

## NOTES ON ANNUAL SPECIES OF *SALICORNIA* IN BRITAIN

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The genus *Salicornia* is a notoriously difficult one, unless all the annual plants are regarded as belonging to one very variable species, as is sometimes done, particularly by those who have little acquaintance with them in the field. During the past century various workers in this country and the adjacent parts of the continent have recognised and attempted to define a number of taxa, mainly as a result of field observation and the examination of living material.

Among the pioneer work may be mentioned Woods' (1851) on species from the south coast of England, Dumortier's "Bouquet du littoral Belge" (1868), and Duval-Jouve's classic account of the southern French species (1868). In the early years of this century, Moss initiated a fresh attack on the problems presented by the annual species of *Salicornia* found on the English coast and on the neighbouring French coast. The results of this work were published in 1911 and 1912, and, in collaboration with Salisbury, in 1914. Shortly after the war of 1914-18, when Moss had gone to South Africa, Wilmott began an extensive study of the genus as represented in Britain. In this he had the assistance of N. D. Simpson and Miss M. S. Campbell at various times. A great amount of herbarium material, drawings, photographs and notes were accumulated (now in Herb. Mus. Brit. and Herb. N. D. Simpson), but unfortunately Wilmott died before he had produced an account of the genus in a form suitable for publication. Through the kindness of Dr. G. Taylor and Mr. J. E. Dandy we have had access to the material in the British Museum (Natural History) and we have derived valuable information from it. We had hoped to be able to make available a portion of the great amount of work and knowledge contained in these notes but this has, for various reasons, proved impossible.

The following notes are the product of field work during the past six years, combined with cultivation and cytological investigation. An attempt has been made to assess the value of the various characters which have been used to delimit species and to determine the correct application of the various names in current use in Britain. We find ourselves in agreement with the conclusion reached by the late A. J. Wilmott that a number of undescribed species exist in this country. Four of these are now sufficiently well-known to us to make descriptions possible, but there are undoubtedly others in Britain and elsewhere in Europe which still require investigation.

### GENERAL MORPHOLOGY

The *Salicornia* plant has a normal root system, usually of considerable extent, but the aerial parts of the plant are highly 'reduced.' The leaves are opposite, decussate and fleshy, and consist of a small free portion extending upwards from the node, and a larger portion extending downwards over the whole of the internode below. The greater part of each leaf is 'fused' to the corresponding part of the other member of the pair, thus forming a green succulent false cortex to the stem (the 'sterile segment'). The main part of the well-branched vascular supply of the leaf runs downwards through this 'cortex.' The inflorescence consists of 3-flowered cymes (rarely solitary flowers), each

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subtended by a leaf, and occupies the distal parts of the main stem (the 'terminal spike') and branches. The flowers have a fleshy, 3-lobed perianth, more or less immersed in the succulent bracts, one or two stamens, and a solitary ovary with two freely branched stigmas.

In the older parts of the stems the leaves decay and only the woody true stem, which has some secondary thickening of the usual chenopodiaceous type, remains. As a result of this construction the whole plant has a jointed appearance, the internodes in the inflorescence ('fertile segments') being considerably shorter than those in the rest of the plant.

#### ASSESSMENT OF TAXONOMIC CHARACTERS

(a). *Habit*. Habit formed the basis of practically all previous classifications of the genus, but, though prostrate phenotypes of certain species are not infrequent, genotypically prostrate plants appear to be uncommon. Seed from a considerable number of prostrate plants has been grown in cultivation and only one collection, of *S. pusilla* (from Gibraltar Point, S. Lincs.), gave prostrate progeny. Plants of most species are liable to fall over at various stages in their growth, owing to waves, tidal currents and other accidents; these often continue to grow and are sometimes not easy to distinguish from plants which have grown more or less horizontally in the first place. It therefore seems unwise, at least at present, to regard habit as having any classificatory value.

(b). *Branching*. Both the degree and angle of branching appear to be useful taxonomic characters, provided that they are used with caution and that allowance is made for the considerable amount of phenotypic variation which occurs. All species, even the potentially most richly branched, can, under the influence of competition, become nearly or quite unbranched. Under favourable conditions certain species regularly show abundant tertiary branches, while others are normally less branched. The offspring of depauperate plants when cultivated in favourable conditions developed the normal branching of the species to which they belonged.

The length of the lower branches in relation to the main stem also provides a useful character if 'normal' well-grown plants are considered.

The degree of branching and length of branches are always increased by injury to the terminal spike and often also by the plant falling over or being phenotypically prostrate.

Two other branching characters were used by Moss: the occurrence of more than two branches at a node and the branching of the flower spikes. Our observations indicate that these characters occur sporadically in a considerable number of species and, though probably genetically controlled, do not appear to be closely correlated with any other characters. It does not, therefore, seem possible to use them for delimiting taxa.

(c). *Inflorescence*. (i) Morphology of the spikes. Moss and other authors have used the length, shape and number of fertile segments in the terminal spike as taxonomic characters. These all appear to provide valuable criteria, provided that well-grown 'normal' plants are examined but, as with branching and other characters, there is considerable phenotypic variation.

(ii) Morphology of the fertile segments. Little or no reference to this is to be found in the literature, though Wilmott had developed an elaborate system for its accurate description; this is unfortunately too complex for ordinary use.

