / salsuginosis indutum / nota, demid- et / une salicorn a Egypte / mais à les feuilles plus / oppossées et a les nombreuses en / les épis - - - - / blanc de - - - - / (manuscript, Delile).

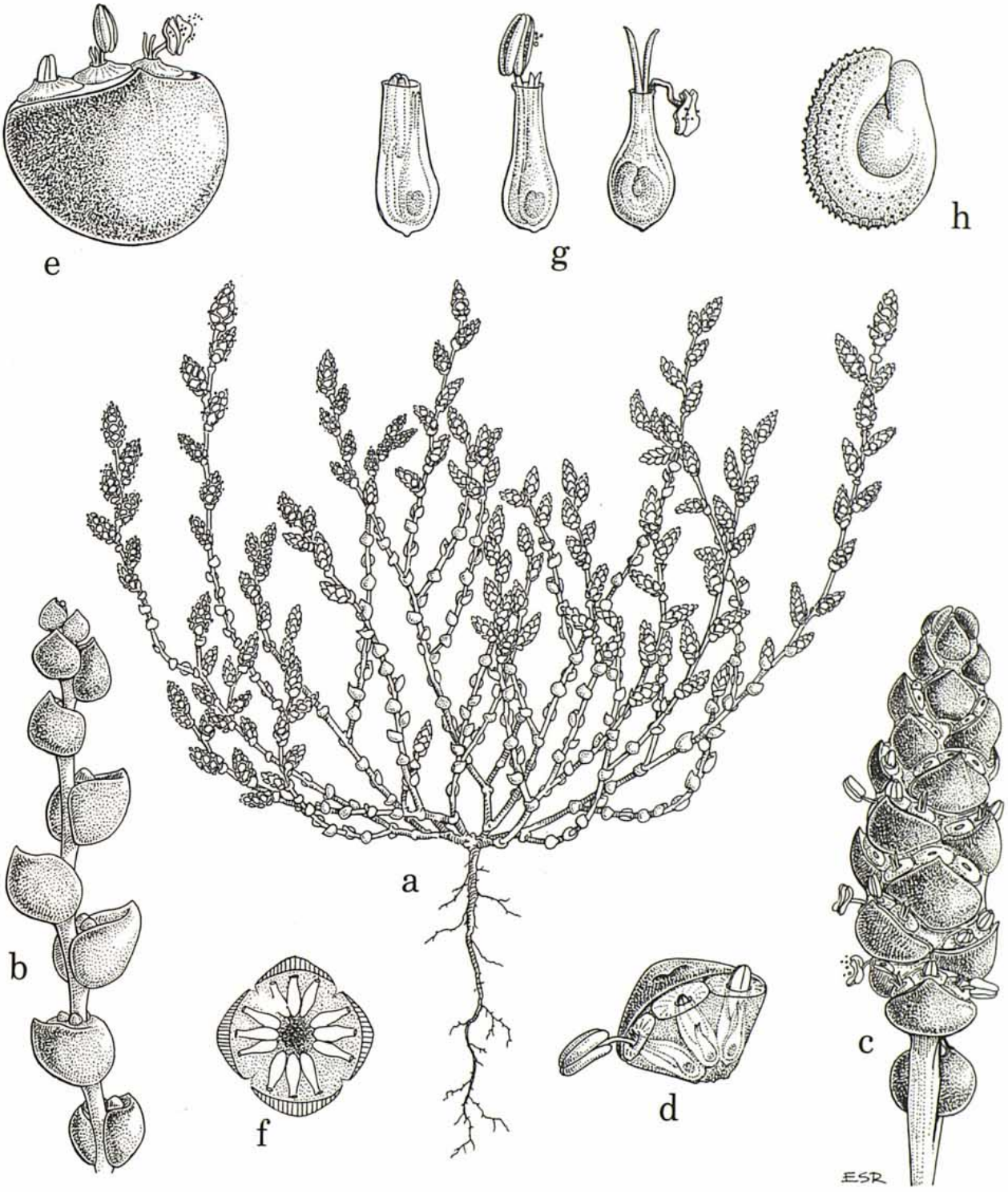

Fig. 6.– Iconography of *H. amplexicaulis* (Bujaraloz, Salada de Guallar). **a)** Habit; **b)** Vegetative branch (x 4); **c)** Flower-bearing branch (x 4); **e)** Hypsophyll with three flowers, outside view (x 9); **f)** Cross section of the axis of the inflorescence with four triflorous tips; **g)** Gradual ripening of the flowers (x 16); **h)** Seed (x 32).

b) Salicornia // à Alexandrie dans la fossée près des murs de la ville des Arabes vers le cimitière du port vieux / (manuscript, Delile).

MPU, ex herb/. Delile (fig. 4).

= *Halostachys perfoliata* sensu Willkomm & Lange, Prodr. Fl. Hisp., 1: 262 (1870), non Moq.