There appears, once again, to be some phenotypic variation in the fertile segments but on the whole they provide useful characters. These have, however, the drawback that they are difficult to describe in a readily understandable way, are lost on drying, and often somewhat distorted by preservative fluids. The most useful features are the outline of the

segment and the width of the scarious border at its top. The shapes of segment can be roughly grouped into 10 arbitrary classes, shown in Fig. 1, but intergrading occurs between several of these.

The apparent separation of the lateral flowers by the central one was used by Moss in defining *S. dolichostachya* but it is a character common to most tetraploid species and is not constant even within a single population.

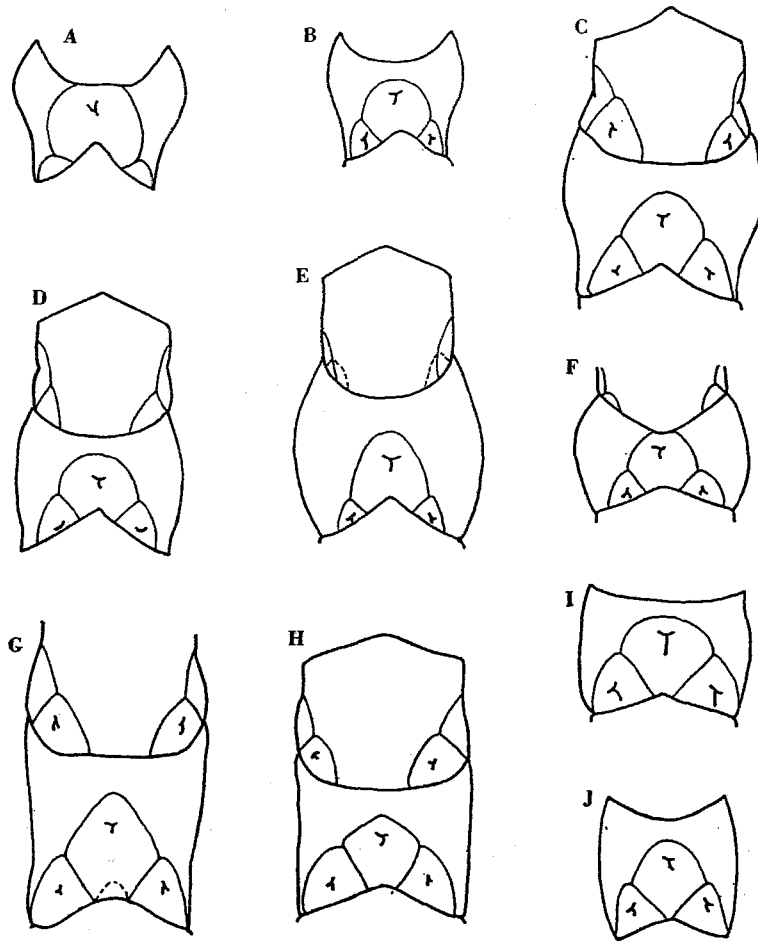


Fig. 1. Types of fertile segments.

(d). *Colour and surface texture.* These appear to be of considerable taxonomic significance, if allowance is made for the variation which is apparently correlated with edaphic factors. Species which normally colour brightly remain dull green when growing on ill-drained muds, but colour earlier than usual on relatively dry or sandy substrata. Species which normally have a matt surface often become polished on sandy soils, presumably owing to the mechanical destruction of the small globular hairs by the sand grains. The way in which the colour appears, whether diffuse or localized round the flowers or the upper margins of the segments, is also a valuable character.

(e). *Microscopic characters.* De Fraine (1912) suggested that the occurrence and distribution of spiral cells and 'steroids' were of taxonomic significance and her data were used by Moss. More recently Miss M. S. Campbell (unpublished) has thrown doubt on the

value of this character, a doubt which appears from our preliminary investigations to be well founded. A thorough examination of the occurrence, development and connection between these peculiar types of cells, and their possible correlation with factors such as substratum, drainage and amount of submergence, would be very desirable.

Two chromosome numbers,  $2n = 18$  and  $36$ , are found among the annual species of *Salicornia* in Britain, and many characters, both macroscopic and microscopic, show a correlation with chromosome number. These correlations, which are set out in Table 1, appear to be sufficiently good for chromosome number to be predicted from morphology.

TABLE 1.

Character	$2n$	$4n$
Angle of branching of the uppermost branches	c. $45^\circ$ , $\pm$ straight	$45-90^\circ$ , curving upwards.
Fertile segments :		
No. in terminal spike	1-12 (- 22)	(6 -) 10-25 (- 32)
Types (Fig. 1)	A-F	G-J
max. width/width at base	1.1-1.4	1.0-1.2
Central flower of cyme	usually larger than visible part of lateral flowers	about equalling visible part of lateral flowers
Free part of leaf	1 mm. or more, acute	rarely more than 1 mm., obtuse to subacute
Stamens	0-1 (- 2), exserted or not	(1 -) 2, always exserted.
Anthers	0.4-0.6 mm.	0.65-0.9 mm.
Pollen grain diam.	(20 -) 24-28 (- 31) $\mu$	(27 -) 31-34 (- 42) $\mu$
Length of stomata on sterile segments at base of terminal spike	(20 -) 24-30 (- 33) $\mu$	(27 -) 29-36 (- 42) $\mu$
Length of seeds	1.0-1.7 mm.	(1.3 -) 1.5-2.3 mm.

#### THE COLLECTION OF ANNUAL SALICORNIA SPECIES

For identification it is desirable to collect a number (preferably 10-12) of well-grown specimens from each population, rejecting any which have fallen over or which have damaged main stems. Damage due to boring larvae is often inconspicuous but may profoundly alter the habit of the plant, the length of the spikes and the shape of the segments. The identity of small poorly-branched plants growing in dense stands is best judged by comparison with well-grown plants in the vicinity.

Identification is usually easiest when the plants are mature and the characteristic colours have developed; this is generally in September or October, according to species and locality. Fresh material is very much easier to identify than even the best preserved plants.

#### ECOLOGY

*Salicornia* species may occur in the whole range of salt-marsh habitats and even on sheltered beaches of muddy shingle, while *S. pusilla* and *S. ramosissima* are sometimes found on the landward side of sea-walls.

The chief types of habitat and the species most commonly found in them are :

- (1) The drift line : *S. pusilla*, *S. ramosissima*.

- (2) The upper parts of the marshes, often just below a sea wall : *S. ramosissima*, *S. obscura*, *S. lutescens*, *S. pusilla*.
- (3) 'General' salt marsh :  
 (a) in more or less closed communities : *S. ramosissima*, *S. obscura* (rather rare)  
 (b) in salt-pans : *S. obscura*, *S. nitens*, *S. ramosissima*.
- (4) Sides of channels : *S. fragilis*, *S. obscura*, *S. ramosissima*.
- (5) Open or sandy mud at low levels : *S. dolichostachya*, *S. europaea*, *S. lutescens*, *S. fragilis*.
- (6) Firm muddy shingle : *S. ramosissima* (prostrate forms).

## KEY.

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1. Cymes regularly 1-flowered; terminal spikes up to c.6 mm. **4. pusilla**
1. Cymes normally 3-flowered; terminal spikes usually more than 6 mm.
2. Fertile segments of types A-F (Fig. 1); stamens 1, very rarely 2 in a few flowers; anthers 0.4-0.6 mm.; seeds 1.0-1.7 mm.
3. Plant dark shining green, often becoming dark purplish-red; fertile segments of types A and B (Fig. 1) with a conspicuous scarious border c. 0.2 mm. wide at top. **1. ramosissima**
3. Fertile segments of types C-F (Fig. 1) with a narrow scarious border not more than 0.1 mm. wide.
4. Plant clear green, becoming yellow and red or pinkish; lower primary branches up to as long as main stem; tertiary branches usually present; fertile segments of types E and F (Fig. 1). **2. europaea**
4. Plant dull glaucous green, fertile spikes dull yellow, rarely purplish round the flowers; lower primary branches usually less than  $\frac{1}{2}$  as long as main stem, tertiary branches 0; fertile segments of types C and D (Fig. 1). **3. obscura**
2. Fertile segments of types G-J (Fig. 1); stamens usually 2; anthers 0.7-0.9 mm.; seeds (1.3 -) 1.5-2.3mm.
5. Terminal spike cylindrical, very obtuse; fertile segments up to 12 (- 15); plant clear green becoming bright yellow or purplish.
6. Plant becoming clear brownish-purple to brownish-orange; fertile segments rarely exceeding 3 mm. long. **5. nitens**
6. Plant becoming bright yellow or yellow-green, rarely with diffuse pink colour; fertile segments usually more than 3 mm. long (if plant is dull green see *S. fragilis*). **8. lutescens**
5. Terminal spike distinctly tapering, acute or  $\pm$  obtuse; fertile segments 12 or more; plant dull yellow (sometimes pinkish on sandy mud).
7. Lower primary branches very rarely more than  $\frac{1}{2}$  as long as main stem, their spikes cylindrical. **6. fragilis**
7. Lower primary branches usually more than  $\frac{1}{2}$  as long as main stem, their spikes distinctly tapering. **7. dolichostachya**
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## DESCRIPTION OF SPECIES

## A. Diploid species.

1. *S. ramosissima* Woods (1851). *Bot. Gaz.* 3, 29.

Erect or prostrate, up to 40 cm. high; typically freely branched and bushy, but very variable and often forming pure stands of simple or slightly branched plants in salt-pans; lowest branches usually shorter than main stem, very rarely with more than 2 branches at a node. Plant dark green; sterile segments becoming yellow-green then dark purplish; fertile segments soon becoming dark purple round the flowers and upper margin, the remainder either remaining dark green or becoming purple or, rarely, yellowish. Terminal spike (5 -) 10-30 (- 40) mm.,  $\pm$  tapering, with (1 -) 4-9 (- 12) fertile segments of types A and B (Fig. 1). Fertile segments (2nd-4th from base of terminal spike) 1.9-3.5 mm. long, 2.0-4.0 mm. diam. at base and top and 2.7-5.3 mm. diam. just above the middle. Free

part of leaf (0.7 -) 1 mm. or more, acute, with a conspicuous scarious border c. 0.2 mm. wide. Central flower 1.5-2.3 × 1.4-2.7 mm., rounded-rhomboid to almost circular, the upper edge not more than 0.5 mm. from top of segment. Lateral flowers 1.3-2.1 × 1.0-2.1 mm., the visible part much smaller than the central flower. Flowers August-September.  $2n = 18$ . In all parts of salt-marshes except the lower mud-flats. Widespread and common in E. and S. England and S. Wales. Distribution elsewhere uncertain. Plants from S. and E. Ireland differ in being clear green, becoming yellow tinged with pink to crimson, and in the terminal spike being cylindrical and obtuse. These differences appear to be maintained in cultivation, but further investigation is required.