DESCRIPTION

Therophyte, 5-20 (30) cm high. Thin axonomorphous root, (3)5-7(10) cm long. Glabrous plant, usually glaucous and pruinose, which can take a greenish, violet, greyish, reddish or even yellowish color when dried. Herbaceous, erect or decumbent; fleshy, smooth stems, ramificated from the base with two patent branches, which in turn divide into smaller units starting from the axil of the nomophylls. The top branches have numerous flower-bearing spikes arranged spirally, of fleshy consistency, 0,5-2 cm long excluding the terminal spikes which are up to 4 cm in length. Very fleshy alternating leaves, 0,2-0,4 cm long; semi-amplexicaul, subglobous, truncated hemispheric nomophyls; much more markedly apiculate hypsophyls: internodes (0,3) 0,5-1 (1,2) cm in length, longer than the leaves. Inflorescence on trimerous sessile tips, resting on a floral bract, fleshy like the *nomophylls.* Monoecious plant with flowers arranged radially inside the excavated flower-bearing cavity on the bract itself, which is contiguous to surrounding bracts. Flowers with tube-shaped membraneous hyaline perianth, ca. 1 mm long, slightly tridentate at the tip. One bitesic stamen, protuding from the side of the bottom third of the ovary, with yellow, exert, oblong, linear anthers. One pear-shaped ovary, slightly flattened on the side, with short style and two stigmas longer than the ovary, cut off at the tip.

CHOROLOGY

H. amplexicaulis is widespread throughout the Mediterranean (Portugal, Spain, Sardinia, Sicily, Italy, Bulgaria, Asiatic Turkey, Cyprus, Lebanon, Syria, Israel, Jordan, Egypt, Libya, Tunisia, Algeria and Morocco (GREUTER, & al. 1984). It is known in the Iberian Peninsula in the following localities identified by province and by UTM grid references:

Hs:
Alicante:
30SXH9829 Dolores-Elche (El Hondo). BOIRA & CARRETERO (1985: 410).
Cádiz:
29S QA 44 Bay of Cádiz (WILLKOMM 1852 : 143).
29S QA 53 Chiclana de la Frontera (WILLKOMM 1852 : 143).
29S QA 45 Puerto de Santa María (*Gutiérrez,* s/d, MA 29364; ibid, WILLKOMM 1852 : 143).
29S QA 37 Sanlúcar de Barrameda (*Clemente,* VIII, MA 29448 et in WILLKOMM & LANGE, 1870 : 263).
Málaga:
305 UG 04 Laguna de Fuente Piedra (C. Vicioso in A. BOLÒS 1957 : 462; ASENSI & NIETO 1981).
Zaragoza:
30T YL 34 Saladeta de Castelserás (FONT i QUER, 1924).
30T YL 39 Bujaraloz: Salada de la Playa ("Salina Grande", *A. Bolòs,* 30-IX-1957, BC 140918 et in A. BOLÒS, 1957 461).
30T YL 38 Bujaraloz: Laguna del Guallar (*Molero,* 23-IX-1977, BCF et in MOLERO, 1978 : 180).
30T YL 28 Alborge: Salada del Rebollón (*Molero,* 9-X-1977, BCF et in MOLERO, 1978 : 180).
LU:
Algarve:
29S PA 09 Between Faro and Olhâo (PEREIRA, 1939 : 218).

BIBLIOGRAPHY

ASENSI, A & J. M. NIETO (1981). Vegetación acuática, halófila y halonitrófila de la provincia de Málaga. Trab. Monograf. Dep. Bot. Málaga 2: 105-122.

BALL, P. W. & K. G. BROWN (1970). A biosystematic study of *Salicornia* in the Dee Estuary. Watsonia 8: 27-40.

BLANCHÉ, C. & J. MOLERO (1986). Las cubetas arreicas al sur de Bujaraloz (Valle del Ebro). Contribución a su estudio fitocenológico. Lazaroa (forthcoming).

BOIRA, H. & L. CARRETERO (1985). Contribución al conocimiento de la flora valenciana. Lazároa 8: 409-411.

BOLÒS, A. de (1957). *Halopeplis amplexicaulis* (Vahl) Ung.-Sternb. en Aragón. Collect. Bot. (Barcelona) 5 (2): 461-463.

CASTROVIEJO, S. & P. COELLO (1980). Datos cariológicos y taxonómicos sobre las *Salicorniinae* A. J. Scott ibéricas. Anales Jard. Bot. Madrid 37 (1) : 41-73.

FAEGRI, K. & J. IVERSEN (1975). Textbook of Pollen Analysis, ed. 3. Blackwell Publ. Oxford.

FONT i QUER, P. (1924). Un género nuevo para la flora de Aragón. Bol. Soc. Ibérica. Cienc. Nat. 23 (6) : 136-137.

GINSBURG, C. (1966). Xerophytic structures in the roots of desert shrubs. Ann. Bot. Nat. Sci. 30 : 403-418.

GREUTER, W.; H. M. BURDET & G. LONG (1984). Med-Checklist, 1. Pteridophyta (ed. 2), *Gimnospermae, Dicotyledones (Acanthaceae-Cneoreceae)*. Berlin.

JALAS, J. & J. SUOMINEN (1980). Atlas Florae Europaeae, 5. *Chenopodiaceae* to *Basellaceae*. Helsinki.

METCALFE, C. R. & L. CHALK (1979). Anatomy of the Dicotyledons, 1. ed. 2. Charendon Press. Oxford.

MOLERO, J. (1978). Aportaciones al conocimiento de la flora aragonesa. Lagascalia 7(2) : 179-188.

MOLERO, J. (1986). Revisión del género *Microcnemum*. Collect. Bot. (Barcelona) 16(2): 327-336.

PLA DALMAU, J. M. (1957). Estudios palinológicos y precisiones morfológicas sobre los granos de polen de quinientas especies botánicas del extremo N.E. de España. Facultad de Farmacia. Barcelona.

PEREIRA COUTINHO, A. X. (1939). Flora de Portugal, 1. Lisboa.