*S. gracillima* (Townsend) Moss was described as a small plant with very short primary branches, short terminal spike and 'steroids' in the fertile segments. Offspring of similar plants from the type locality (Pagham Harbour, W. Sussex) were large and much-branched and apparently identical with *S. ramosissima*. *S. prostrata* auct. angl. (incl. Moss, Butcher, and Tutin) is described as prostrate with long widely spreading lower branches. The progeny of plants of this kind have so far proved to be erect in cultivation and to resemble *S. ramosissima*, except that the angle of the lower branches is often c. 90° (instead of c. 45°), the plant colours more rapidly, and the spikes are rather more slender. Many intermediates occur. *S. appressa* Dumort. and *S. smithiana* Moss are doubtfully distinct from *S. prostrata* auct. and appear to behave in the same way in cultivation. *S. prostrata* Pallas, with which British plants have been regarded as conspecific, was described from the N.W. coast of the Caspian. The description is uninformative and the figure is that of a plant, probably diploid, in flower. It is at present impossible to be certain of the identity of Pallas's plant but, as was pointed out by Townsend (1904), it is in any case unlikely that it is the same as any found in western Europe.

## 2. *S. europaea* L. (1753). *Sp. Pl.*, 3.

*S. herbacea* L. (1762) *Sp. Pl.*, ed. 2, 5, ? *S. stricta* Dumort. (1868) *Bull. Soc. Bot. Belg.*, 7, 334.

Erect, (10 -) 15-30 (- 35) cm. high; typically freely branched; lowest branches up to as long as the main stem; rarely with more than 2 branches at a node. Plant dark green; sterile segments becoming yellow-green to yellow, then pink or red before collapsing; fertile segments soon becoming yellowish, then rather diffuse pink or red starting round the flowers. Terminal spike (10 -) 15-50 mm., slightly tapering, obtuse, with (3 -) 5-9 (- 12) fertile segments of types E and F (Fig. 1). Fertile segments (3rd and 4th from base of terminal spike) 2.5-4 mm. long, 3.0-4.5 mm. diam. at base and top and 3.5-6 mm. diam. at about the middle. Free part of leaf c. 1 mm., acute, with an inconspicuous scarious border c. 0.1 mm. wide. Central flower 1.7-2.5 × 1.7-2.5 mm., rounded above, the upper edge not more than 0.5 mm. from top of segment. Lateral flowers 1.6-2.0 × 1.3-1.8 mm., the visible part much smaller than the central flower. Flowers August.  $2n = 18$ . Open sandy mud, rather local. S. and W. coasts of England. ? Ireland. W. Europe. The only diploid species occurring at low tidal levels. Irish plants appear to differ only in the longer terminal spikes with 10-22 fertile segments.

Dumortier's description of *S. stricta*, "Herbacea, caule ramisque erectis, fastigiatis", would apply to the majority of W. European species. In 1935 Mr. N. D. Simpson examined the type (in Herb. Jard. Bot. Bruxelles) and visited the probable type locality (Nieuport). The specimens collected by him, as being almost identical with the type, appear to be similar to *S. europaea*. However, it should be pointed out that, with dried specimens, only the characters of habit and branching can be observed, and that under these circumstances it is very doubtful whether *S. europaea* (or any other diploid, 3-flowered species)

can be distinguished from the very variable *S. ramosissima*, which according to Simpson also occurs in Nieuport.

*S. stricta* auct. angl. (including Townsend, Moss, Butcher & Strudwick, and Hambler) appears to be a composite species made up of *S. obscura*, *S. fragilis* and *S. lutescens*.

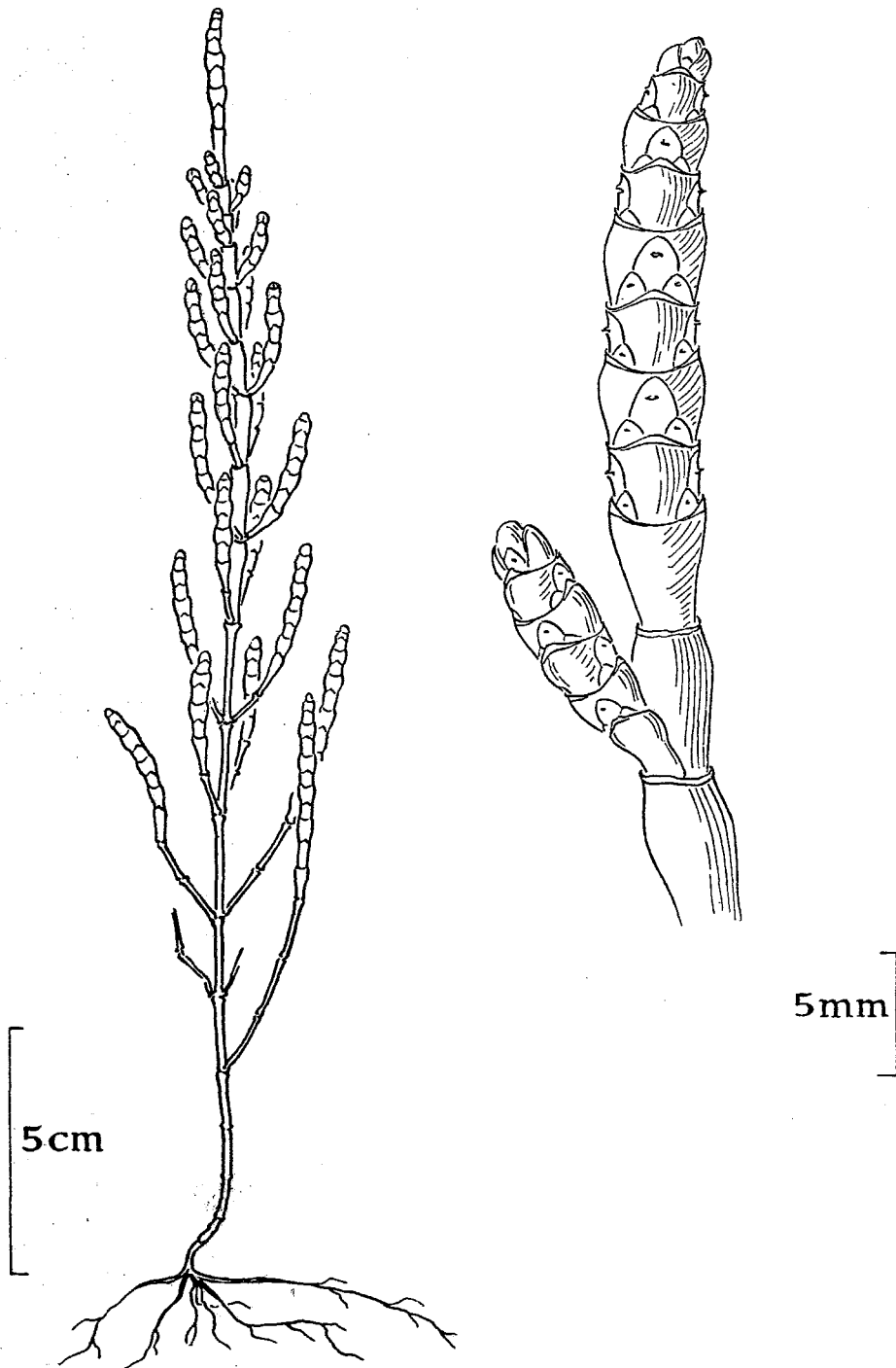


Fig. 2. *Salicornia obscura*.

3. *S. obscura* P. W. Ball & Tutin (Fig. 2).

Erect, 10-40 (- 45) cm. high, commonly with primary branches only; lowest branches not more than half as long as main stem, usually less. Plant dull, slightly glaucous, green, usually with matt surface; sterile segments becoming dull yellow just before collapsing. Fertile segments becoming dull yellowish-green, rarely with a slight purple colour round the pores of the flowers. Terminal spikes 10-40 (- 45) mm. long, nearly cylindrical, obtuse, with (3 -) 5-9 (- 14) fertile segments of types C and D (Fig. 1). Fertile segments (2nd to 4th from base of terminal spike) 2.5-4.5 mm. long, 2.8-4.0 (- 5.0) mm. diam. at base and top with a maximum diameter of 3.2-5.0 (- 5.5) mm. usually above the middle. Free part of leaf c. 1 mm. long, triangular, acute, with a very narrow scarious border. Central flower 1.35-3.1 × 1.5-2.5 mm., semicircular above, the upper edge not more than 0.7 mm. from the top of the segment. Lateral flowers 1.5-2.7 × 1.5-2.7 mm., the visible part small, more or less triangular. Stamens usually solitary and not exerted. Seeds 1.1-1.7 mm. Flowers August-September.  $2n = 18$ . On bare damp mud, in salt-pans and at sides of channels. East and south coasts from S. Lincs. to S. Hants.

Generally recognisable by the dull colour, the short, simple branches and the bulging fertile segments with narrow scarious margins and usually cleistogamous flowers. It is often difficult to separate with certainty from forms of *S. fragilis* and *S. lutescens*, except when it is in flower.

4. *S. pusilla* Woods (1851) *Bot. Gaz.* 3, 30.

*S. disarticulata* Moss (1911)

Erect or prostrate, up to 25 cm., usually much branched and bushy. Plant yellowish-green, becoming brownish- or pinkish-yellow. Terminal spike up to c. 6 mm., with 2-4 fertile segments. Cymes 1-flowered. Flowers almost circular, often brownish. Fertile segments eventually disarticulating. Flowers August-September.  $2n = 18$ . In the drier parts of salt-marshes and particularly along the drift line. Dorset to Kent, Essex, Norfolk; Carmarthen; Waterford. N.W. France.

A very distinct species, readily recognised by its solitary flowers and disarticulating fertile segments. The identity of *S. pusilla* sensu Moss, described as a small, little-branched species with 3-flowered cymes, remains quite obscure.

## B. Tetraploid species.

5. *S. nitens* P. W. Ball & Tutin (Fig. 3)

Erect, 5-25 cm. high, usually with primary branches only; lower branches usually less than  $\frac{1}{4}$  the length of the main stem, upper branches generally curving upwards at the tip. Plant green to yellowish-green with a smooth, shining, somewhat translucent appearance; sterile segments widened conspicuously near the top, soon becoming clear light brownish-purple to brownish-orange. Fertile segments soon becoming light brownish-purple, the colour appearing more or less diffusely, but at first particularly in the flowers and just below the upper edge of the segment. Terminal spike 12-40 mm. long, cylindrical, obtuse, with 4-9 fertile segments of type J (Fig. 1). Fertile segments (2nd to 4th from the base of the terminal spike) (1.8 -) 2.0-3.0 (- 3.5) mm. long, 2.0-4.0 mm. diam. at base and top and a maximum diameter of 2.3-4.5 mm. about the middle. Free part of leaf c. 0.5 mm. long, subobtusate, with narrow scarious border. Central flowers 1.1-2.2 × 1.1-1.8 mm., semicircular above. Lateral flowers 1.2-1.8 × 1.0-1.7 mm., the visible part triangular, almost as long as the central flower. Seeds 1.5-1.7 mm. Flowers



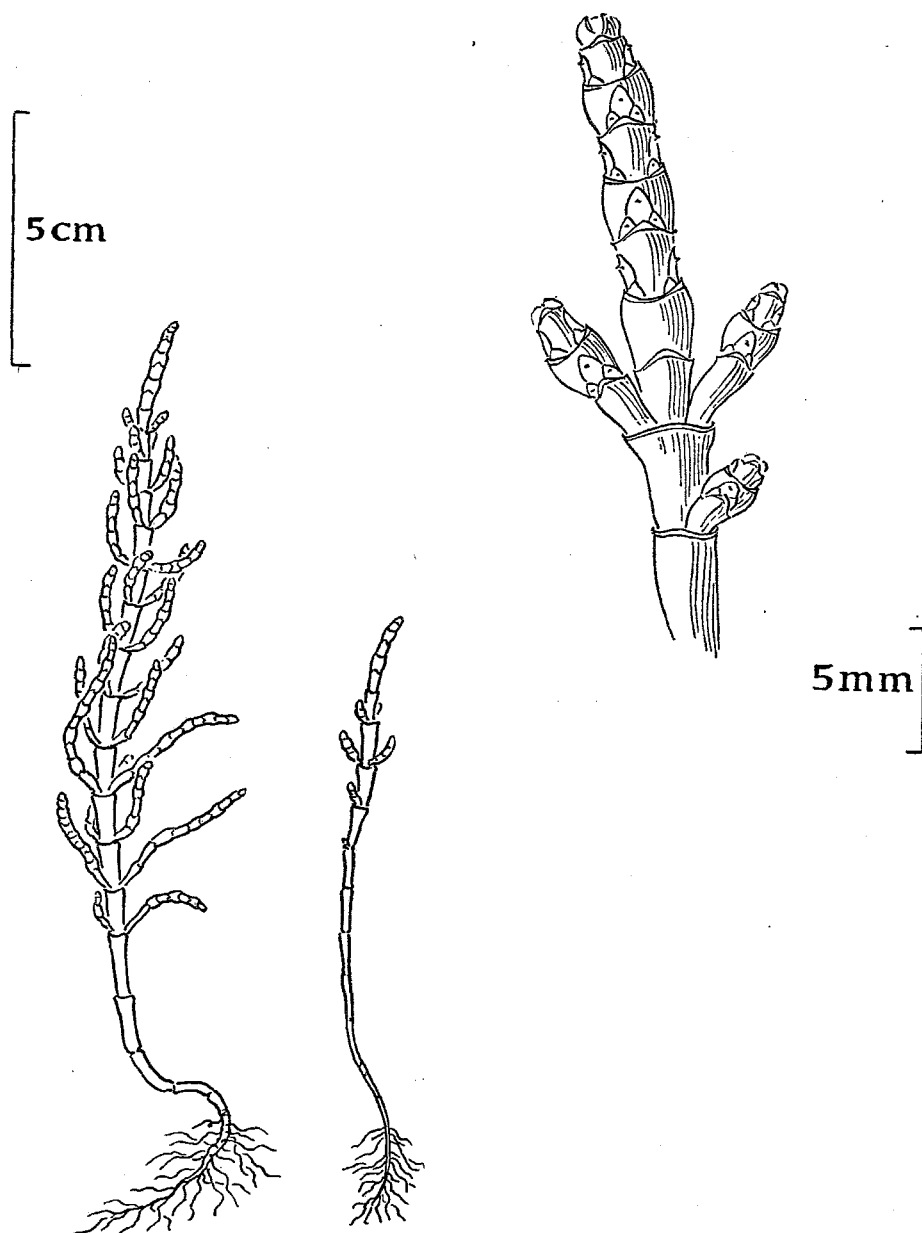


Fig. 3. *Salicornia nitens*.

September. Probably tetraploid. Bare mud and in pans in the upper parts of salt-marshes. S. and E. England, apparently common in suitable habitats from E. Suffolk to Hants. Distribution elsewhere unknown.

6. *S. fragilis* P. W. Ball & Tutin

Erect, (10 -) 15-35 (-40) cm. high, usually with primary branches only; lowest branches usually less than  $\frac{1}{4}$  the length of the main stem; rarely more than 2 branches at

a node. Plant dull, often slightly glaucous green; sterile segments becoming dull yellowish-green when mature. Terminal spike (20 -) 30-80 (- 100) mm. long, somewhat tapering, with (6 -) 8-16 (- 20) fertile segments of types G-I (Fig. 1). Fertile segments (3rd and 4th from base of terminal spike) 3.0-5.0 × 3.0-4.5 mm., more or less cylindrical. Free part of leaf not more than 1 mm. long, subobtusate, with a very narrow scarious border. Central flower 2.0-3.0 × 1.8-3.0 mm., semicircular to triangular above, the upper edge at least 0.5 mm. from the top of the segment. Lateral flowers 2.0-2.5 × 1.8-2.2 mm., the visible part more or less triangular and almost as long as the central flower. Seeds 1.5-2.0 mm. Flowers August-September.  $2n = 36$ . Bare mud at sides of channels and in the lower levels of salt-marshes. E. Suffolk to Kent. Distribution elsewhere unknown.

*S. fragilis* shows an inverse correlation between the length of the terminal spike and the abundances of branches.

7. ***S. dolichostachya*** Moss (1912) *New Phytol.* **11**, 409.

Erect 10-40 (- 45) cm. high, abundantly branched and bushy; lower primary branches usually about as long as main stem; often more than 2 branches at a node. Plant dark green; sterile segments becoming paler or dull yellow then brownish before collapsing. Fertile segments usually becoming paler, rarely dull yellow or with a slight diffuse purple tinge. Terminal spike (25 -) 50-120 (- 200) mm., distinctly tapering but often obtuse, with (7 -) 12-25 (- 32) fertile segments of types G-I (Fig. 1). Lateral spikes tapering, subacute, those of the longest primary branches often nearly as large as the terminal spike. Fertile segments (3rd and 4th from the base of the terminal spike) 3.0-6.0 × 3.0-6.0 mm., nearly cylindrical. Free part of leaf c. 1 mm. or less, subobtusate, with a very narrow scarious border. Central flower 2.4-4.0 × 1.9-2.9 mm., triangular to semicircular above, the upper edge at least 0.5 mm. from the top of the segment. Lateral flowers 1.8-3.0 × 1.5-2.3 mm., the visible part triangular and almost as long as the central flower. Flower July-August.  $2n = 36$ . On open mud or sandy mud in the lowest zone of salt-marshes, occasionally on the sides of narrow channels in the middle zone. Coasts of Great Britain from Lancs. to Devon, Kent and E. Ross; S. and E. coasts of Ireland, W. Galway, Netherlands, Denmark.

*S. dolichostachya* is the chief coloniser of open mud and muddy sand in many places. It is abundant on gradually sloping intertidal flats which are not too exposed, and it appears to require frequent submersion. The habit varies from straggling to strongly fastigiate. The taxon, as delimited here, possibly includes more than one species.

8. ***S. lutescens*** P. W. Ball & Tutin (Fig. 4).

Erect, (10 -) 15-30 (- 40) cm. high, usually abundantly branched and bushy; lowest branches up to 2/3 (- 1) the length of the main stem; very rarely more than 2 branches at a node. Plant green to yellowish-green; sterile segments soon becoming yellow, occasionally with a diffuse purplish tinge. Terminal spike (15 -) 25-60 (- 70) mm., cylindrical, obtuse, with (5 -) 8-12 (- 16) fertile segments of types G-I (Fig. 1). Fertile segments (3rd and 4th from base of terminal spike) 3.3-5.0 × 3.5-6.0 mm., more or less cylindrical. Free part of leaf not more than 1 mm., subobtusate, with a very narrow scarious border. Central flower 2.0-3.5 × 2.0-2.5 mm., semicircular to triangular above, the upper edge at least 0.5 mm. from the top of the segment. Lateral flowers 1.8-2.5 × 1.7-2.5 mm., the visible part triangular, almost as long as the central flower. Seeds 1.4-2.1 mm. Flowers July-August.  $2n = 36$ . Usually on firm and comparatively dry mud or muddy sand. Coasts of England from S. Lincs. to S. Hants.; Glamorgan, Merioneth.

Distribution elsewhere unknown.

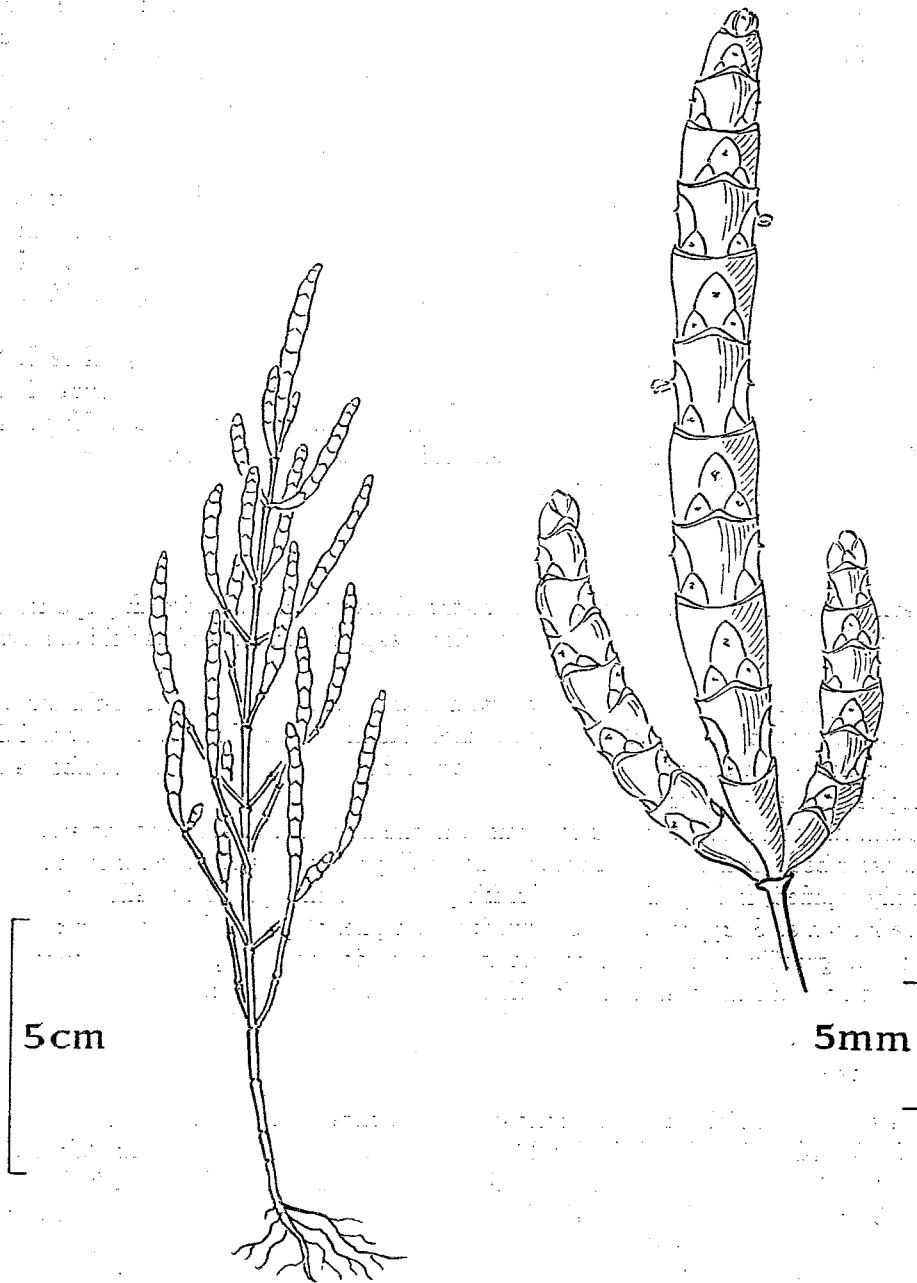


Fig 4. *Salicornia lutescens*.

*Diagnoses of new species.*

**S. lutescens** sp. nov. *S. dolichostachyam* simulans, sed colore laete viridi vel flavo-viridi mox laete lutescente, spicis terminalibus brevioribus (25-60 mm.) cylindricis obtusis cum segmentis fertilibus paucioribus (8-12) praeditis differt. Typus in Herb. Mus. Brit. : North bank of R. Ogmore, Glamorgan (v.c. 41). Upper part of sandy salt-marsh. Leg. A. Loosemore & B. Miles. September, 1957.

**S. fragilis** sp. nov. A *S. dolichostachya* ramis lateralibus brevibus ipsis raro iterum ramosis, spicis terminalibus brevioribus (30-80 mm.) cum segmentis fertilibus paucioribus (8-16) praeditis diagnoscutur; praeterea a *S. lutescente* habitu ramoso, colore haud laete lutescente, spicis terminalibus ad apicem attenuatis differt. Typus in Herb. Mus. Brit. : Leigh-on-Sea, South Essex (v.c. 18). Mud flats on side of a broad channel. Leg. P. W. Ball. September 1956.

**S. obscura** sp. nov. A *S. europaea* ramis primariis plerumque brevibus ipsis raro iterum ramosis, colore opaco subglaucescenti-viridi demum hebeti-flavescente, superficie opaca haud nitente, habitu fere semper cleistogamo differt. Typus in Herb. Mus. Brit. : North Hayling, S. Hampshire (v.c. 11). Pan in upper part of salt-marsh. Leg. P. W. Ball. September, 1957.

**S. nitens** sp. nov. A *S. obscura* superficie levi nitente subtranslucente, colore laete viridi vel flavo-viridi mox pallide brunneo-purpureo vel gradatim brunneo-aurantiaco, segmentis sterilibus sub apicem conspicue inflatis, habitu chasmogamo differt. Typus in Herb. Mus. Brit. : North Hayling, South Hampshire (v.c. 11). Bare mud in upper part of salt-marsh. Leg. P. W. Ball. September, 1957.

#### SUMMARY.

An attempt is made to assess the value of the characters used in defining species of *Salicornia*, taking into account evidence from culture experiments as well as field observation.

Notes are given on the collection, preservation and habitat preferences of the annual species of *Salicornia*, together with a key for their identification. Diploid and tetraploid series of species are described and the correlation between chromosome number and morphological characters indicated.

The annual species of *Salicornia* recognised in the British Isles are reviewed and four new ones described. It is suggested that the name *S. prostrata* Pallas, even if it could be satisfactorily typified, is inapplicable to British plants and that plants so called, together with those known as *S. appressa* and *S. smithiana*, are phenotypes of *S. ramosissima*. The identity of '*S. gracillima*' is discussed and it is concluded that on present evidence this taxon cannot be maintained as a species distinct from *S. ramosissima*.

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